EVALUATION OF CLASSROOM BATS PROGRAM

December 2000

EXECUTIVE SUMMARY

The National Science Foundation awarded a three year grant (1998-2000) to the Bermuda Biological Station for Research (BBSR) and its partners the College of Exploration (TCOE) and Florida International University (FIU). The grant was for development of programs for teachers and students using real data from the Bermuda Atlantic Time Series (BATS) collected by BBSR scientists. The grant covered two years of development and operation and a partial third year for evaluation. The two-year program called Classroom BATS (CBATS) was a collaborative program in which scientists from BBSR interacted with pre-service teachers at FIU through course modules set up by the TCOE on a virtual campus on the World Wide Web. It also encompassed development of a public web site, resources related to the oceans and ocean data, and an online workshop, which expanded the program to other educators.

The FIU students learned how to use real time web-based BATS data that the scientists collect and analyze. Selected BBSR scientists acted as online guest faculty to assist the prospective teachers in learning about climate change, oceanography and ocean data. Course participants were to develop curriculum projects related to the Classroom BATS materials. With the aid of embedded help and screen guides the prospective teachers learned how to access web-based data sets and use them in grades 6-12 classrooms. The overall project created a web-supported learning environment that supports science education using scientific data sets.

The primary ***goal*** of the CBATS project was to provide middle school and secondary science teachers and students with on-line resources to help them conduct inquiry-based learning using web-based data from BATS. One goal of the online courses and workshops was to bring scientists and educators together online, benefiting both research and education participants. Another goal was to have these courses and workshops serve as useful models of web-based learning opportunities for science teachers. Additionally the project strove to offer a successful model for using science data sets in classroom settings.

The ***purpose*** of this evaluation is to assess the effectiveness of the CBATS program as a professional development tool primarily for pre-service science teachers but also for in-service teachers. This evaluation project examined how the program was implemented in Florida International University courses and in the public online workshops as well as how effective the web site activities and materials and MS-Excel OceanExplorer workbook were as learning resources.

The ***focus*** of the evaluation was to review and assess the main components of the two-year program. The Classroom BATS Public web site, The Classroom BATS Virtual Campus, The Ocean Data 2000 Workshop, and The OceanExplorer Excel Workbook

The Classroom BATS Web site. http://www.coexploraton.org/bbsr/classroombats The development of the web site was a collaborative venture between BBSR scientists and TCOE. The web site consisted of several sections: Oceanography 101, How the data is Collected, Ships Crew Profiles, Adopt a Link, Crush A Cup, Lesson Planner, Compete in the BATS Bowl and the Ocean Explorer spreadsheet program.

The Classroom BATS Virtual Course Modules A virtual campus was created on the TCOE web site for use by BBSR scientists and FIU students in the course modules created for the CBATS project. This was a private password protected online environment. It consisted of presentations and discussions between scientists and students. The modules were designed to fit into two existing FIU courses: one was a course for teaching secondary school science teachers; the other course focused on middle school science teachers, and was entitled 'Methods of Teaching Middle School Science'. These modules were incorporated into FIU courses in 1998-1999.

Ocean Data Workshop The Ocean Data 2000 online workshop was held in May 2000 for one month. The workshop was offered to Miami-Dade teachers, other pre-service teachers, and teachers who had downloaded the Ocean Explorer Spreadsheet. Despite personal marketing efforts to pre-service institutions, the team only obtained participation from a very small number of pre-service teachers in this workshop. The online workshop modeled a face-to-face workshop format with keynote presentations, a teacher workroom and a reception area. Dr. Debbie Steinberg presented ocean topics and Dr. David Malmquist presented BATS data and introduced the OceanExplorer excel workbook that was to be used to help the teachers more easily use the BATS in their teaching. Cheryl Schroeder and Gail Scowcroft from the University of Rhode Island led activities in the virtual teacher workroom.

Ocean Explorer Spreadsheet The *OceanExplorer* is a Microsoft Excel© workbook designed especially for Classroom BATS. As the teacher or student selects, analyzes, and graphs the data to meet individual class interests, unique worksheets and charts can be added to the overall *OceanExplorer* workbook

The ***evaluation model*** used to evaluate the implementation of the Classroom BATS program combined qualitative data analyses with quantitative analyses and presentation of questionnaire data. Throughout the two-year program, feedback was obtained through informal interviews, web review and questionnaires. Thus the evaluation was both formative and summative.

The overarching ***guiding question*** for the evaluation was:

How well did the Classroom BATS program address the need for educators (primarily pre-service science teachers, but also in-service teachers) to effectively use web-based scientific resources, including web data and online interactions with scientists, in their learning and teaching of ocean sciences?

The following ***methods*** were employed as part of the data collection for this evaluation project: review of project documents, review of web site statistics, review of participation statistics from the online courses, needs assessment questionnaires, post-course questionnaires, interviews with key project personnel, and a survey on the use of the OceanExplorer spreadsheet.

The ***results*** were examined in light of the project goals and were aimed at helping readers understand the value of the Classroom BATS materials to pre-service science teachers and in-service teachers. The results of the review of each of the main components are presented below.

The Classroom BATS Web Site The use of the web site was analyzed for the period January 22, 1998 to November 11, 2000 using commercially available web site analysis software from WebTrends.com. During that time the web site recorded a total of 26000 individual user sessions completing 76,988 page views, or an average of 76 per day. The majority of site visitors were from the USA and Bermuda; however access from Canada, United Kingdom, United Arab Emirates, Australia, Spain, Netherlands and South America was also noted.

The Classroom BATS web site and its related materials, especially the OceanExplorer data workbook received favorable recognition as a valuable tool for educators when the BRIDGE web site of Virginia Institute of Marine Science listed it as one of the Data Tips of the Month.

Review of Participation Statistics from the Online Courses and Workshop For the May 1999 FIU course, 20 students from FIU were registered to participate in the project. Of these, 12 entered the virtual campus at least once and 6 actively participated. In the fall of 1999 another group of 20 had the opportunity to participate. This time only three students actively participated. Two students worked diligently on using all the materials and the spreadsheet and became active contributors to the development of the program. There were 44 registered participants in the Ocean Data Workshop. There were a number of participants who were teachers in Miami-Dade Schools, but there were also teachers from five other states. Of the 44 registered participants, 29 signed on and actively participated. Participation was good in the beginning but declined noticeably in the second week, coinciding with the work becoming more difficult and especially challenging with the Ocean Explorer spreadsheet. Despite the difficulty participants clearly showed they valued the opportunity to incorporate real ocean data into their classroom lessons, viewing the data as both relevant and motivating.

Needs Analysis Survey Results From the needs analysis survey of the FIU students, academic background and interests of the participants was established. The groups were made up of an even mix of teachers working towards certification, those already certified taking the course as part of a graduate program, and a smaller number of graduates in teacher training programs. Their interests ranged from coral reefs to the relationship of the oceans to changes in weather patterns. The majority of students expressed concern at their lack of computer skills and knowledge of the web.

Post Course Survey Results There were 12 respondents from the two surveys out of a total of approximately 40 course students. The content topics incorporated in the workshops were seen by all as curriculum appropriate for the grade levels represented by the teacher participants. It was found that the participants valued the non-data resources in almost equal measure to the value they placed on the BATS data itself. It was apparent from the completed evaluations that the participants generally recognized the potential value of using BATS data in their classrooms.

Ocean Data Workshop Survey Results. Out of the 29 participants who actively participated in the Oceandata 2000 online workshop 13 responded to the evaluation survey. The presentation on oceanography was overwhelmingly viewed as good or excellent as were the content and activities provided on the Classroom BATS web site. The teacher workroom activities and the OceanExplorer spreadsheet had mixed reviews, with the Ocean Explorer evoking comments of frustration.

Feedback on the Ocean Explorer Spreadsheet The OceanExplorer spreadsheet, an Excel workbook is the culmination of efforts to make the BATS data more readily available to teachers and students. The OceanExplorer spreadsheet contains the majority of the BATS data sets. The positive aspects of using real data in the classroom in a commercially available workbook program should not be underestimated.

Challenges included difficulties with downloading and problems with complicated instructions. The survey respondents portrayed a mixed picture of students' interest in the workbook, with 2 out of 3 teachers stating that their students found it interesting. Benefits of the workbook highlighted by the respondents included: "Real data is the big benefit." "Access to scientists and opportunities to expand knowledge of oceanography and ocean data."

Conclusions reflected both the benefits and challenges of the program. In the Ocean Data workshop a strong sense of collegiality was observed among the participants. Those who were keenly interested in ocean data and ocean sciences were reinforced and felt more connected with like-minded peers through participation in the online community. Pre-service and in-service teachers who participated in the online classroom expanded their use of the web and developed greater facility with online conferencing software. They appreciated the opportunity to interact with scientists and explore the excellent ocean science content.

Any professional development program needs to offer information and materials that are relevant to existing curriculum and to standards. The teachers who created lesson plans in the Ocean Data workshop linked their activities to the standards. However neither the web site materials nor the virtual classroom presentation directly listed the related standards. As a results of feedback from the Ocean Data workshop it appeared to the CBATS team that the content was not well suited for elementary teachers.

Though its potential was rated as high and the value of working with real data was paramount, nevertheless one of the biggest challenges was working with the spreadsheet. The program assumed some knowledge of Excel workbooks and Excel software, which many of these teachers did not have. The fact that the OceanExplorer spreadsheet was still in a rough developmental phase with a variety of glitches led to discouragement and frustration on the part of many participants. This coupled with the limited background of many of the participants with using ocean data and dealing with complex oceanography topics made the overall experience less than satisfactory for a good number of the participants.

The Ocean Explorer spreadsheet, the online course modules and the web site underwent much iteration over the two-year period. The revisions were interactively co-developed by BBSR scientists and TCOE staff. It would have been helpful to have FIU faculty more involved in the interactive and iterative development process but this was not forthcoming. A core group of program participants worked diligently through some of the difficulties of the spreadsheet with the scientist.

Recommendations included making technical improvements, helping faculty with integrating the materials, and expanding and enhancing the content. Incorporating projects that draw comparison to the participants' local environments, as well as referencing local curriculum standards should also be considered. Suggestions were made for future implementation in other pre-service teacher university courses as well as for expansion to greater numbers of in-service teachers. Because of the nature of the project, much more faculty involvement is needed and guidance for how to present the topic and Classroom BATS materials to pre-service teachers is needed.

While more work needs to be done to make the OceanExplorer spreadsheet more usable by prospective and current teachers and to help make an effective learning partnership between faculty and scientists, nevertheless positive comments such as the following reaffirmed the efforts of the team to make ocean data come alive.

I thought it was great how being involved in this project made me more comfortable with teaching this subject to students. I loved all the information accessible to us through Classroom Bats.

I. INTRODUCTION

A. OVERVIEW OF CLASSROOM BATS

Classroom BATS (CBATS) was a collaborative program in which scientists from the Bermuda Biological Station for Research (BBSR) interacted with pre-service teachers at Florida International University (FIU) through course modules set up by the College of Exploration on a virtual campus. The FIU students learned how to use real time web-based Bermuda Atlantic Time Series (BATS) data that the scientists collected and analyzed. Selected BBSR scientists acted as online guest faculty to assist the prospective teachers in learning about climate change, oceanography and related topics. Course participants were to develop curriculum projects related to the Classroom BATS materials. Course topics focused on the use of the BATS data set to investigate phenomena related to global environmental change and its relation to changes in the ocean. With the aid of embedded help and screen guides the prospective teachers learned how to access web-based data sets and to use them in grade 6-12 classrooms. The overall project created a web-based learning environment that supported science education using scientific data sets. The project involved new partnerships among the education and research communities as well as new technologies.

The primary goal of the CBATS project was to provide middle school and secondary science teachers and students with online resources to help them conduct inquiry-based learning using web-based data from BATS.

The members of the project team were:

Dr. David Malmquist, BBSR
Dr. Debbie Steinberg, BBSR
Dr. Luis Martinez-Perez, FIU
Mr.Joel Delgado, FIU
Dr.Kristina Bishop, TCOE
Mr.Peter Tuddenham, TCOE
Mrs. Kathryn Houston, TCOE

B. PURPOSE OF THE EVALUATION

The purpose of the evaluation was to assess the effectiveness of the CBATS program as a professional development tool primarily for pre-service teachers but also for in-service teachers. This evaluation project examined how the program was implemented in Florida International University courses and in the public online workshops as well as how effective the web site activities and materials and MS-Excel OceanExplorer workbook were as learning resources.

Overall Project Criteria

The following project criteria were delineated at the start of the project and were used as measures for assessing overall project effectiveness:

1. The project teams have participated in building an effective learning community.
2. Scientists and educators are brought together, benefiting both research and education participants.
3. A useful model of web-based instructional design is developed for use with science teachers.
1. A successful model for using science data sets in classroom settings is demonstrated.

Course Criteria

For each course that was part of the Classroom BATS program, the following criteria were used to guide the evaluation:

Prospective teachers will demonstrate:
1. Understanding of real-time science data
2. Increased enthusiasm about science and appreciation of scientists' work
3. Increased knowledge of climate change through study of the oceans
4. Use of project-based learning as a model for use in their future classrooms
5. Skill in using technology as a means to enhance communication.
6. Create lesson plans for Grades 6-12 that reflect science standards and that can be used by other teachers.

Program Model Goals

The Classroom BATS model will:
1. Utilize distance learning for all types of students, of different learning styles, ethnicity, age or gender.
2. Present materials from several science disciplines
3. Provide a guide for use on the virtual campus as a tool for all participants
4. Make the BATS dataset more usable and meaningful for science teachers

These criteria were used throughout the project to guide decisions and were also used to provide a framework for this evaluation.

C. LIMITATIONS OF THE EVALUATION

Only a few of the student projects were shared with the CBATS team and these were only minimally tangentially related to CBATS and they did not relate to Bermuda.
The lack of student-produced projects made it difficult for the CBATS team to ascertain how well the program was helping the FIU in-service teachers learn and use the CBATS material and also to determine whether the program was effectively integrated into the existing university courses. There were only a few respondents to the survey about the

OceanExplorer workbook solicited from those who had downloaded the workbook from the web.

Although there had been dialogue from time to time about the program with the university faculty as part of ongoing program monitoring, there were no concluding statements about overall program perspectives as part of the final evaluation. Despite several attempts to obtain FIU feedback and materials, none were forthcoming.

D. OVERVIEW OF REPORT CONTENTS

The focus of the evaluation and methodology used in this evaluation are presented in sections II. and III. of this report. Section IV. presents a detailed discussion of the evaluation results, including interviews with instructors/scientists and pre-service and in-service teachers' responses to the questionnaires. The evaluation team's concluding summary and recommendations for improving various aspects of the program are provided in Section V.

II. FOCUS OF THE EVALUATION

The focus of the evaluation covered the main program components, namely:

A. The Classroom BATS Public web site
B. The Classroom BATS Virtual Campus
    1) As related to Florida International University Courses
    2) As related to the Ocean Data 2000 Workshop for teachers
C. The OceanExplorer Excel Workbook
D. Partnerships, Collaboration and Management

A. THE CLASSROOM BATS PUBLIC WEB SITE

The Classroom BATS web site provides a detailed overview of the program together with a brief history of oceanography, giving students, teachers, and the public sufficient background material to allow them to develop an interest in the program and explore how they can use it in their own situations. Development of the web site was a collaborative venture between TCOE staff and BBSR scientists. Extensive links were provided to various resources and additional web sites on related topics and a number of activities had been developed to help motivate and facilitate the use of BATS data. These activities are detailed below:

Adopt a Link - Visitors to the site are offered the opportunity to *'adopt a link'* by creating their own multimedia resources on related topics and then submitting their materials to the Classroom BATS design team. A link will then be created to these new materials so helping enrich the Classroom BATS web site.

This is just one example of several interactive activities available on the web site to encourage public participation and involvement with Classroom BATS. Other exciting links are outlined below.

Crush A Cup – This is a fun project to involve schools in the Classroom BATS experience. It demonstrates the deep sea's bone-crushing pressure through the use of polystyrene cups submitted by the students and submerged deep in the ocean during the regular BATS cruises. The full project package includes lesson plans, a slide set featuring photographs of deep-sea fish and plankton, and an informative booklet that explains ocean pressure, its effects on deep-sea creatures, and the adaptations that deep-sea creatures exhibit to deal with the high-pressure environment in which they live. During the 1999-2000 school year a total of 435 cups were processed from 14 different schools representing six different states and Bermuda.

Crew Profiles - To motivate interest in how ocean data is collected a questionnaire was distributed to *Weatherbird* crewmembers. This was designed to highlight what life is like for the scientists and crew aboard a research vessel and to define their role in BATS and

the career path that has taken them to Bermuda, BBSR, and the *Weatherbird*. The resulting crew profiles are now on the CBATS web pages.

Lesson Planner - The CBATS *LessonPlanner* provides an on-line form that you can use to create lesson plans based on the BATS oceanographic data and other resources on the CBATS web site. Selected lesson plans are added to the CBATS web pages once they have been submitted and vetted for content accuracy, grade-level appropriateness, and pedagogical merit by the CBATS design team.

OceanExplorer – see detail in Section III C.

Compete in the BATS Bowl – This is a proposed science contest, in which participating classrooms would compete each month during the school year to determine which group can most accurately predict the measured value of a chosen BATS data parameter from a pre-announced depth. The overall winners at the end of the school year would be recognized on the Classroom BATS web site. The BATS Bowl provides a fun and challenging way to encourage students' interest in oceanography, motivate their mastery of OceanExplorer and increase their understanding of the physical mechanisms that control ocean behavior.

B. THE CLASSROOM BATS VIRTUAL CAMPUS

The virtual campus provided a place for presentation of materials and a dialogue among scientists and educators. The virtual campus was set up on the College of Exploration web server, using Caucus conference software. The campus provides a password protected, private environment for asynchronous dialogue using both text and multimedia facilities. The virtual campus was the location for the FIU course modules and the online workshop.

The Florida International University Courses

An online campus was set up for each of three semesters to complement the existing face-to-face online courses at Florida International University. These virtual classrooms were established in fall 1998, Summer Session 1, 1999 and fall 1999.

Classroom BATS was designed as a module to fit into two existing FIU courses: one was a course for teaching secondary school science teachers. This was ‘Teaching Science in the Secondary School’. The other course focused on middle school science teachers, and was entitled ‘Methods of Teaching Middle School Science’.

For the summer 1999 course, TCOE staff members Peter Tuddenham and Tina Bishop went to Miami during the first week of classes to introduce the virtual campus to the students. They presented an overview of the online conferencing system that was the

basis for the virtual campus. They worked individually with students and offered hands-on support as the students first tried out the virtual campus.

The course requirements were to create lesson plans based on materials from the BATS project. A microteach and a course project were also listed as course requirements and were to be based on BATS data.

Ocean Data Workshop

The Ocean Data 2000 online workshop was held in May 2000 for one month. It was offered to any teacher who wanted to participate but the marketing effort was focused on two audiences. The first target group was in-service teachers at Miami-Dade Schools. Arrangements were made with the Teacher Education Center and the Science Coordinator to advertise the workshop. The Miami-Dade teachers could receive master plan points for their satisfactory participation in the workshop. It was felt that the in-service teachers could not only benefit from the workshop information themselves but could also be models for the pre-service teachers who were anticipated to be part of the workshop.

The second group was other pre-service teachers. The marketing effort for this group included requesting participation from another FIU class and also from the College of Education at Florida Memorial College. Despite personal marketing efforts to the pre-service institutions, the team only obtained participation from a very small number of pre-service teachers in this workshop.

The online workshop modeled a face-to-face workshop format with keynote presentations, a teacher workroom and a reception area. Two BBSR scientists provided keynote presentations. The first by Dr. Debbie Steinberg provided an introduction to Oceanography and a graphical presentation on spring bloom. Dr. David Malmquist presented BATS data and introduced the OceanExplorer Excel workbook that was to be used to help the teachers more easily use the BATS data in their teaching.

Two University of Rhode Island science educators, Cheryl Schroeder and Gail Scowcroft facilitated the Teacher Workroom area. The Teacher Workroom was the place for the teachers to discuss ideas for implementation of the keynote presentations into their classroom curriculum. It was also designed for sharing of ideas and lesson plans related to this theme.

C. OCEANEXPLORER

The *OceanExplorer* is a Microsoft Excel© workbook designed especially for Classroom BATS. It contains four default worksheets: *BATSData*, *HydroStation S*, *Profiler*, and *TimeSeries*. The first two of these worksheets provide selected oceanographic data from these long-term ocean monitoring programs, together with the software tools to enable

analyses and graphing of these data. The *Profiler* and *TimeSeries* worksheets each provides a place and the tools needed to draw one's own depth profiles and time-series plots and can be used to help assess learners' preconceptions concerning ocean properties and behavior.

Several special features are available to help analyze the scientific data and adapt it to an appropriate level for individual classrooms. Each of these features – Autofilter, Extraction and Graphing – is explained in detail on the web site. As the teacher or student selects, analyzes, and graphs the data to meet individual class interests, unique worksheets and charts can be added to the overall *OceanExplorer* workbook. These objects can be saved within the *OceanExplorer* workbook, copied to other Excel workbooks, and/or printed to post in the classroom. Throughout this process unfamiliar terms and concepts in the *OceanExplorer* are explained and illustrated by way of hyperlinks to appropriate multimedia resources on the Classroom BATS web site. Throughout the OceanExplorer workbook there are hot links to pages on the web site, and also pop-up help windows that explain terms and concepts.

D. PARTNERSHIPS, COLLABORATION AND MANAGEMENT

After the NSF grant was awarded the whole team held their first meeting at Florida International University in June 1998. At this meeting the team reviewed the proposal and developed a three-year work plan for the program. The FIU faculty presented an overview of the teacher preparation courses, and showed the team the computer labs used for the teacher classes.

The next meeting of the whole team was held in January 1999, at the Bermuda Biological Station for Research. At this meeting FIU faculty and College of Exploration team members were given an overview of the Bermuda Atlantic Time Series data, and related oceanographic topics relevant to the National Science Foundation grant. A course by course plan was developed and the requirements for the data presentation and supporting materials developed.

The process of design worked well for the first 12 months of project. There were two face-to-face meetings and many conference calls between the team members. The online conference meeting space on the College of Exploration virtual campus was used also used by Bermuda scientists and College of Exploration team members, to develop and design the programs. The faculty members from Florida International University were not active participants in this online environment. The reasons for this were not apparent.

In April 1999 a workshop was hosted by BBSR in Bermuda. This was used to formally introduce the BATS scientists and technicians to the Classroom BATS project and to gather feedback concerning the content, layout and functionality of the web site.

During the first six months of the second year, the emphasis was placed on developing the OceanExplorer workbook. This development effort was the main focus of the

program during that time. As the program developed various versions were offered to other team members for comment and feedback. Bermuda scientists and College of Exploration team members participated in this interactive design of a fairly complex workbook program. There was a very limited participation from the faculty and FIU in this phase of the Classroom BATS program development.

During the last nine months of the program the OceanExplorer workbook was further refined. Additionally a number of instructional web- based videos and pages were developed to describe the functions and applications of the workbook. It is not clear whether any faculty member from FIU actually has used the OceanExplorer or examined its functionality in any way. To date, there have been no recommendations from them that could help in the development of the application.

E. GUIDING QUESTION

Encompassing all these major project components, the focus of the evaluation can be summarized by the following guiding question:

How well did the Classroom BATS program address the need for educators (primarily pre-service science teachers, but also in-service teachers) to effectively use -based scientific resources, including web data and online interactions with scientists, in their learning and teaching of ocean sciences?

III. METHODOLOGY

A. EVALUATION MODEL

To evaluate the implementation of the Classroom BATS program, the evaluation team combined qualitative data with quantitative presentation and analysis of questionnaire data. The evaluation was both formative and summative in nature. Throughout the two-year program, feedback was obtained from a wide spectrum of participants through informal interviews, web review, course and workshop participation patterns, and questionnaires. This information was collected prior to, during, and after each program segment. This monitoring was done in order to make continuous improvements and to make changes for upcoming phases of the project.

At the conclusion of the two-year implementation a summative look at the merits of the program was made to guide decision-making for the future of Classroom BATS. Key stakeholders at FIU, BBSR and TCOE, as well as workshop participants, workshop facilitators, and spreadsheet users provided input to this evaluation.

The approach to this evaluation combined a review of program documents, analysis of web statistics, review of the online classroom participation statistics, questionnaires, and interviews/team feedback.

B. OVERVIEW OF EVALUATION INSTRUMENTS

The following methods were employed as part of the data collection for this evaluation project. The methods are explained more fully in the remainder of this section.

1. Review of project documents.
2. Review of web site statistics
3. Review of participation statistics from the online courses
4. Needs Assessment questionnaires
5. Post-course questionnaires
6. Interviews with key project personnel
7. OceanExplorer survey and overview

Review of Project Documents

As preparation for completing this evaluation, the evaluation team reviewed the original proposal, and the years' one and two yearly report summaries that were submitted to NSF. In addition the FIU course syllabi, student projects, and workshop lesson plans were examined to provide relevant background information.

Review of Web Site Statistics

Web Trends software was used to gather detailed statistics from the Classroom BATS web site. This provided information on a wide variety of areas including general locations of visitors to the site, activity levels on the site by day/hour during the period of the project, most/least requested pages, most downloaded files and common browsers/platforms used by visitors to the site.

Review of Participation Statistics from the Online Courses

The evaluation team looked at participation statistics from the course modules. This included looking at a number of postings (written responses) as well as reviewing the number of participants only reading responses. This review was possible due to a feature of the Caucus software that tracks participation. A query of "Who Has Seen this Item? in each of the respective online areas evoked a listing of all participants and the number of responses they had displayed on their screen.

Needs Assessment Questionnaires

Prior to the two FIU courses, a needs assessment questionnaire was posted on the web for the course participants to fill in. This 21-question survey included 17 selective response questions and four open-ended questions. This needs assessment survey provided background information about the participants by asking questions about participant's education, technology, and oceanography background together with their interests and expectations for the course. This information was used by the course designers to better plan and present the course materials. Key demographic data was collected from the participants in the ocean data workshop. One of the Needs Assessment questionnaires is included in Appendix A.

Post-Course Survey

At the end of the FIU course modules, a questionnaire was posted electronically on the web for the participants to fill in. This 20-question survey included a mix of 13 selective response and seven open-ended questions that were related to both the content and process of their participation. This questionnaire asked for feedback on ease of use of the web-based classroom and resources, the benefits and helpfulness of the materials for their own learning and for use in their future and present classrooms, and the value of the online interactions with scientists and other educators, and recommendations for improvement of the program. The Post-course survey was included in Appendix A.

The Ocean Data Workshop Survey

At the conclusion of the May 2000 online workshop, a questionnaire was posted on the web. This twenty-five-question survey included a mix of 20 selective response and 5 open-ended questions that were related to both the content and process of their participation. This questionnaire asked for feedback on the content and presentation of

the workshop materials and the usefulness and ease of use of the data from an educator's perspective. The open-ended questions sought opinions on difficulties with participation, benefits from a personal and professional viewpoint and suggestions for improvements for future workshops. See Appendix A for the Ocean Data Workshop Survey.

Interviews with Key Project Personnel

Ongoing monitoring of the project was accomplished through informal interviews in which the team members offered their reflections on the past activities of the project and brainstormed ways to improve the process. These reviews were held in July 1999 midway through the program implementation, in November 1999 at the end of the final FIU course module, in April 2000 in preparation for the Ocean Data online workshop and then in October 2000 as a wrap up session.

OceanExplorer Survey and Team Feedback

To get feedback about the usefulness of the OceanExplorer spreadsheet a questionnaire was issued by e-mail in September 2000 to the 55 people who had downloaded the OceanExplorer workbook up to that point. The survey was also posted online for those who preferred to submit their responses via the web. This questionnaire included 24 questions and was a mix of open ended and selective response questions. Five questions related to the web site, two questions asked about potential participation in future online workshops, and 17 questions explored the respondents' use of the OceanExplorer workbook. In addition to user feedback about the OceanExplorer, an overview of the OceanExplorer workbook by the project personnel involved in its design and development is also included as part of the evaluation. See Appendix A for Ocean Explorer survey.

IV. RESULTS

The results of the evaluation are presented in this section and discussed in light of the guiding question and criteria identified in Sections II. above. The analyses cover learning outcomes, partnership considerations and technical and logistical issues. The results are examined in light of the project goals and are aimed at helping readers understand the value of the Classroom BATS materials to pre-service science teachers and in-service teachers.

A. THE CLASSROOM BATS WEB SITE

Web Trends software was used to identify statistics on access levels and usage of the Classroom BATS web site over a two year period. This provided useful information such as average hits per day, popular times for access, top entry level points and location of users accessing the site. Statistics for these areas are summarized below.

Site Access

The use of the web site was analyzed for the period January 22, 1998 to November 11, 2000 using commercially available web site analysis software from WebTrends.com. During that time the web site recorded a total of 26000 individual user sessions completing 76,988 page views, or an average of 76 per day. The majority of site visitors was from the USA and Bermuda; however, access from Canada, United Kingdom, United Arab Emirates, Australia, Spain, Netherlands and South America was also noted.

Statistics showed that the CBATS web site had an average of 263 hits per day, with users staying on the site the site for an average of 10 1/2 minutes per visit. The distribution of users, based on the number of times each user visited the site, showed over 6000 users having only one visit during the period of analysis. Over 470 users visited the site twice with the same number registering 10 or more visits. For the interim range of 3-9 visits, the number of users went from 34(9 visits) to 174 (3 visits).

Web Trends provided interesting detail on the most popular access times to the CBATS web site. Weekdays were more popular with an average of 38 users and 443 hits per day, with Tuesday being identified as marginally the most active day of the week and Sunday as the least active. The most popular time for access was between 7-10 in the evening. This reinforced the fact that users liked the ability to access the BATS workshops and web site materials at a time convenient to them.

Another positive factor, noted by the statistical software, was the number of successful hits for the site. Only 0.56% of the total hits were unsuccessful, which provided a strong indicator of the reliability of the CBATS site.

Content Access

As would be expected, the software showed the CBATS home page to be the most requested page. Other pages showing up on the 'most requested' statistics included Lesson Plans, Introduction to Oceanography, Virtual Plankton Tow, OceanExplorer, BATS Resources and BATS at Sea. At the opposite end of the scale, the least requested pages were identified as Chlorophyll Contour Plot, Vertical Migration, Spring Bloom in the Sea, Concentration of Plant Pigments at BATS and Interpreting BATS data.

The first page viewed by the majority of visitors to the web site was the home page. This suggested that they cam from a direct link to the web site home page URL. Three known references are from the BBSR home page, the TCOE home page and from within the online CBATS workshops. The limitation of the web site logs does not give additional information on how visitors are referred to the CBATS web site. Statistics also indicated that in these cases users were most likely to access only the page they were taken to by the URL and then they would exit from the site.

Two out of three respondents to the OceanExplorer survey commented on the web site. They said that they used the web site on average once a month. The most popular activity noted was the Virtual Plankton Tow. One of the respondents commented that "the students found the site useful and easy to use".

B. REVIEW OF PARTICIPATION STATISTICS FROM THE ONLINE COURSES

Participation Data for the FIU Course Modules

Participation in the online discussion with the scientists was overall quite limited. However several students demonstrated considerable interest in the presentations and in the OceanExplorer workbook and engaged in ongoing dialogue with the scientists and other students.

For the May 1999 FIU course, 20 students had passwords for participation. Twelve of these students entered the online environment and introduced themselves but only six participants actively engaged in conversation with the scientists.

Participation in fall 1999 FIU course was very limited, which was discouraging to all involved. 20 people had passwords but only three actually got involved in the dialogue. There were two students who worked diligently on the Excel workbook and engaged regularly in discourse with the scientists about the workbook.

Participation Data for the Ocean Data Workshop

There were 44 registered participants in the Ocean Data Workshop. A number of participants were teachers in Miami-Dade Schools, but there were also teachers from five

other states. Only 29 of those who registered actually entered the workshop and introduced themselves, which was a fairly high attrition rate.

In the Virtual Hanson Hall where the keynote presentations by the scientists occurred, there was a great deal of interest during the first week's presentation on oceanography. Dr. Steinberg's question to the participants " I am interested in using real ocean data in my classroom because..." evoked some thoughtful comments such as:

- "It is real data that my kids can relate to since we live in South Florida"
- "It is a way for my students to become familiar first of all about the diligent and thorough work that goes into it."
- "I think it is a topic that stimulates the greatest amount of interest in both the students and myself."
- "I may be able to use the information that we gather from this workshop to promote student learning, specifically within an online laboratory setting in my classroom."

Clearly the participants valued the opportunity to incorporate real ocean data into their classroom lessons as both relevant and motivating.

In week two Dr. David Malmquist introduced the OceanExplorer workbook. He presented the week's objectives and a very well organized plan of approach to working with the workbook. During the week there was limited dialogue and it was focused on difficulties with the workbook and their possible solutions.

In week three, the participants were asked to enter the Teacher Workroom area. This area was for general discussion about how to use the workshop information in classrooms. The participants were asked to share their ideas about using the OceanExplorer tool to enhance curriculum. Those who wished to gain Master Plan points for Miami-Dade schools were required to create and share lesson plans. A sample lesson plan was provided.

Dialogue in the teachers' workroom was overall fairly limited with only 66 responses to all the items in the room. A lively discussion of marine mammals was the highlight of the dialogue. The middle school teachers' section was the most active grade-level specific area.

C. NEEDS ANALYSES SURVEY RESULTS

Background

From the pre-surveys of the FIU students, the academic background of the participants was established. The groups were made up of an even mix of teachers working towards certification, those already certified taking the course as part of a graduate program, and a smaller number of graduates in teacher training programs.

The participants were all current or aspiring Middle or High school teachers, and although the majority of those taking the Fall 1999 program fell into the same category, a small number (7%) taught at Elementary level. For those who were pre-service teachers, all were interested in Middle or High school positions.
Although over half of all participants had no previous experience in online courses or oceanography courses they all had a strong background in science based courses, particularly Chemistry and Physics.

Desired Learning Outcomes

Many of the participants expressed the desire to learn new ways to incorporate the vast resources available on the Internet into their classroom activities and thus develop online research skills for both students and teachers. Another major goal was to gain a better understanding and knowledge of Oceanography topics and use the information from Classroom BATS to identify inter-relations with other scientific disciplines such as Physics and Chemistry. Participants also felt that bringing 'live' data into the classroom would help develop science lessons that would make science class a more interesting and fun learning experience for the students.

Topic Interests

Participants were asked to state their interests in particular areas of oceanography to help the keynote speakers create a focus for their presentations and to ensure, as far as possible, that participants expectations from the course were addressed. Although some felt their lack of knowledge in the area prohibited them from stating a specific interest some common topics highlighted for exploration included coral reefs, ecotoxicology and the relationship between the oceans and global weather patterns.

Concerns and Anticipated Successes

The major concern expressed by the majority of participants was their lack of computer skills and experience using the web. Experience with working with online conferencing ranged from average to very low. A majority of participants (70%) marked their web technical skills as average with only a small number (10%) marking themselves in the very high category. Similarly for web search skills half of the participants registered average skill levels. Email was a more common skill with a third of all participants falling in the high to very high skill range. Many were worried that their lack of experience in these areas would hinder their ability to get the most from their online experience within the time limit of the workshop. They also noted that their limited prior experience of online conferences could make navigation of the conference space, to find the required information, more difficult. Another concern was that the volume of information available would make it difficult to break down for practical use and hard to acquire the ‘right’ information to develop successful lesson plans.

On the positive side the participants looked forward to the opportunity to expand their knowledge of oceanography and discuss their own ideas and thoughts with experienced

people in this specialized area of interest. Others saw it as a means of experiencing a new way of learning via the online environment and how they could create ways to use this in their own classrooms. They were also attracted by the anticipated benefits associated with that way of learning, namely working at their own pace during the period of the workshop, having virtual interaction with their colleagues and enjoying the benefits of their home surroundings as opposed to a typical classroom setting.

D. POST-COURSE SURVEY RESULTS

The results from the two post-course surveys were combined to give an overall picture of the successes, concerns and thoughts put forward by the participants. There were 12 FIU students who responded to the two surveys out of a total of the 40+ who were registered as part of the FIU courses. Two thirds of these respondents felt that the experience was a valuable one, with a third remaining neutral.

When responding to questions on their participation in the Classroom BATS program, a third of respondents stated that they logged on 2-5 times a week with the other two thirds logging on once a week. On viewing our program statistics on user involvement however, it was apparent that although the participants were actively reading the Classroom BATS materials, only a few were posting their own comments or questions.

The materials used in the Classroom BATS virtual campus were viewed as a useful teaching tool by 83% of the respondents and this same number agreed that the manner in which the materials were organized made for an easy transition into the classroom. Only one respondent disagreed with these points, with three remaining neutral. The content topics incorporated in the workshops were seen by all as curriculum appropriate for the grade levels represented by the teacher participants. The concept of using 'real live data' in classroom lessons was attractive to many of the respondents and over 80% of participants stated that they would use a combination of the data and other resources found on the web site for future lessons within their classrooms.

Course Module Successes

One high point of the program noted by the respondents was the provision of excellent oceanography resources, not only within the workshops themselves, but also via many hyperlinks to other web sites with related information. It was found that the participants valued the non-data resources in almost equal measure to the value they placed on the BATS data itself. Having access to such a wide range of information gave the teachers more confidence about teaching this subject in the classroom and also provided them with an extensive source of information for future lessons on general oceanographic and basic science issues.

The format of the online course module meant that participants could post questions on particular topic areas and get direct responses from experts addressing their areas of

concern. In general the survey respondents were enthusiastic about the online interaction with the scientists, with only one person in disagreement about the benefits of this involvement. In the summer 1999 course about half of the FIU students engaged in dialogue with BBSR scientists at least once during the course period, even if only to introduce themselves; but in the fall course there was less conversation and participation. One of the respondents noted that it was great to '…know that I was getting answers to my questions from a real person with experience rather than just out of a book'.

Overall 83% of the respondents viewed the workshops as a positive means to enhance the sharing and exchanging of knowledge with one participant noting that '…without it I may not have ventured to try a "virtual classroom"…and so would have been keeping something that I now know is valuable from my students.'

Course Module Concerns

The main concern highlighted in both surveys was with the operation of the OceanExplorer workbook. Although all participants were able to successfully access this, only two of them agreed that it was easy to use. Others noted that it appeared too complicated and that more specific instructions on how to process the data would have been useful. This area proved frustrating for the teachers, as many were enthusiastic about the ability to graph the data, and could see the benefits of this in the classroom, but were unable to successfully complete the task. Also the volume of available data was overwhelming for many of the participants.

In summary it was apparent from the completed evaluations that the participants generally recognized the potential value of using BATS data in their classrooms. However the evaluations also indicated that a more effective and user-friendly data analysis and graphing tool was required to allow the participants to fully appreciate the potential of this data.

E. OCEANDATA 2000 WORKSHOP SURVEY RESULTS

Overview of Workshop Participation and Experience

Out of the 29 participants who actively participated in the Oceandata 2000 online workshop only 13 responded to the evaluation survey. Of those responding, 39% stated that they logged on 5 or more times a week with a further 46% logging on 2-4 times per week.

Nine out of the 13 respondents agreed that the workshop was a valuable experience. There was one lone dissenter.

Figure 1: Overall Value of Ocean Data 2000 Workshop Experience

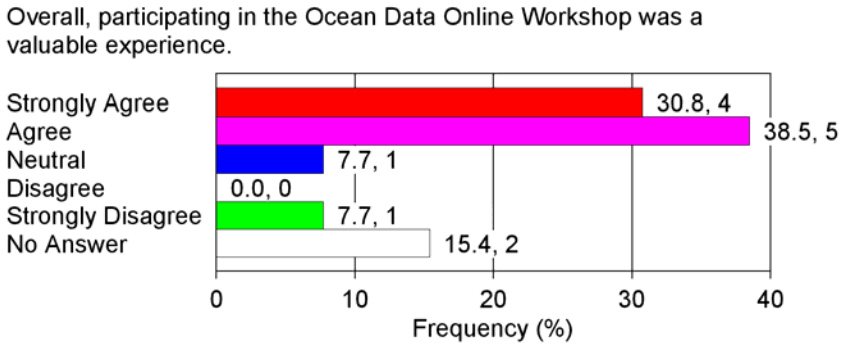

Figure 1:

The presentation on oceanography was overwhelmingly viewed as good or excellent as were the content and activities provided on the Classroom BATS web site.

The teacher workroom activities and the OceanExplorer workbook had mixed reviews. Although the majority of respondents said that they were excellent or good, almost a quarter of respondents rated them fair or poor.

Providing Useful Materials

As was found with the FIU courses, one of the most positive aspects of the workshop, defined by the participants, was the provision of helpful teaching materials (See Figure 2) and extensive links to important oceanography teaching resources (See Figure 3). Respondents were also in agreement that the organization of the CBATS materials made them easy to transfer for use in the classroom. The content topics were seen as curriculum appropriate for the grade levels represented by the majority of participants i.e. middle and high.

Figure 2. Materials as Helpful Teaching Tool

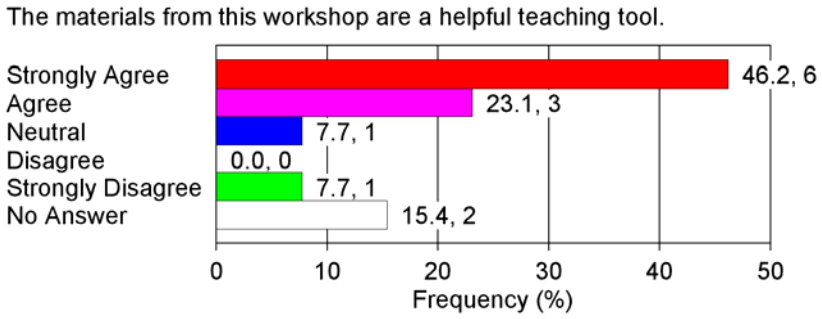

Figure 2:

Figure 3: Provision of Important Ocean Learning Resources

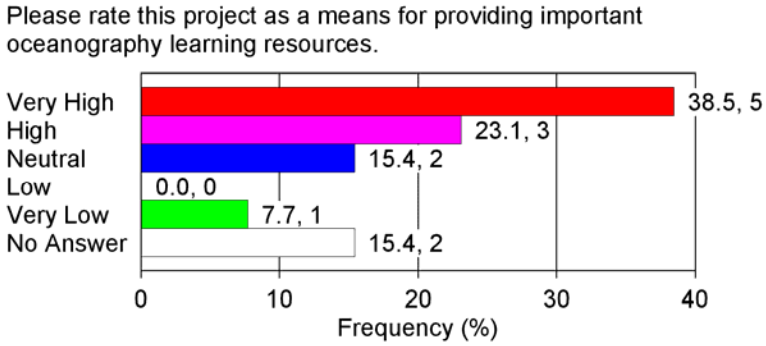

Figure 3:

The workshop was seen as a powerful means for sharing and exchanging knowledge. (See Figure 4) However there was some expression of disappointment with the limited amount of dialogue.

Figure 4: Sharing and Exchanging Knowledge

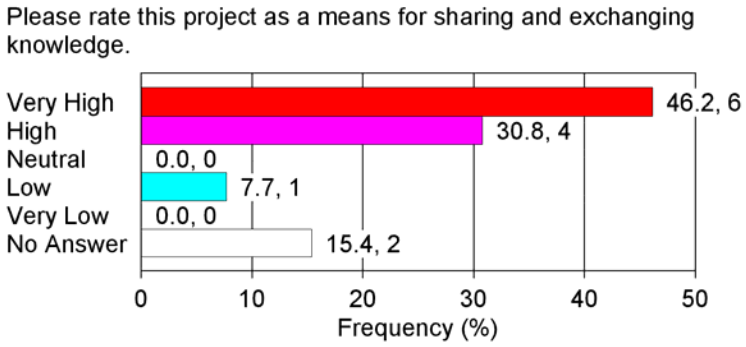

Figure 4:

Workshop Successes

The greatest personal and/or professional benefits identified by those workshop participants responding to the survey were highlighted as follows:

- *Workshop provided access to 'real data' in addition to useful materials and resources for future use* - the teachers noted their appreciation of access to such extensive information with one respondent stating "..having an available source of data and some other lesson plans is a real time saver for me."

- *Opportunity to work with and learn from experts in the field* - participants noted the benefits of being able to pose questions or suggestions and have an answer within a reasonably short time frame.

- *Opportunity to enhance skills on new technology* - teachers enjoyed the insight the online workshop gave them into new ways of learning and how they could make more use of the Internet as a classroom resource. The fact that the workshop was a "..self forcing opportunity to deal with new technology" was seen as a positive factor by several of the participants.

Workshop Concerns

The participants and facilitators who completed the evaluation survey highlighted two major areas:

OceanExplorer Workbook – this was generally seen to be over complicated and overwhelming for the majority of teachers who had limited experience with the MS-Excel application. Although the scientists had endeavored to make it user friendly, a lot of time was still required from the participants to get 'up to speed' with the application in order to make the best use of the data provided. This was time that the teachers had not scheduled for and didn't have available during the period of the workshop.

Timing of the Workshop - the end of the school year was deemed a very busy time of year by participants and was not seen as the best period for offering a workshop. One of the facilitators felt that this factor played a significant role in the lack of participation in the program. This factor together with the limited four week duration of the workshop meant the participants did not have long enough to make the leap from oceanography presentation and working with data to actually using data in the classroom and creating useful activities.

F. INTERVIEWS WITH KEY PROJECT PERSONNEL

In the July 1999 meeting, the feedback from the May 1999 course was discussed. These discussions led to modifications of the web site and course. Ideas were explored for developing better instructions for how to use the data sheet, enhancing the web site resources, and getting the data sheet ready in a timely way.

In the November 1999 phone call Dr. Martinez-Perez indicated that there had been problems getting the data sheet working creating frustrations for the students. Also he said there was a reluctance on the part of students to do extra work since the Classroom BATS module was an addition to the curriculum and not the main focus.

A review and reflection meeting was held with Dr. David Malmquist, Dr. Debbie Steinberg, and Mr. Peter Tuddenham in October 2000 to get their feedback on the program as preparation for the anticipated project's conclusion and writing of the report.

Comments from the team members are incorporated in this report as part of the conclusions and recommendations.

G. FEEDBACK ON THE OCEANEXPLORER WORKBOOK

Project Staff Views

The OceanExplorer workbook was the culmination of efforts to make the BATS data more readily available to teachers and students. Almost 100 downloads of the program had occurred since December 1999. (As tracked up to early December 2000.) These downloads are in addition to the specific use of the program that was achieved during the courses at Florida International University. Downloads of the workbook have occurred as a result of web searches and word-of-mouth referral. One middle school used it as a basis for the oceanography unit.

It is apparent from the students at Florida International University, and also from feedback from those that have downloaded the OceanExplorer program, that teacher' understanding and use of workbook applications is limited. Many users of the program described initial difficulties in terms of just using the workbook as an application irrespective of the data. One recommendation that we have is for the topic of workbook applications in the use and analysis of scientific data to be offered more as a pre-service and in-service teacher professional development course

The OceanExplorer program contains the majority of the BATS data sets. The macro features enable users of the program to compare and contrast multiple variables and to use a wide range of graphs. For many users this feature is a welcome addition. For many others however it over complicates the process and content of the material. Another recommendation is for the data sets to be made available in stages, or modules, each increasing in variety and complexity.

Compatibility between different versions of Microsoft Excel for Windows, and also between the Windows version and the Macintosh version, add to the challenges of offering data sets in an available program that is not consistent across all versions. Unfortunately there is no easy remedy to this situation. The limitations and difficulty of maintaining up to date versions in a variety of formats restrict the widespread use and also the level of support that can be offered. During the last three years Web technologies have improved dramatically. It may be that it would be preferable to revisit the opportunity of presenting BATS data, in a workbook with all of the functions of the macros, accessed and displayed through Java applets on a Web page.

However the program is developed in the future, it is important to note that the presentation and accessibility of data in a spreadsheet format is a great improvement for teachers and students. The positive aspects of using real data in the classroom in a commercially available workbook program should not be underestimated.

User Views

Although the survey was sent to 55 people who had downloaded the survey (up to that point in September 2000) from the web, there were only three respondents. Nevertheless, these three did provide some helpful feedback and interesting commentary.

Two out of the three respondents said they experienced difficulty in downloading the workbook. They listed the problems as:

- Slow speed
- Unable to complete download on some machines
- Intimidating number of steps in the instructions
- Repetitive downloads seemed overwhelming for the network lines
- Some graphs are difficult to read due to the small print

Two respondents said they used the workbook once a month, while the other said it was used only once a year. These teachers used the workbook for:

- Modeling abiotic conditions and depth
- Studying ocean profiles of temperatures through time and changes with depth

The survey respondents portrayed a mixed picture of students' interest in the workbook, with 2 out of 3 teachers stating that their students found it interesting. Benefits of the workbook highlighted by the respondents included:

- "Real data is the big benefit."
- Large amount of data
- Use of macros

Responses to this survey also included comments on the Classroom BATS web site. This was positively viewed by the three respondents with two stating that they would use the materials provided once a month in their classroom activities.

V. CONCLUSIONS AND RECOMMENDATIONS

In conclusion, interpretive commentary synthesizes all the data from formal and informal feedback and participation statistics to identify common themes and points of interest. The evaluation team's interpretation and synthesis of the information provides an overall appreciation of the effectiveness of the Classroom BATS materials and their use in the university settings. The evaluation team summarized how the program met the original goals and criteria, drawing the following conclusions.

The Classroom BATS online course modules and workshops were moderately successful at building learning communities. There was a core of interested and dedicated pre-service and in-service teachers in each of the learning programs who benefited significantly from participation. There was better online participation and interaction among the Ocean Data workshop participants than the FIU pre-service teachers who had less incentive because they met face to face twice a week anyway.

The instructional design model worked well for presenting the oceanography materials, resources, and data. The combined experiential (Crush a Cup), web site and links, Ocean Explorer spreadsheet, and online discussion opportunities offered a good combination of learning modes.

The success of the Ocean Explorer as a means for using ocean data sets in the classroom was demonstrated only for a few Classroom BATS participants; those who were the most knowledgeable in spreadsheet use with scientific data. Many of the participants reported little or no knowledge of basic spreadsheet operations or analyses and stated frustration with a number of technological and data usage problems.

Pre-service teachers in the courses did gain an appreciation for scientists' work from the well-documented presentation of oceanographic research and scientific endeavors of the Bermuda Biological Station for Research.

It was not possible to gain a thorough understanding of how the Classroom BATS program was used by pre-service teachers in Miami due to a lack of concrete products from FIU students that were directly related to Classroom BATS. AS part of the workshop, a small number of in service teachers successfully completed the Master Plan point process for Miami-Dade Schools by completing related lesson plans, which included identification of the appropriate science standards.

A. BENEFITS

The main benefits expressed by the participants were:

- *Access to scientists* and opportunities to expand knowledge of oceanography and ocean data.

- In the Ocean Data workshop a *strong sense of collegiality* was observed among the participants. Those who were keenly interested in ocean data and ocean sciences were reinforced and felt less isolated through participation in the online community.

- Pre-service and in-service teachers who participated in the online classroom *expanded their use of the web and developed greater facility with online conferencing software*.

- They obtained access to the data, which otherwise were not available except through the web. This *use of actual data* was a powerful feature of the program.

The Classroom BATS web site and its related materials, especially the OceanExplorer data workbook received favorable recognition as a valuable tool for educators when the BRIDGE web site of Virginia Institute of Marine Science listed it as one of the Data Tips of the Month. The BRIDGE is a focal point for resources for marine educators. (http://www.vims.edu/bridge). *The Crush a Cup* component of the Classroom BATS program was well received and seemed to be a good motivator for learning about oceans.

B. CHALLENGES

Though its potential was rated as high and the value of working with real data was paramount, nevertheless one of the biggest challenges was working with the spreadsheet. These difficulties occurred irrespective of the BATS data and the extensive contextual embedded help throughout the BATS Ocean Explorer worksheet. Most teachers did not know how to use a basic spreadsheet. This situation coupled with the fact that the Ocean Explorer was in a developmental phase with a variety of glitches led to discouragement and frustration on the part of many participants. This problem was accentuated by the limited background of many of the participants with using ocean data and dealing with complex oceanography topics and made the overall experience less than satisfactory for them.

To summarize the major challenges:

Challenges Related to the Classroom BATS Content

1. This topic is a narrowly focused topic that may be difficult to understand, particularly without much background in oceanography. Many teachers are more motivated to teach about marine biology, sea creatures, and severe weather phenomena, which captivate the imagination better. There is a need to balance and blend quantitative data presentation with photos, interesting fact of sea creatures, and tell stories of scientists engaged in research projects. This was the direction that the Classroom BATS team started to take and felt that it was positively received.
2. The program assumes some knowledge of MS-Excel workbooks and MS-Excel software, which the majority of teachers participating in this project did not possess.

This is especially true with elementary level teachers. Our first approach was to use web presentations using applets but server and program requirements were too restrictive and overly complex and challenging so we decided to make it a stand-alone process using data and macros combined a standard MS-Excel spreadsheet.

3. Any professional development program needs to offer information and materials that are relevant to existing curriculum. These materials must fit in without demanding major adjustments and must be seen to add interest and value to what the teacher is currently planning to teach. Since ocean sciences are not a part of most state curricula and standards, this makes oceanography face a bigger challenge in being attractive from both professional development and curriculum integration standpoints.
4. A corollary to the problem mentioned in #3 above is that more direct tie-in to standards should have been explicitly stated. Although we expected that teachers creating lesson plans in the Ocean data workshop would link their activities to the standards, neither the web site materials nor the virtual classroom presentation directly listed the related standards.
5. As a result of feedback from the Ocean Data workshop it was determined that the content was not well suited for elementary teachers. It also seemed less suited to middle school teachers and was most appropriate on the secondary level.

Challenges Related to the Classroom Bats Process

1. Incentive to be Online - it seemed that there was not as much incentive to go online on the part of the pre-service students who were part of a face to face class at FIU, as there was with the Ocean Data online workshop in which participants were spread out geographically around the country. When students are all in one location, there appears to be less motivation to go online. The FIU students were sitting in a traditional classroom environment, though admittedly with a number of state of the art technology tools available, in a learning setup that adhered to a fairly traditional approach.
2. The inability to maintain regular and adequate communication with FIU College of Education faculty at key points in the program implementation was a disappointment in the implementation of Classroom BATS. Although the Classroom BATS program was listed as a key part of the courses, the other Classroom BATS team members did not get a sense of how the integration of the BATS resources worked because they only saw a very limited number of lesson plans and projects. Students in the course experienced frustrations related to the technical problems with the spreadsheet and this was a major deterrent in maintaining communication and enthusiasm. Not much was conveyed by the faculty neither to the rest of the team to guide the evaluation nor the next phases of development of the program.
3. Students initially described themselves (1998-1999) as lacking technology skills and web capabilities. However the use of the Internet and comfort level with the web in the education community has changed dramatically in the last couple years. Therefore some of these reported difficulties might not be a problem today. Likewise refinements of the Classroom BATS web site, virtual campus and Ocean Explorer spreadsheet in response to the participant feedback and driven by technology

improvements, made the program components much stronger educational tools by the end of the program.

C. RECOMMENDATIONS

The goal in future classroom BATS programs is to maximize the experience for those who have already shown a desire to participate and to increase participation by those who are less motivated. Recommendations are aimed at addressing some of the challenges outlined above and have been summarized under four main headings.

Program Prerequisites

Selection and Training of Partner Faculty

- If expanding the program to other universities for pre-service science teachers, it is suggested that careful consideration should be given to selecting and training partnering faculty. The scientists and virtual campus designers should provide the faculty with background preparation on both the content and process. Faculty need to have the time and support for integrating the Classroom BATS module into their courses if it is to be a positive experience for all. This is true particularly for faculty members who are not marine biologists. Not only do they need a briefing or training on the content area, but they also need to become familiar with the virtual classroom and how to use the conferencing software.

- They need time to review the various components of the Classroom BATS program to figure out what and how to incorporate them, revising their existing curriculum to make the Classroom BATS piece fit in a sound pedagogical way. They need to be able to work with scientists as a part of an instructional team to demonstrate data applications using standard data analysis programs like MS Excel. They also need to be proponents of the online experience and actively engage in the process. Modeling of the online behavior would serve to encourage student participation online also.

Expectations for Participants

- Before offering a public online workshop we need to more carefully clarify expectations for the participants: define who should take the workshop and prerequisite knowledge required making it more useful and easy to be successful. This could be accomplished by adhering to NSF suggestions for scope, sequence and coordination that would allow the program to develop with unfolding complexity. This might mean starting with Crush a Cup activity, then moving to OceanExplorer and then to the BATS ocean data bowl. The levels of participation: Beginner, Intermediate, Advanced could be labeled and defined.

Program Support

- Not only should faculty be trained but they also should receive ongoing facilitation in both subject matter and online technology.
- In order to ask scientists to contribute time to help create lesson plans, provide additional funding must be built into the budget. Most scientists do not have an education background and this is not the focus of their everyday work. Therefore compensation is needed for time to get up to speed on how to present information to pre-service and in-service teachers.
- The CBATS team must be more attuned to specific needs of participants of various experience levels and background, providing necessary resources for assisting to achieve a positive experience with the program

Technical Improvements

- The technical difficulties and various implementation issues related to the spreadsheet need to be remedied before another effort to present them to other groups of teacher participants is attempted.
- To technologically improve the OceanExplorer workbook part of the project we need to hire a C++ programmer or else put it in simplified Java virtual ocean.

Program Expansion

Content Expansion

- It would be a wonderful extension of the program if some in-service teachers or pre-service teachers could go out on the ship to observe and assist in the collection of the ocean data. This could be a culmination of the online experience for a small number of participants.

- Another important consideration is that both pre-service and in-service teachers want materials that will tie in with their local environment. Teachers want to relate the information for their students for application in the local setting. Although Bermuda and the deep oceans are of interest, a stronger program would be to engage the teachers in some comparative study to include their local environment.

- It would be helpful when working with school districts to tie the material to local curriculum standards and to provide relevant links to regionally specific web sites. Also, when dealing with large numbers of Hispanic teachers, it was recommended to refer to web sites that are in Spanish, as well as English-language sites.

- In future development of the web site, we would like to create key research questions for different disciplines that are grade appropriate. We would also tie the web components to the standards. E.g. if one was interested in Chemistry one could click on Chemistry and go to content related to Chemistry with the appropriate standards

highlighted. It appears that an effective way to motivate interest in a subject is to build bridges to it from topics in which the audience already expresses an interest.

Expansion to Other Audiences

The following are suggestions for expanding the program to other audiences:

- Pre-service science education students in other universities
- In-service teachers, most likely partnering with a school district that supports the program for professional development requirements for its teachers
- Students in an undergraduate oceanography course.
- Community college faculty and faculty of Secondary Science Education in Colleges of Education

Despite the technical difficulties with use of the spreadsheet and the challenges of incorporating the program into pre-service courses, nonetheless there have been a number of grateful participants who appreciated the excellent resources and the opportunity to interact with scientists and real data. In presenting the program at conferences such as NSTA and AGU, the Classroom BATS team has been reinforced by the number of educators who come up and let them know how important a tool like the OceanExplorer is and reiterate the need for this type of program.