Evaluation of Innovative Technology Experiences for Students and Teachers (ITEST) Grant Activities

For

The Marine Advanced Technology Education (MATE) Center

July 2010

Submitted by:

SESRC

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For

The Marine Advanced Technology Education (MATE) Center

BY: CANDIYA MANN & KYRA KESTER

SOCIAL & ECONOMIC SCIENCES RESEARCH CENTER, PUGET SOUND OFFICE

WASHINGTON STATE UNIVERSITY

JULY 2010

In September 2009, the National Science Foundation (NSF) funded the Marine Advanced Technology Education (MATE) Center's proposal for an Innovative Technology Experiences for Students and Teachers (ITEST) grant. Through this grant, the MATE Center planned to support middle school students and teachers by expanding the entry-level (SCOUT class) ROV competition, providing marine STEM career information targeted to this age range, and building ROVER, a cyber-learning center, to support them.

The evaluation is based on multiple data sources (primarily surveys and interviews) and reflects the input of a variety of stakeholders, including middle school students, teachers, parents, regional coordinators, community college students, and MATE management and staff. This report covers grant activities that took place between September 1st, 2009 and June 30th, 2010. It describes the project implementation as well as the preliminary findings for each of the research questions.

Project Implementation

The first nine months of the grant focused primarily on grant Objective One: building the support infrastructure for an entry-level ROV competition. The four regions implementing the project in the first year were Monterey Bay, the Pacific Northwest, New England, and Southern California. As expected, the regions took a variety of approaches to implementing the grant, relying on each region's unique strengths and responding to their distinct challenges. An overview of the implementation approaches for each region is presented below.

In the Monterey Bay, the program was implemented through working with the coordinators of After School Academies at two school districts. The program sent MATE staff to the schools weekly to provide technical support. The program offered two culminating events in the spring of 2010: participation in the regional ROV competition and a school district "ROVER Night". Fifteen new SCOUT class teams participated in the culminating events in the Monterey Bay region. It should be noted that Monterey is the only region that had a robust SCOUT competition prior to grant implementation, with 46 non-ITEST SCOUT teams participating in the regional competition.

The Pacific Northwest program worked with multiple schools in multiple districts. The regional coordinators hired a graduate student to manage teacher outreach and communication. Regional coordinators and Marine Technology Society members performed student outreach by visiting schools and making presentations to approximately 1,500 students. Technical support was provided to teams via a series of workshops for teachers, students, and parents. They created a mini-grant program to distribute supplies and tools to teams. This region was particularly successful at involving parents, and many teams were mentored by parents. Twenty-four new SCOUT class teams participated in the regional ROV competition, up from one team the prior year.

In the Southern California region, the program was implemented by working with a single school district plus one private middle school academy. After attaining School Board approval, teacher and student recruitment was performed by the school administration. Long Beach Community College students, who were also Explorer class ROV team members, were paired with ITEST teachers to provide technical assistance to the teams. The college students visited the middle schools to provide assistance at least once per week, as requested by the teachers. The involvement of college students was noted as a successful approach by all stakeholders. Twelve new SCOUT class teams participated in the Southern California regional competition. This was the first year that SCOUT teams participated in this regional event.

The New England region worked primarily with two after-school programs: the Citizen's Program and the Boys and Girls Club of Fall River. The regional coordinator assigned engineering students from Bristol Community College to work with each of the programs. The college students developed a 10-week curriculum and taught it to the students in these programs. There were two 10-week sessions culminating in two mini-competitions, one in the fall and one in the spring. A total of six new SCOUT class teams participated in these mini-competitions.

All of the regions successfully implemented the grant in that the number of SCOUT class teams participating in the ROV competition increased markedly in all four regions.

Preliminary Findings

The preliminary evaluation findings indicate that the MATE Center's ITEST project is achieving the expected outcomes. The project strategies that were implemented in the first year of the grant are reviewed below.

Project Strategy 1: Provide Professional Development

- **Increased confidence facilitating STEM learning experiences:** In the post-workshop surveys (N=30), all of the respondents (100%) stated that they felt more confident facilitation STEM experiences.
- **Strengthened commitment to participate in the program:** As a result of the training, 89% of the workshop attendees indicated that they felt more committed to participating in the competition.

Project Strategy 2: Support the Development of the SCOUT (Entry Level) ROV Class

- **Increased Awareness of STEM Careers:** After building their ROV, 97% of the students surveyed (N=98) indicated that they knew more about careers in marine STEM.
- **Increased Interest in STEM Careers:** Seventy-one percent (71%) of the students stated that their ROV project made them more interested in a marine career.
- **Increased Interest in STEM:** Three quarters of the students (75%) indicated that their ROV project made them want to learn more about ocean STEM. Ninety-five percent (95%) of the parents surveyed (N=80) stated that building an ROV made their child more interested in STEM.
- **Increased STEM Knowledge & Skills:** Parents reported that building an ROV contributed to improving their children's grades in science (72%), math (55%), computers (61%), and engineering/robotics (76%).
- **Increased SCANS Skills:** All of the teachers/mentors surveyed observed increases in their students' skills in team building, problem solving, and/or critical thinking. Seventy percent (70%) of parents reported that their children were better able to work with others due to their involvement in the ROV project; 70% indicated that their child's self confidence improved; and 28% marked that their child was better organized.
- **Increased Parental Support of Their Children's Interest in STEM:** Eighty-one percent (81%) of the parents indicated that participation in the ROV program changed how they envisioned their child's future, making it easier to picture their child with a STEM career.

The remaining project strategies will be evaluated in future grant years as they are implemented.

Preliminary Findings by Gender and Ethnicity

Overall, positive results were found regardless of gender or ethnicity, including the following:

- increased awareness of and interest in STEM careers,
- increased interest in studying STEM topics, and
- increased STEM knowledge.

In general, the ROV program appeared to generate stronger gains in the boys than the girls and in the white students than the minority students. A few findings ran counter to this trend. Female students were slightly more likely than male students to indicate that they wanted to learn more about undersea volcanoes (male: 65%; female: 69%). Minority students showed slightly greater gains than the white students in their desire to take courses in math (white: 37%; minority: 41%) and substantially more interest in courses in engineering (white: 9%; minority: 29%).

One of the goals of the grant is to help determine the most effective strategies for engaging youth of diverse backgrounds. The project proposes several different strategies for improvement in this area. Future evaluations will track the implementation of these strategies to reach out to underrepresented students, the effectiveness of these strategies in increasing the participation of these students, and the differential impacts on student outcomes.

INTRODUCTION

In September 2009, the National Science Foundation (NSF) funded the Marine Advanced Technology Education (MATE) Center's proposal for an Innovative Technology Experiences for Students and Teachers (ITEST) grant. The MATE Center's ITEST program, titled *MATE ROV Competitions: Providing Pathways to the Ocean STEM Workforce*, leveraged their extensive network of remotely operated vehicle (ROV) student competitions. In the past, the ROV competitions mainly focused on students at the high school, college, and university levels. This grant enabled the MATE Center to support middle school students and teachers by expanding the entry-level (SCOUT class) ROV competition, providing marine STEM career information targeted to this age range, and building ROVER, a cyber-learning center, to support them.

As stated in the proposal, the project's objectives are fourfold:

- Objective 1: Build the support infrastructure for an entry-level ROV competition class by
    - a) providing professional development and student support workshops in after-school and informal settings; and
    - b) developing, adapting, and enhancing ROV-focused STEM curriculum materials.
- Objective 2: Increase ocean STEM career awareness and present trajectories to those careers for middle and high school audiences.
- Objective 3: Build a cyberlearning center to
    - a) foster collaboration and increase communication among students, educators, parents, and working professionals; and
    - b) improve access to STEM instructional resources. (In this project, cyberlearning refers to the use of cyberspace or "cyberconnections" to advance learning.)
- Objective 4: Evaluate and track project participants to determine the impact on a) students' STEM knowledge, skill development, and inclination to pursue STEM education and careers; and b) teachers' confidence in facilitating STEM learning experiences and delivering career information.

This report covers grant activities that took place between September 1st, 2009 and June 30th, 2010. The results are presented below in two chapters. The first chapter, *Project Implementation,* describes how the ITEST grant has been implemented in the first year. The MATE Center proposed a staged geographic roll-out of the grant, with four regions implementing the grant each year. As expected, the four regions implementing in year one used a variety different strategies to accomplish the grant's goals. The differing regional approaches are explored in this chapter.

The second chapter, *Preliminary Findings*, discusses the preliminary results of the outcome evaluation. This chapter covers the evaluation questions listed in the methodology section below and includes analysis by demographics.

The MATE Center's ITEST grant evaluation was performed by the Puget Sound Division of the Social and Economic Sciences Research Center at Washington State University.

METHODOLOGY

The evaluation connects each of the project strategies with research questions and expected outcomes of the project. These strategies and research questions are presented below. Please see the Appendix for the detailed evaluation plan, including the expected outcomes, data sources, and evaluation schedule.

Table 1: Project Strategies and Research Questions

Project Strategy	Research Questions
1. Provide professional development: workshops and Summer Institutes	1.1. Did the teachers gain confidence facilitating STEM learning experiences through the workshops? 1.2. What was the impact of the workshops on the teachers' decision to participate in the ROV competition? 1.3. Did attendance at the Summer Institutes lead to greater awareness/understanding of ocean STEM careers?
2. Support the development of the SCOUT (Entry Level) ROV Class	2.1. To what extent did participating in the ROV program lead to an increase in the students' interest in STEM and STEM careers? Did educators and parents observe an increase in the students' interest in STEM and STEM careers as a result of the program? An increase in the students' STEM knowledge and skills and SCANS skills? 2.2. Did participating in the workshops (or observing the competitions) lead to an increase in the parents' support of their children's interest in STEM careers? 2.3. Were the curriculum materials and workshops at the appropriate level for a middle school audience? 2.4. What was the impact of the workshops and other support on the teams' ability to build an ROV and participate in the regional competitions?

Project Strategy	Research Questions
3. Modify career guidance resources to better suit middle & high school students	3.1. Has the *Exploring Ocean Careers* course and web site been modified so that the appeal, information and delivery are appropriate for the middle and high school audience? 3.2. Did students, educators and parents use the career guidance tools? Did their awareness of ocean STEM careers increase as a result of these tools?
4. Build ROVER, a cyberlearning center	4.1. Has ROVER increased access to career and instructional resources? Increased use of the resources? 4.2. To what extent were the website users satisfied with the ease-of-use of the website? With the materials available through the website? 4.3. Has ROVER increased communication between students, educators, industry professionals, and parents? 4.4. Did the availability of ROVER affect the teams' ability to build an ROV and participate in the regional competitions?

DATA SOURCES

The evaluation relies upon multiple sources of data. The data collection includes input from a variety of stakeholders, including students, teachers, parents, regional coordinators, college students helping with grant implementation, and MATE staff. Below are descriptions of each of the data sources.[1] All of the surveys were developed in collaboration with MATE staff and regional coordinators.

Pre and Post Teacher Workshop Surveys

Pre and post paper surveys were administered to teacher workshop attendees in the Monterey, Pacific Northwest, and New England regions at the beginning of the workshop day and at the end of the training. The surveys addressed issues of teacher confidence facilitating STEM learning experiences, commitment to bringing a team to competition, concerns about mentoring students in designing and

[1] Please see Appendix for survey and interview protocols.

building an ROV, expectations of the workshops, and additional ways that the regional coordinators and the MATE Center could support the participants. Surveys were tallied in Microsoft Word and Excel.

Post Competition Surveys of Students

At the ITEST SCOUT class competitions, students were asked to complete surveys. The survey protocol was a modified version of the student survey that has been administered to over 1,500 students over the past five years at regional and international ROV competitions. The survey covered the following topics: awareness and interest in ocean STEM careers, increased desire to take STEM courses due to involvement in the program, awards/honors received as a result of competition experience, and self-assessment of change in STEM knowledge.

Student surveys were collected at the Monterey, Pacific Northwest, and New England regional events. At the Monterey regional competition, surveys were completed online via Survey Monkey. All other surveys were conducted via paper forms later entered into Survey Monkey. The Monterey and New England regional competitions offered incentives to complete the survey. At the Monterey competition, the students received raffle tickets for prizes that were raffled off at the end of the day. At the New England competitions, students received a competition t-shirt as an incentive. Data was extracted and analyzed with the Statistical Package for the Social Sciences (SPSS). Preliminary analysis of student survey data was conducted by gender and ethnicity.

Post Competition Surveys of Teachers/Mentors

Teachers/team mentors also completed surveys at the ITEST SCOUT class competitions. The survey protocol was a modified version of the faculty/mentor survey that has been administered to over 400 respondents over the past five years at ROV competitions. The survey addressed topics such as the value of the competition, incorporation of competition into course curriculum, interest in participating in future competitions, assessment of change in their students' STEM knowledge/skills, SCANS skills, and interest in STEM careers, and related topics.

Teacher/mentor surveys were collected at the Monterey and Southern California regional events. At the Monterey regional competition, surveys were completed online via Survey Monkey. Teachers/mentors in the Southern California region received email invitations containing a link to the survey. Data was extracted and analyzed with SPSS.

Post Competition Surveys of Parents

In contrast to the student and teacher/mentor surveys, which have been conducted for years at MATE ROV competitions, this was the first year parent input was solicited. Paper surveys were administered to parents at the ITEST SCOUT class competitions in Monterey, Pacific Northwest, and New England. Parent surveys addressed the topics of parental support of their children's interest in STEM and STEM careers, the value of the competition, and changes they have observed in their children since they became

involved in the program. Data was entered into Survey Monkey and analyzed using the tools within the website.

End of Program Follow-up Surveys of ITEST Teachers/Mentors

In some regions, ITEST teams competed next to non-ITEST teams at regional events. The same post-competition teacher/mentor survey was administered to all teams. In order to avoid asking non-ITEST teachers/mentors questions that only applied to the ITEST teams, a separate web survey was conducted. ITEST teachers/mentors received an email invitation to participate in the survey, containing a link. The survey asked the respondents to rate the ROV program and the support they received and to report on the obstacles they faced and suggestions for how the program could better support them. The response rate was very low, with only six responses received. Next year, we will explore ways to combine this survey with the post-competition survey of teachers/mentors. Responses were submitted by teachers in the Monterey and Pacific Northwest regions.

Interviews of MATE Center Staff

Structured interviews were conducted with MATE regional coordinators from all four regions implementing the grant in year one, students involved in implementing the grant activities, and the grant PI. The interviews solicited information such as detailed descriptions of grant implementation (recruitment of students and teachers, workshops and other methods of providing technical assistance, other support provided to teams, partnerships with other organizations, and staffing), effectiveness of the workshops, observations on student outcomes, parental involvement, successes/program strengths, challenges, changes planned for next year, and ratings of the MATE Center's support of the regions implementing the grant.

Other Data Sources

Additional data sources informing the evaluation include the annual reports turned in by the regional coordinators to the ITEST grant PI, demographic information collected from the schools, clubs, and teams, observations of the Pacific Northwest regional competition, the regional coordinators meeting, and the Advisory Committee meeting, review of participation data, and document review, such as curriculum and supporting technical materials and the MATE Center's annual report.

Challenges and Weaknesses of the Evaluation

Unfortunately, as this was the first year of the evaluation, the survey implementation was somewhat uneven, and the data does not cover all of the regions. Regional coordinators were responsible for administering the surveys. With the quick project ramp-up, regional coordinators were pulled in many different directions, and occasionally, survey implementation was forgotten. We intend to improve the data collection efforts in year two of the evaluation by stressing the importance of the data collection in

communication with the regional coordinators. We will provide them with a complete set of data collection instruments at the Regional Coordinator's meeting at the beginning of the program year, along with a training on how and when to implement each. In addition, the demographic data collection tools will be revised to streamline the data collection process and improve the quality of the data.

While the variety of project implementation methods is a strength of the program, it introduces challenges to the evaluation design. The goal is to apply the same evaluation data collection methods to all regions. Some of the original data collection plans had to be changed because they would not be possible in all regions. For instance, the evaluation plan originally called for pre-surveys of students prior to attending an introductory workshop about the program. In practice, none of the regions offered an introductory workshop for students. Thus, the student pre-survey was removed from the evaluation.

An additional difficulty of this evaluation report was the timing of the report. Given the fact that the regional competitions took place as late as June 12th, it was a challenge to complete data entry and analysis prior to the report deadline. In the future, we plan to change the competition surveys to a scannable format so that data input will be much faster. An additional distraction was the MATE ROV international competition in Hilo, Hawaii, which took place in late June. All of the regional coordinators, the ITEST PI, and the evaluator attended the international competition.

With the tight turn-around between the end of the regional competitions and the evaluation report, the participation numbers were not available prior to writing this report. Thus, it was not possible to calculate response rates for each of the surveys. We hope that with better advance planning next year, we will be able to remedy this weakness.

PROJECT IMPLEMENTATION

This chapter reviews the progress towards implementing each of the four grant objectives. Each of the four objectives is discussed in turn, followed by a summary of additional grant activities that the MATE Center has performed in support of the overall grant.

OBJECTIVE ONE

Objective 1: Build the support infrastructure for an entry-level ROV competition class by a) providing professional development and student support workshops in after-school and informal settings; and b) developing, adapting, and enhancing ROV-focused STEM curriculum materials.

The first nine months of the grant focused primarily on grant Objective One. Thus, this report section comprises the bulk of the chapter. This section discusses each of the four regions that implemented the grant in year one: Monterey Bay, Pacific Northwest, Southern California, and New England. The goal of the section is to highlight the differences in regional grant implementation: strengths, challenges, and unique approaches. This section also reviews the progress preparing for the ITEST Summer Institute.

MONTEREY BAY

Unique Features of Regional Implementation

- Worked with the coordinators of after school programs at two school districts
- Implemented ITEST activities in the context of a region with an existing robust SCOUT class competition (e.g., 49 SCOUT class teams registered for the 2010 regional competition)
- Sent MATE staff for weekly visits to the schools to provide technical support
- Offered two culminating events: participation in the regional competition and a separate school district ROVER night

Staffing

The Monterey Bay regional coordinator is Jill Zande, the MATE Center Associate Director and ITEST PI. Jill was responsible for managing the grant implementation in the Monterey region. Kim Swan, Teen Programs Manager at the Monterey Bay Aquarium, helped with school recruitment. Technical support in the classrooms was supplied by Matt Gardner, MATE Competition Technical Manager and Head Rules Judge, Jim Davidson, retired mechanical engineer, and two Monterey Peninsula College students. The teacher workshops were taught by Jill, Matt, and Jeremy Hertzberg, Automotive Technology Laboratory Technician and Instructor, Monterey Peninsula College.

Implementation Overview

As soon as Jill received word that the grant would be funded, she began reaching out to her regional recruitment collaborators. Her ITEST recruitment targeted the two regional school districts serving youth who are consistently under-represented in math and science courses, including low-income and minority students: the Pajaro Valley Unified School District (PVUSD) and the Monterey Peninsula Unified School District (MPUSD). Both districts serve a high proportion of low-income, Hispanic, migrant students.

Through the Monterey Bay Aquarium's Community Partnership Program, Jill was put in touch with the PVUSD after school program. Jill made three visits to the PVUSD: one to meet the director, one to present to the middle and high school after school program coordinators, and one to speak with the staff of the Gifted and Talented Education (GATE) program, who had expressed interest in the ROV program. Many of the middle school after school program coordinators were interested in the ROV program. They passed along information about the program to their middle school teachers who were also interested. Only one school in the PVUSD ended up participating in the program in the 2009-2010 school year, but there is continued interest from the coordinators and the GATE program. District participation may increase in future years.

In parallel with the PVUSD recruitment efforts, Jill reached out to the After School Academy (ASA) through MPUSD. She held meetings with the director and presentations with the middle school and high school ASA coordinators. While the ITEST grant did not fund the program in high schools, Jill still found it useful to speak to the high school coordinators so that when the middle school students transfer to high school, the high schools are aware of their ROV experiences and may be interested in starting the program at the high school level as well. The director of the ASA program decided to move forward with implementing the ROV program, and she mandated that the middle schools implement the ROV program as an ASA activity. This was a mixed blessing. While this decision resulted in five MPUSD schools implementing the program, since the teachers did not self-select into the program, some of them were not as excited as others to participate.

The Monterey region held the earliest teacher workshop of the four ITEST regions, in November. Five MPUSD schools and one PVUSD school attended. Some schools sent a teacher as well as an ASA coordinator, while others only sent a coordinator. One school sent a teacher, coordinator and parent. Over the course of the program, Jill noted that the schools that sent a teacher to the training were the most likely to successfully implement the program.

As a side note, there was enough interest in the ROV program from high school teachers that the Monterey Peninsula College Tech Prep program provided funding for the MATE Center to offer a separate teacher workshop for the high school teachers.

By the end of January, the teachers received all of the supplies, equipment, and tools to start building the ROV's. In addition, Jill provided a CD of curriculum and technical resources and a proposed course outline.

The original implementation plan called for the region's strong cadre of industry volunteers to visit the schools weekly to provide technical support to the teachers and students. In practice, Jill found that the group of active volunteers was already fully taxed with supporting the existing SCOUT class participants (providing wiring workshops and similar activities). Instead, MATE staff, one volunteer, and/or two MPC students visited the schools on a weekly basis, and the teachers/mentors visited Monterey Peninsula College to speak to the MATE staff on an as-needed basis. While this level of support resulted in teams bringing functioning vehicles to the culminating events, Jill noted that since the teams met twice a week, it would be ideal for them to have technical support available at both meetings.

In addition to the technical support provided by MATE Center personnel, one MPUSD team received support from a student at California State University, Monterey Bay (CSUMB) in the service learning program, and one PVUSD team received support from his school's MESA program.

An additional potential source of support for the middle school teams was the Monterey Academy of Oceanographic Sciences (MAOS) at Monterey High School.[2] This group has a robust ROV program with many years of experience competing at MATE ROV events. The director of the MAOS ROV program was excited to get involved, envisioning that it would help to solidify his current students' learning as they mentored the younger students and that it would help him recruit incoming high school students to his MAOS program and ROV team. The plan was to pair the MAOS students with the teams from a MPUSD school located close to Monterey High School. In the 2009-2010 grant year, the MAOS program did not end up becoming involved with supporting an ITEST SCOUT team because the middle school they were planning to work with did not organize a team due to turnover in the ASA coordinators. In the next grant year, a middle school teacher who attended the ITEST Summer Institute will be moving to this school. It is likely that the school will field an ROV team next year, and the MAOS program plans to support this team.

The ITEST teams were invited to participate in the two pool practice days (in March and April) that were offered to all of the SCOUT teams in the region. Three of the ITEST schools took advantage of these practice days.

On April 24th, the Monterey regional competition was held. Forty nine SCOUT class vehicles competed, four of which were the ITEST SCOUT teams that attended the pool practice days. Three teams were from MPUSD and one was from PVUSD. All three teams performed well, with functioning vehicles.

[2] Jill is on the Advisory Board for MAOS.

Because the regional competition already serves so many SCOUT teams, it was unable to accommodate a large influx of all of the SCOUT class teams. Therefore, the ITEST schools were directed to hold internal run-off competitions and to send the best team per school. As noted above, only four teams had vehicles ready to compete by mid-April so only one school used an internal selection process to determine which team to send to the regional competition.

Since only four ITEST teams competed in the regional competition, the ROV program offered a second culminating event, the MPUSD ROVER Night. This event was held on May 26th at the Monterey High School pool. The MAOS program supported the event, and the director of the MAOS ROV program attended. Students, teachers, parents, and the CSUMB student attended. Students received certificates of participation, and the 10-12 teams had a chance to participate in a mini-competition.

Successes/Program Strengths

- The ROV ITEST program made connections with many different organizations and individuals, including middle school and high school coordinators at two districts, the GATE program, the Tech Prep program, and the MAOS program. Some of these connections paid off in this year of the grant and others will continue to be developed in future years.
- Similarly, the connections with feeder high schools were a strength of the program. While this grant does not specifically focus on high schools, it is positive to see increasing awareness and participation in the program among high schools that the middle school students will attend. High schools in the PVUSD and MPUSD attended the high school teacher workshop, and at least one high school plans to start a team for the first time due to this outreach.

Challenges

- It was a significant time investment to make the connections with the schools in these districts.
- Selecting the timing for the initial teacher workshop was a challenge – allowing teams enough time to prepare for the regional competition but not so much time that they lose motivation over the holidays.
- It was a challenge learning how to work effectively with these school districts: how the after school academy worked and how best to work with the middle school audience.
- Working with teachers who did not self-select for the program meant that the internal teacher motivation and excitement was not always present.
- The fact that there was already a robust SCOUT class in the region created challenges. For instance, many of the schools and/or teachers that would be "easy" to motivate to participate were already involved in the program. Additionally, the existing cadre of volunteers was not able to take on any additional commitments due to their involvement with the large group of non-ITEST SCOUT teams. The ITEST teams required support at the same time of year that the support activities started up for the non-ITEST teams.
- It was a challenge that the grant PI was also acting as a regional coordinator. Both of these roles have significant time commitments and responsibilities.

Changes for Next Year

- The schools will be required to send a teacher to the teacher workshop. After school coordinators will be welcome to join the teachers but not to attend by themselves.
- Jill plans to reach out to the middle school principals to try to engender program support from the administration of the schools.
- The teacher workshop will be offered in January in order to eliminate the long wait between the November workshop and January start date.
- The program will start recruiting volunteers earlier in the grant year and will reach out to new sources of volunteers. Specifically, they will reach out to college students, offer a stipend for their involvement, explore coordinating with the schools' service learning requirements, and offer volunteer training. The MPC Vice President of Student Affairs has committed to working with the program to recruit underrepresented college students to serve as volunteers.
- The ITEST grant proposal calls for recruiting a new group of middle school teachers each year. In the Monterey region, they will change this plan. They will bring in a few new middle school teachers but mainly continue to train and support the teachers who were involved in this year's program. Jill is worried that without continued support these teachers will not continue to mentor ROV teams. She plans to change the regional grant focus from impacting a larger number of teachers and students to focusing on program sustainability and the quality of support offered to these teachers and schools.
- They are considering the possibility of adding teacher/student wiring and waterproofing workshops.
- Next year, they are planning to shift some regional coordinating duties to Matt. Jill will still be available to support the regional efforts, but this will reduce the load of holding down two roles at the same time.

PACIFIC NORTHWEST

Unique Features of Regional Implementation

- Worked with multiple schools in multiple districts
- Performed student outreach school visits and presentations (regional coordinators and Marine Technology Society members)
- Hired a graduate student to manage teacher outreach and communication
- Created mini-grant program for teams

Staffing

The regional coordinators in the Pacific Northwest are Fritz Stahr and Rick Rupan, both professional staff in the School of Oceanography at the University of Washington (UW). Fritz was responsible for managing and administering the grant in the region. He also taught the workshops, performed some outreach, and coordinated the regional ROV competition. Rick's main responsibilities were outreach, workshops, and being the main team contact for technical help in building their vehicles. Through ITEST funds, Fritz and Rick hired Kailey Genther, a graduate student pursuing her Masters in Marine Affairs at UW. Her responsibilities were recruiting teachers and acting as the main team contact for administrative items (workshops, sourcing supplies and tools, etc.). Over the course of the program, her total salary was roughly $2,300.

Implementation Overview

In the PNW, Fritz and Rick kicked off the grant by hiring Kailey in the fall of 2009. Kailey brought a background in science education and outreach. She was charged with recruiting middle school and junior high teachers, especially those working in schools with a high proportion of minority and low income students.

To recruit teachers, Kailey's strategy was to create a flyer advertising the upcoming teacher workshop in December.[3] She mailed five copies of the flyer to every middle school and junior high in the Puget Sound area (roughly 150), directed to the schools' science or engineering departments. In addition, the flyer was emailed to teachers who were involved in prior MATE ROV competitions as well as teachers involved in the Ocean Inquiry Project. She then handled all inquiries generated by the flyers. The goal was to find 10 teachers for the workshop, but they ended up enrolling 12. (Two schools sent two teachers apiece.) One high school teacher expressed interest but was unable to participate because of the grant's focus on the lower grade levels.

[3] Please see appendix for a copy of the flier.

At the December workshop, each participant was provided with an "ROV in a bag", all the components to build an ROV. Fritz and Rick taught them to assemble it. In the afternoon, they were able to fly it in the pool, and they left that day with their own ROV. The regional coordinators noted that many of the teachers had minimal technical skills so the instruction needed to start from scratch. (This was common across all of the regions. When the grant was written, it was expected that middle school teachers would lack technical skills, and one of the goals of the grant was to help teachers feel more comfortable facilitating STEM learning experiences, even if they had weak skills in this area.) During the workshop, participants were able to sign up for follow-up school visits, where a representative of the program would come to their school and talk to their students. The regional coordinators mentioned that they thought this was an important piece of ongoing support that helped the teachers feel more comfortable with the program.

The school visits started in January 2010. Overall, Rick completed five school visits, Fritz did one, and two representatives of the local Marine Technology Society (MTS) presented at a school apiece on dates when Rick and Fritz were not available.[4] (The MTS representatives had participated in the ROV competition in the past so were very familiar with it.) The school visits were all-day affairs, where the presenter would talk to roughly 25 students at a time and speak to four to five classes per day, plus often an after school club as well. In total, the school visits involved contact with over 1,500 students.[5] The presentations included information about the MATE Center, ROV's, the ROV competition, and careers in oceanography. Rick and Fritz brought props as well: an ROV, a sea glider, and an argo float.

The goal of the presentations was to motivate students to form a team, build an ROV, and participate in the regional competition. Towards that end, each student attending a presentation left with a flyer telling them to contact Rick if they were interested. The regional coordinators found these flyers to be very effective. In many cases, the students took the flyers home and spoke to their parents who contacted Rick. The parents often became the team mentor, rather than the teachers. In some cases, a single teacher's class had multiple teams, with the parents acting as team mentors and the teacher overseeing them all. One example was a student who attended a presentation, brought the information home and told his sibling about it. His mother contacted Rick and ended up mentoring two teams, one for each of her children.[6]

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[4] The Pacific Northwest region of the MATE ROV program has a close relationship with the Puget Sound Section of MTS. Many of the MTS members serve as volunteers and judges at the regional competition event, and MTS member organizations are major donors to the regional MATE ROV program. In addition, the regional MATE ROV program has coordinated with the local chapter of MTS to handle the accounting and disbursement of ITEST funds.

[5] This is calculated as seven schools at 200-250 students apiece.

[6] It was not uncommon for multiple children from the same family to be involved in the competition. Across all the ITEST regions, 14 percent of the parents responding to the post-competition survey (N=80) had two or more children participating in that day's competition.

A unique element of the Pacific Northwest ITEST implementation was the mini-grant program that they developed.[7] In order to ensure that financial constraints would not prevent teams from building an ROV, Fritz and Rick reallocated their ITEST funding, basically shifting some of their salary towards this mini-grant program.[8] Each ITEST team was offered the opportunity to apply for supplies or specialty tools, whatever they needed to build their ROV. Instead of providing money, the program purchased the materials for the teams. This offered the dual advantages of allowing the coordinators to find bulk discounts on some items and relieving teams of the often difficult task of finding sources for these specialty items. All of the teams received a grant, and most received everything that they requested. The grant materials were ready for the teams to pick up at the wiring workshop.

The next event held was a wiring workshop in March for students, teachers, and parents. This was a very popular workshop with over 50 attendees. Interestingly, only three of the adult attendees were teachers, and the rest were parents mentoring teams. (Exact counts are not available.) This was a much larger crowd than expected, but they were able to accommodate everybody. All of the teams left the wiring workshop with a working controller. As reported by Rick, the majority of teams that attended this workshop made it to the regional competition – all but two teams.

Other support activities included a half-day meeting to discuss the competition. Individual help was provided to teams as requested. Two teams requested help from Rick and came to the University of Washington to work with him one-on-one. He provided advice on topics such as wiring, ballasting, and piloting.

Some teams had difficulty finding a body of water for testing the vehicles so Fritz and Rick opened the test pool at the School of Oceanography for two practice days of four hours each. Students came and tested their vehicles, and Fritz and Rick helped troubleshoot any issues. Seven teams attended the first pool day, and six attended the second.

Prior to the regional competition, two of the team mentors (one parent and one teacher) volunteered to help build the mission props.

The culminating event for the Pacific Northwest ITEST teams was participating in the regional competition. In the 2009 regional competition, three SCOUT class teams registered, and only one actually competed. In the 2010 regional competition, 24 SCOUT class teams competed, comprised of 101 students. At the competition, several of the Explorer class college students acted as SCOUT class judges.

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[7] See addenda for mini-grant application form.

[8] All of the regions provided supplies, equipment and/or tools to teams, but the PNW was the only region to create a formal mini grant process.

The retention rate was about the same between the SCOUT class and the Ranger class. One of the 11 Ranger teams dropped out, and two of the SCOUT class teams dropped out. At the same time, new teams formed and registered. This last minute "flux" of teams follows the patterns of prior years' competitions.

Successes/Program Strengths

- The main accomplishment was the sheer number of new SCOUT class teams (24). The regional coordinators attributed this to the availability of funding for supplies, both for the teachers' "ROV in a bag" kits and for the students' ROV's.
- The mini-grant program was an effective method to ensure that each team received the core materials they deemed necessary to build their vehicle.
- The connection with the University of Washington School of Oceanography was another strength of the program. The UW administration supports the use of department facilities and resources for this program. This includes meeting space for workshops, the test pool, tools, and leftover supplies from other department projects.
- The intense parental involvement also strengthened the program. The fact that so many teams were mentored by parents enabled multiple teams to come from a single classroom.
- Hiring Kailey to perform the outreach was a good decision, since she had more experience working with the school districts than the coordinators. She knew how to design an effective outreach campaign, and her assistance in coordinating the communication with the teachers and teams helped the coordinators focus on the technical side and managing the logistics.
- The school visits were an effective method of supporting the teachers who attended the workshop as well as recruiting students for the program. The presentations also provided STEM career information to a much broader audience of students. Handing flyers to the students to bring home worked well to generate parental support of the program.

Challenges

- Managing the growth of the program was a challenge. The ROV competition tripled in size from the prior year, increasing the complexity of the logistics. For instance, the larger number of teams meant an increase in the number of volunteers needed (70 volunteers were involved at the 2010 regional competition).
- The other major challenge was recruiting the targeted groups. The coordinators were pleased with the number of girls involved in the competition but did not meet their goals for the minority and low income participation. Rick did school visits to three schools in particular with a high proportion of minority and low income students, but program participation in those schools was minimal.[9] He attributes the lack of participation from these schools to an absence of parental support for the program. In the other schools, parents were very involved in mentoring

[9] Note: Rick is of minority background. In other MATE Center research, outreach to minority students was found to be more effective when performed by outreach personnel who were also of minority background.

the teams and were a major source of support for the teachers. In this region, major employment sectors include information technology and manufacturing. (For instance, Microsoft and Boeing are based in the Puget Sound). Anecdotal reports suggest that in many cases, parents were able to provide the technical skills that the teachers lacked. In classrooms without this parental support, teachers were too overwhelmed by the other demands on their time to participate successfully in the program. Rick plans to develop a cadre of industry professionals (e.g., former ROV competition judges) who can be matched with individual teachers to provide technical support for building the ROVs.

- With the large number of teams from the various schools and districts, communication and tracking who needed which materials and information was a challenge. It worked well to have dedicated staff to handle communications (Kailey and Rick).

Changes for Next Year

Several changes are being contemplated for next year:

- An additional team member will be brought into the leadership team. Wes Thompson will help with the competition logistics.
- As mentioned above, Rick would like to create a group of professionals available to provide technical advice to the teams.
- The competition has reached the maximum capacity for a one-day event in the current venue. They do not want to expand to a two-day event, due to financial and logistical constraints. This means that they will need to find a way to limit the number of teams. They are considering proposing that schools with multiple teams hold an internal competition and send their top one or two teams to the main regional competition. They are also considering limiting the grades allowed to compete. (Some elementary schools participated this year.)
- An additional change for next year will be that all team protests during the competition need to come from the team captain. No parents, mentors, or other team members will be allowed in the judging room.

SOUTHERN CALIFORNIA

Unique Features of Regional Implementation

- Worked primarily with a single school district plus one private middle school academy
- Attained School Board approval then student and teacher outreach was performed by the school administration
- Paired Long Beach Community College (LBCC) students, who were also LBCC Explorer class ROV team members, with teachers to provide technical assistance to teams

Staffing

The regional coordinator for Southern California is Scott Fraser, Electronics Department Head at Long Beach Community College (LBCC). Implementation in Southern California involved the participation of five LBCC students in electrical program. These students were also on the LBCC Explorer class ROV team. The students were paired with teachers at the teacher workshops. Throughout the program, the students then visited their teachers' school regularly, providing technical support for the teams. The LBCC students received a stipend for 40 hours of work, though they all worked more hours than this. The students called the stipend "nice to have" though they explained that they "would have done it for free". They did not receive any school credit for their work.

Implementation Overview

In order to begin implementing ITEST in his region, Scott was required to obtain Board approval from LBCC then from Long Beach Unified School District (LBUSD). This process involved a significant investment of time. By November, both Boards had approved the project. After surpassing this hurdle, the recruitment of teachers and students went very quickly. The superintendent of middle schools selected four schools to participate; the schools selected several science teachers; and the teachers selected the students. Scott reports that most of the teachers were very excited to participate. Only one school was unsure if or how they wanted to get involved. One team did their ROV activities during the school day, and the others held their ROV team meetings after school.

One school outside of the LBUSD also decided to participate in the program. This private middle school academy serves 90 percent African American and 10 percent Hispanic students. The involvement with this school came through one of the past LBCC ROV team members who had contacts in this school. Scott contacted the two principles, and they agreed to participate.

None of the schools had any of the necessary equipment so Scott put together five identical sets of equipment and tools that he supplied to the schools. As an interesting side-note, one of the schools contacted him after the competition to find out where they should return the tools. They were surprised and touched to find that it was theirs to keep, hopefully for use by future ROV teams.

The Southern California region started their program with an all-day teacher training workshop in February. At this workshop, teachers were paired with LBCC college students in the electrical program, based on proximity of the student's home to the teacher's school. The students continued their involvement with these teachers by visiting their schools at least weekly. The role of the LBCC students was to help as requested by the teacher. Some teachers were very self-sufficient, while others required much more hand-holding. In one case, the student visited the teacher's school four days per week, even going so far as to purchase a textbook and create a curriculum to help the teacher explain the science behind the technology. In other cases, the LBCC students acted in more of an advisory capacity.

Another all-day workshop was held in March, then in April there was an all-day pool practice. All of the teams took advantage of the pool practice day. The LBCC students helped at all of these events.

In May, twelve ITEST SCOUT teams took part in the Southern California regional competition. (All total there were 13 SCOUT and 6 RANGER class teams. Many of the ITEST schools had two or three teams, and there was one non-ITEST SCOUT team.) This was the first year that any SCOUT teams participated in this regional event. The teams brought a lot of school spirit, in many cases wearing school t-shirts or t-shirts that had been made specifically to celebrate their ROV team.

Successes/Program Strengths

- Recruitment of teachers and students was easy after securing administrative buy-in for the program.
- Pairing LBCC students from the electrical program with teachers was a positive experience for the college students, middle school students, and teachers. (Electrical tasks are often the most difficult for teachers lacking a technical background so this pairing was particularly appropriate.) This experience was enjoyable for the LBCC students, helped cement their own knowledge, and also acted as a valuable resume builder for them. The LBCC students remarked on the relationships that they had built with the middle school students with comments such as "The kids' reaction to accomplishing a goal, just seeing their faces brighten up, it was all worth it." This pairing also worked well for supporting the teachers. It was a boon for the regional coordinator since it removed some of the time burden and allowed the program to reach more schools than he would have been able to support on his own. Anecdotal reports indicate that it was a positive experience for the middle school students as well; the LBCC students served as role models and examples of postsecondary education options in the field. The fact that some of the LBCC students were of minority background may have helped them connect well to the minority middle school students.

Challenges

- The time commitment necessary to obtain approval from both school Boards was a burden. However, since the approval has been obtained, next year's program should be much less time consuming to start up.
- One of the schools had a difficult adult volunteer who was asked to leave halfway through the program.

- Some of the teams were frustrated with the time lag between the last competition event and the announcement of winners and awarding of prizes – the time it took to tally the scores. The regional coordinator is considering adding some sort of event to keep the participants entertained during this period.
- Managing the growth of the competition is a challenge. The regional coordinator is considering expanding it to a two-day event. However, this creates logistical challenges for teams that have to travel to the event.
- This model of implementation required pulling five of the most active LBCC Explorer class ROV team members away from working on their own ROV. While the college students did not complain about the additional time commitment, it did take longer to complete their own ROV.
- One LBCC student said his challenge was the short attention span of the students and keeping them on track. Another said that his challenge was the teacher not taking his advice and having to correct the teacher's mistakes later.

Changes for Next Year

- The regional coordinator plans to encourage the teams to make much smaller ROV's. He noticed that some teams created large structures which didn't perform well with the small SCOUT class motors. He will suggest that they limit themselves to structures that would fit inside an eight inch cube. Some of the vehicles this year were up to two feet wide.
- As noted above, the regional coordinator is considering different ways to manage the growth of the competition with the size limitations of the pool used as the competition venue. One option is to expand into a two-day event.
- Now that administrative approval has already been secured, Scott plans to start the program earlier in the school year.

NEW ENGLAND

Unique Features of Regional Implementation

- Worked primarily with two after-school programs: Citizen's Program and Boys and Girls Club of Fall River
- Assigned Bristol Community College (BCC) engineering students, many of whom were also on the BCC Explorer class ROV team, to teach two 10-week sessions at the after school programs
- Held two separate 10-week sessions culminating in two mini competitions, one in the fall and one in the spring
- Planning a three-day teacher workshop in July

Staffing

The regional coordinator for New England is Meghan Abella-Bowen, faculty in the Division of Mathematics, Science, and Engineering at Bristol Community College (BCC). ITEST implementation in the New England region involved the participation of 12 volunteer BCC engineering students, four of whom were also on the BCC Explorer class ROV team. The students were responsible for developing a 10-week curriculum and delivering it to middle school students participating in after school clubs. They also helped with teacher workshops. The BCC students were purely volunteers and did not receive any salary or course credit for their time. At the end of the school year, all of these students received the Presidential Volunteer Service Award, two at the Silver Level and the remainder at the Bronze Level.[10]

Implementation Overview

In New England, the ITEST implementation took part in two separate phases: fall and spring. Prior to receiving the ITEST grant, Meghan had been approached by the New Bedford Schools' Citizens Program, an after school program serving low income and minority students. This existing relationship facilitated a quick ramp-up of the program in the fall. Seven of the BCC engineering students participated in the fall program, developing and delivering a 10-week curriculum on how to build an ROV for two middle schools in the Citizens Program. Four of the BCC students taught at one school, and three taught at the other. Each school had 15 middle school students divided into two teams. The fall session culminated in a mini ROV competition in January. There were some breakdowns in communication, and the schools did not receive all of the information about the logistics of the competition; therefore, only one team made it to the pool to participate in the competition.

[10] For further information about the Presidential Volunteer Service Award, please see: http://www.presidentialserviceawards.gov/tg/pvsainfo/dspAboutAwards.cfm

In the fall, Meghan also started to recruit teachers for the spring session, to be launched with a January workshop. She emailed teachers in all of the local schools, starting with the science chairs or the top administrators in the district. Another source of outreach was through her contacts at Lockheed Martin. She emailed them, and they forwarded the information to their network of teachers. She also contacted education collaborative and the state science teachers' listserv. One challenge was that the technology programs have been removed from the schools in Massachusetts, and many of the science teachers didn't immediately see how the ROV program related to their courses. Meghan offered to come present at department meetings, but no one took her up on the offer so most of her recruitment was through email and phone calls.

Another recruiting activity that took place in the fall (September) focused on students. At the Working Waterfront Festival in New Bedford, Meghan and the BCC ROV team had a booth. They set up a tank with little ROV's and let children use the ROV to pick something up from the bottom of the tank. The children won a sticker for successfully retrieving the item. When students and parents were interested in learning how to build an ROV themselves, she encouraged them to talk to their teacher – and for the teacher to attend the upcoming workshop.

In January, Meghan held an all-day teacher workshop for both middle school and high school teachers. (The high school teachers were paid out of a separate grant.) The middle school teachers included several teaching at all-girls schools that plan to participate in the ROV program next year.

In February, she invited the local schools, YMCA, Boys and Girls Clubs, Boy Scouts and Girl Scouts to an ROV in a Bag workshop. Partners from Lockheed Martin came and worked with the students, and the BCC engineering students helped as well. Twenty-two middle school students participated, including eight from the Boys and Girls Club of Fall River.

After this workshop, Meghan was approached by the Boys and Girls Club of Fall River to run the 10 week program again. She found five different BCC engineering students who started in the first week of March, implementing the same curriculum from the fall program. This program was different because the Boys and Girls Club had their own pool so each week's activities could include pool time for the ROV. The culminating event was another mini ROV competition, held in June. Three teams of students participated.

In July, Meghan is planning a three-day ROV teacher workshop. She found that the one-day workshop was not sufficient for middle school teachers because they lacked the necessary technical background. In the July workshop, the participants will start from scratch (e.g., introduction to soldering) and will leave with a toolbox including their own soldering iron. The goal is for them to feel comfortable with a basic electrical circuit.

Successes/Program Strengths

- Using college students to work with the middle school students was a strength of the program. Please see the "Successes" section of the Southern California description for a discussion of the

positive aspects of this implementation method. While the students in this case were actively teaching the material, rather than acting as technical support, the same positive effects of their involvement apply here.

- The regional coordinator's prior relationship with the school system and the Citizens Program allowed for a quick ramp-up of the ITEST program, which enabled the region to offer the fall session. The two-session format was unique among the regions.

Challenges

- Outreach to the middle school teachers was a challenge. They had difficulty making the connection between the science in their classroom and the technical aspects of the ROV program. Next year, the regional coordinator plans to bring on a former middle school teacher who is familiar with the MATE ROV program and ask her to talk to the local middle school teachers about how to integrate this activity into their classrooms.
- Determining the best timing for each of the workshops was an additional challenge.

Changes for Next Year

- There is a lot of ROV activity in Southeastern Massachusetts, and one of the future challenges and opportunities is learning how to best collaborate with the other programs. There are two ROV summer camps for gifted and talented students, and the Massachusetts Maritime Academy will be running three week-long workshops for students. A colleague of Meghan's is going to be on an expedition from July to September and is planning to blog about her work as an ROV technician. Meghan would like to find a way to integrate the blog into her teacher workshops or share it with teachers in a way that they could use it with their students.
- As mentioned above, the regional coordinator plans to work with a former middle school teacher to help with teacher outreach.

RATING OF THE MATE CENTER'S SUPPORT

Overall, the coordinators were pleased with the support provided by the MATE Center for grant implementation. In general, they found the instructional materials helpful and stated that it was useful to have the grant implementation money provided up front. They indicated that students found the PDF document about careers with wage information very interesting.

In the future, they would like to have additional curriculum materials, both for performing the technical tasks (e.g., soldering), and for showing how specific classroom subjects (i.e., physics) are tied to the ROV project. Another suggestion was to produce a video for use in student outreach or class presentations that would show the beginning student the SCOUT class vehicles and how the students could progress through the different competition classes, then show previous competitors who work in the field – demonstrating what they do and how much money these professions pay.

SUMMER INSTITUTE

The ITEST Summer Institute is planned for July 12th – 18th. The goals of the program are to provide the participants with the knowledge to become resources for the ROV programs in their regions. This includes not only technical skills but also information about marine STEM careers. Please see the MATE Center annual report and addenda for detailed information about the plans for the Institute, including speaker biographies and the daily agenda.

The main Summer Institute activities covered by the timeframe of this evaluation report consist of participant outreach and recruiting and planning the content and logistics of the Institute. The MATE Center has many years of experience running Summer Institutes for the advanced technical skills so planning the ITEST beginner-level Summer Institute went smoothly.

Recruiting participants was more challenging than expected, given that the program covered all expenses for travel and instruction and provided a stipend as well. Outreach was first conducted in the four regions that implemented the grant in the 2009-2010 year, through contact by the regional coordinator and personal emails and phone calls by the Summer Institute coordinator. This resulted in eight applicants being accepted. After May 1st, registration was opened to all regions, and an additional six applicants were accepted.

It is not entirely clear why recruitment was so challenging. Possible explanations include the following:

- Outreach may have begun too late in the school year. Next year, outreach will begin sooner.
- The current economic climate has made teacher contracts more tenuous. If the teachers are unsure if they have a contract for the following year, they may be less likely to apply for the Institute. (Note: This possible explanation was offered by an ITEST regional coordinator.)
- Outreach and connections to the middle school principals could be strengthened.
- Many teachers who initially expressed interest but later declined cited family vacations as the reason, especially the fact that the Institute covers a weekend. The MATE Center does not plan to shorten the Institute.

Teachers who could not attend offered explanations such as the following:

> *I was excited to say "yes". I just recently was forwarded the application to fill out and realized it was not just Monday - Friday but through Sunday. I have a wedding that I must attend in Ventura on the 17th.*
>
> *I am leaving the country with students on Friday for Space Camp in Turkey as part of a Global Friendship through Space Education program we participated in this year.*
>
> *The students at our school loved the program are already excited about next year's competition. Again, thank you for your patience. We are having a big turnover of*

science teachers at our school this year so I don't think we will send someone this summer.

I'm on a two-year cycle with my curriculum so the next time it would make sense to do a ROV program would not be until the 2011 - 2012 school year. Perhaps we could remain in touch..and I can still come to any trainings that are offered?

Teachers who were planning to attend seemed very excited about the Summer Institute and offered responses such as the following:

Yes, we are incredibly interested in sending a staff member. We have been working with the project all year and would love to attend. We are working on the application now. Please hold a spot for me.

I'm so excited I'm about to pop!

OH HECK YEAH!

Analysis of the ITEST Summer Institute will be included in the next evaluation report.

OBJECTIVE TWO

Objective 2: Increase ocean STEM career awareness and present trajectories to those careers for middle and high school audiences.

In the first grant year, project staff reviewed existing middle school resources (both within the MATE Center and external resources) and met with advisors and middle school teachers in order to understand how to best modify the existing MATE Center career resources, the www.OceanCareers.com website and the *Exploring Ocean Careers* online course, to meet the needs of the middle school audience. Special attention was paid to strategies for making the resources engaging for underrepresented students and their parents. Progress on this objective is several months behind schedule due to staff turnover. The work has been reallocated to other staff, and the updates to the resources are planned to take place in the fall of 2010, with dissemination in the spring of 2011.

OBJECTIVE THREE

Objective 3: Build a cyberlearning center to a) foster collaboration and increase communication among students, educators, parents, and working professionals; and b) improve access to STEM instructional resources.

Development of the initial iteration of ROVER, the cyberlearning center, is almost complete. The website is scheduled to launch in September of 2010, to coincide with the start of the school year. A pre-launch version of the website is available for viewing at www.rover.itest.us/main. For details of the website development, please see the MATE Center's ITEST Annual Report.

Implementation, usage, and effectiveness of the ROVER website will be assessed in the next evaluation report.

OBJECTIVE FOUR

Objective 4: Evaluate and track project participants to determine the impact on a) students' STEM knowledge, skill development, and inclination to pursue STEM education and careers; and b) teachers' confidence in facilitating STEM learning experiences and delivering career information.

In the first year of the grant, multiple interview and survey protocols were developed and administered to a variety of project stakeholders. Records review and observations of meetings and competitions also informed the evaluation. Analysis of the multiple data sources provided preliminary findings on the project's movement towards the expected outcomes. This report demonstrates the progress made towards Objective Four.

ADDITIONAL GRANT ACTIVITIES

In addition to the grant implementation activities that fit within each objective, the MATE Center also performed several other implementation tasks in support of the project as a whole. These included a Regional Coordinators Meeting held in Biloxi in conjunction with the MTS/Institute for Electrical and Electronics Engineers (IEEE) Oceanic Engineering Society (OES) Oceans Conference on October 26th, 2009. This meeting kicked off the ITEST grant implementation.

Additionally, the MATE Center held an ITEST Curriculum and Cultural Advisory Committee meeting on March 15th and 16th, 2010 in Monterey, California. At this meeting, the advisory committee members provided insight into the challenges that middle school teachers face, strategies for reaching out to diverse audiences, and suggestions for an extensive list of books and resources to inform the background research for this project.

The project also conducted a variety of outreach activities, including workshops and presentations to students, teachers, and industry professionals. Please see the Annual Report for a complete list.

PRELIMINARY FINDINGS

This chapter reviews the project strategies and associated research questions. Evaluation results from all applicable data sources are summarized under each research question. This report primarily focuses on project strategies one (professional development) and two (developing the SCOUT class ROV competition). Implementation of the other strategies is not yet complete. Preliminary findings of evaluation results by gender and ethnicity are included at the end of the chapter.

Project Strategy 1: Provide Professional Development, including Workshops and Summer Institutes

Research Question 1.1. Did the teachers gain confidence facilitating STEM learning experiences through the workshops?

Pre and post workshop surveys demonstrate that the participants gained confidence facilitating STEM learning experiences.

In the pre-workshop surveys, only one about one-quarter of the respondents (28%, N=32), indicated that they were very comfortable facilitating STEM learning experiences. Close to half (45%) stated that they had concerns about mentoring students in designing and building an ROV. Half of the teachers (50%) indicated that they were concerned that they may not have the necessary technical skills and expertise. According to the interviews with the regional coordinators, as a whole, the middle school teachers had minimal technical skills when they started the program so it appears that this concern was valid.

In the post-workshop surveys (N=30), all of the respondents stated that they felt more confident (48% "much more confident" and 52% "somewhat more confident") facilitating STEM learning experiences for students. When asked if the training addressed their concerns about designing and building an ROV, 83 percent indicated that they felt less concerned. Overall, 90 percent of the respondents rated the usefulness of the training as "excellent", and 10 percent gave it a rating of "good".

Research Question 1.2. What was the impact of the workshops on the teachers' decision to participate in the ROV competition?

Post workshop surveys indicate that the workshops helped affirm the teachers' decision to participate in the program. After the training, 72 percent of the respondents marked that they intended to mentor a team. (The other 28 percent marked "maybe"). Eighty-nine percent indicated that as a result of the training, they felt more committed to participating in the competition; seven percent stated that their commitment level was unchanged, and one respondent was less committed.

Research Question 1.3. Did attendance at the Summer Institutes lead to greater awareness/understanding of ocean STEM careers?

The ITEST Summer Institute took place after the timeframe covered by this report. Initial feedback on the Institute was collected immediately upon completion of the program, and the participants will be contacted again in six months to inquire about the application of what they learned. Results of these surveys will be included in the next evaluation report.

Project Strategy 2: Support the Development of the SCOUT (Entry Level) ROV Class[11]

Research Question(s) 2.1. To what extent did participating in the ROV program lead to an increase in the students' interest in STEM and STEM careers? Did educators and parents observe an increase in the students' interest in STEM and STEM careers as a result of the program? An increase in the students' STEM knowledge and skills and SCANS skills?

Increased Awareness of and Interest in STEM Careers: After building their ROV, 97 percent of the students (N=98)[12] indicated that they knew more about careers in marine science, technology, and engineering. Indeed, 50 percent marked that they knew "a lot more". Seventy-one percent (71%) stated that their ROV project made them more interested in a marine career. (Overall, 46 percent of the students were interested in having a career in marine science, technology, or engineering; 47 percent were not sure, and 7 percent were not interested in a career in this field.)

Among the teachers/mentors who completed post-competition surveys (N=8), all of the respondents (100%) indicated that they had observed that their students were more interested in pursuing a STEM career. While this is a small sample size, the teacher/mentor survey results are in line with the results of prior years' surveys of teachers/mentors of Ranger and Explorer class teams.

Increased Interest in STEM: Three quarters of the students (75%) stated that their ROV project made them want to learn more about ocean science, technology, and engineering. Students indicated that their ROV projects increased their desire to take courses in science (72%), computer science (48%), math (39%), engineering (19%), and other hands-on classes or club activities like robotics, electronics and shop courses (65%). Additionally, 65 percent of the students wanted to learn more about undersea volcanoes, including how ROV's are used.

In the post-competition survey, all of the teachers/mentors (100%) indicated that their students were more interested in learning about science, technology, engineering and math. This follows patterns of prior surveys of teachers/mentors.

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[11] In the proposal, this project strategy was stated as "Provide student workshops and ROV STEM curriculum". After the first year of implementing the grant, it became clear that the wording of this strategy and the associated research questions needed to be broadened to "support the development of the SCOUT (Entry Level) ROV Class."

[12] All student survey results presented in this report chapter are based on a total of 98 completed surveys.

Parents concurred with the other sources reporting increased student interest in STEM. Ninety-five percent (95%) of the parents surveyed (N=80)[13] stated that building an ROV has made their child more interested in science, technology, engineering or math. Open-ended comments from the parents include the following:

More interest in hydrodynamics

More interested in the ROV industry

Interest in aquatic science

Has had a slight shift from loving astrophysics to also loving marine engineering

Increased STEM Knowledge and Skills: Most students entered with no knowledge about ROV's. Over half of the students (52%) did not know what an ROV was before entering this program, and for over three quarters of the students (78%), this was their first time building an ROV. One indication of increased STEM knowledge is that before beginning their research for the competition, only 9 percent of the students indicated that they knew "a lot" about undersea volcanoes. After completing their research, 41 percent marked that they knew "a lot". Students also gained research skills as part of the competition. Fifty percent used the Internet to conduct research, including websites for organizations including NOAA, Hawaii Center for Volcanology, and the University of Hawaii School of Ocean, Earth Science and Technology. Additionally, 22 percent interviewed teachers or parents, and 17 percent used print resources, such as journals and newspapers.

Parents reported that building an ROV contributed to improving their child's grades in science (72%), math (55%), computers (61%), and engineering/robotics (76%).[14]

[13] All of the parent survey results are based on 80 completed surveys.

[14] Percentages are calculated among students studying each topic.

ROV Program Testimonials

Parents

This program kept my highly disillusioned, turned-off, gifted child in school.

My daughter…thoroughly enjoyed the experience, and it inspired her classmates' interest in robotics and design. I loved watching her grow in this new direction. At the competition, she watched other students intently, seeking new ideas for designs. Thanks so much to organizers and volunteers for making this possible.

This has been the most fantastic experience. The kids have learned so much through this process without thinking of it as 'work'. I hope this program continues for many years and that my younger son can participate too.

Faculty/Mentors

All students took something valuable away from the experience.

The kids learned a lot about teamwork.

This was our school's first year participating. At the competition…I thought they performed very well, and I was proud of their willingness to adapt and desire to learn. We used their scores on the tasks and looked at their strengths and areas for growth for next year. They want to get started the minute the tasks are out next November!

Among the teachers/mentors who completed post-competition surveys, all of the respondents reported that they observed improvements in their students' STEM knowledge and skills.

Increased SCANS skills: In the post-competition surveys, all of the teachers/mentors mentioned that they observed increases in their students' skills in team building, problem solving, and/or critical thinking.

When parents were asked what changes they have seen in their child as a result of their involvement in the ROV project, 70 percent reported that their children were better able to work with others; 70 percent indicated that their child's self confidence had improved, and 28 percent marked that their child was better organized. In the open-ended comments, other changes that parents observed in their children included the following:

> *Increased passion for building, mechanics, out of box thinking, outlet for creativity in thinking of mechanical solutions.*
>
> *Social skills, leadership, team building skills, collaboration – very positive experience.*
>
> *Remarkable improvement in leadership and speaking skills.*
>
> *More persistent when things don't work right away.*
>
> *Imagination has improved!*
>
> *Great to see an interest in something other than videos. Loves the hands on problem solving.*
>
> *Working on a team was an excellent experience. Having a task that was compelling was very important.*
>
> *More involved in school, more social, happier.*
>
> *Excited to go to school on days when the ROV club met.*

Overall, parents rated their children's experience building and competing with an ROV extremely positively. Seventy percent rated it as excellent, 26 percent gave a rating of good, 3 percent marked fair, and 1 percent rated it as poor.

2.2. Did participating in the workshops (or observing the competitions) lead to an increase in the parents' support of their children's interest in STEM careers?

Eighty-one percent of the parents surveyed indicated that participation in the ROV program changed how they envisioned their child's future, making it easier to picture their child with a STEM career. Eleven percent marked that the program participation did not affect how they picture their child's future, and 8 percent were not sure.

2.3. Were the curriculum materials and workshops at the appropriate level for a middle school audience?

Curriculum materials: Due to the extremely quick ramp-up time of this year's grant implementation, there was no time to design a curriculum specific to this program. Rather, the MATE Center sent a collection of previously developed instructional and support materials to the regional coordinators. The regional coordinators selected the materials that best fit into their teacher, student, and mentor workshops and class presentations. Anecdotal reports from the regional coordinators were that the materials were useful. In the future, they would appreciate having materials specifically designed for this program, including items that would help show teachers how this program fits into their classroom topics (e.g. how ROV's apply to physics, etc.) The MATE Center has plans to develop support materials specifically for this program. Once the new materials are released, they will be evaluated for appropriateness for the middle school audience.

Workshops: Anecdotal reports from regional coordinators, faculty, and parents indicate that the workshops targeting a broad audience (students, teachers/mentors, and parents) were at the appropriate level for the middle school audience, and that the participants were very engaged. It appears that the middle school teachers generally had minimal technical skills, and the regional coordinators struggled a bit with the teacher workshops: how to provide enough information that the teachers would have the skills to succeed without overwhelming them. The regional coordinators responded to this challenge with different approaches: most offered multiple workshops throughout the program duration. The New England regional is planning a three-day workshop in July, with the goal of taking teachers who have no technical skills and bringing them to the point that they are comfortable wiring a basic controller. Another professional development opportunity for these teachers is the MATE Center's week-long Summer Institute.

This evaluation question will be investigated more rigorously in the upcoming year.

2.4. What was the impact of the workshops and other support on the teams' ability to build an ROV and participate in the regional competitions?

As stated above, 89 percent of the teachers indicated that as a result of the workshops, they felt more committed to participating in the competition. The biggest indicator that the regions successfully supported the teams was the increase in the number of SCOUT class teams participating in regional competitions and other SCOUT class culminating events.

Project Strategy 3: Modify Career Guidance Resources to Better Suit Middle & High School Students

3.1. Has the *Exploring Ocean Careers* course and web site been modified so that the appeal, information and delivery are appropriate for the middle and high school audience?

The Exploring Ocean Careers course is in the process of being updated and modified. It will be evaluated once the revised website is launched in the 2010-2011 project year.

3.2. Did students, educators and parents use the career guidance tools? Did their awareness of ocean STEM careers increase as a result of these tools?

The career guidance tools are in the process of being updated. It is unclear to what extent the current tools are being used by the ITEST audience. Nonetheless, there are indications that students' awareness of STEM careers has increased through their participation in the program. As stated above, after building their ROV, 97 percent of the students (N=98) indicated that they knew more about careers in marine science, technology, and engineering. The usage and effectiveness of the updated career guidance tools will be evaluated once they are released.

Project Strategy 4: Build ROVER, a Cyberlearning Center

4.1. Has ROVER increased access to career and instructional resources? Increased use of the resources?

ROVER will be evaluated after it is launched in September 2010.

4.2. To what extent were the website users satisfied with the ease-of-use of the website? With the materials available through the website?

ROVER will be evaluated after it is launched in September 2010.

4.3. Has ROVER increased communication between students, educators, industry professionals, and parents?

ROVER will be evaluated after it is launched in September 2010.

4.4. Did the availability of ROVER affect the teams' ability to build an ROV and participate in the regional competitions?

ROVER will be evaluated after it is launched in September 2010.

Preliminary Findings by Gender & Ethnicity

In the ITEST proposal, the evaluation proposed exploring the findings by gender, ethnicity, and socio-economic status. Socio-economic status has proved difficult to collect, considering the large number of schools and clubs involved and their varying privacy concerns. We are considering different possible proxies for this demographic factor. However, preliminary analysis by gender and ethnicity was possible, based on self-reported demographics in the student survey. According to the demographic data in the surveys (N=98), the students were about three-quarters male (74%), and slightly more than half were of minority backgrounds (53%). [15]

The results by gender and ethnicity (minority status) are presented below. [16] The analysis focuses on the following topics:

- Awareness of STEM careers
- Interest in STEM careers
- Interest in STEM topics
- STEM knowledge

Positive results were found regardless of gender or ethnicity; however, the strongest gains were among white students and male students. This is a strong area of concern for the PI, and steps are being taken to improve both the recruitment of underrepresented students and the impact that the program has on them.

Prior to the ITEST grant, the MATE Center conducted a study on effective strategies for recruiting underrepresented college students for a marine STEM internship program. The study found that the most effective outreach had the following characteristics:

- Conducted by personnel of diverse backgrounds,
- Used recruitment materials depicting students of diverse backgrounds,
- Offered a contact person for the project, rather than impersonal project contact information, and
- Provided frequently asked questions responding to the parents' concerns.

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15 As noted in the methodology section, student surveys were not collected from all of the regions; thus, the demographics reported here do not match the overall demographics reported elsewhere.

16 The sample size of participant surveys from each ethnicity was not large enough to do analysis by individual ethnicity. Instead, all non-white respondents were coded as "minority", and results were analyzed by this "minority status" variable.

While this ITEST project targets a younger age range than the college students in the study, it is likely that many of these lessons apply to the ITEST program as well. The ITEST project will attempt to apply these lessons in a more thoughtful way in year two of the grant, starting by sharing this information with the regional coordinators at the regional coordinators meeting scheduled for September of 2010. As noted in the first chapter of this report, the regions have a variety of implementation methods for the grant; however, within this variety, it should still be possible to incorporate these lessons.

The project has made efforts to include the participation of teachers, college students, staff, and competition judges (industry professionals) of diverse backgrounds who can serve as role models for the middle school students. In the second year of the grant, demographic data will be collected on these stakeholders.

The project has also turned to their Curriculum and Cultural Advisory Committee for advice on this topic. In particular, the committee stressed the importance of reaching out to middle school parents in addition to students. As stated in the ITEST Annual Report, the committee suggested addressing questions such as the following: "Will my family accept this? Can I do this with my family? Will I be able to support my family? I want to live the good life: will an ocean career give me that?" In year two, the project plans to include this information in the updated career information resources.

One of the goals of the project is to help determine the most effective strategies for engaging youth of diverse backgrounds. Future evaluations will track the implementation of these strategies to reach out to underrepresented students, the effectiveness of these strategies in increasing the participation of these students, and the differential impacts on student outcomes.

Results by Gender

Overall, positive results were found in both male and female students: increased awareness of and interest in STEM careers, increased interest in studying STEM topics, and increased STEM knowledge. In general, the ROV program appeared to generate stronger gains in the boys than the girls.

Awareness of STEM Careers: Prior to participation in the ROV program, the level of awareness about careers in marine science, technology and engineering was similar between boys and girls. Eleven percent of the boys and twelve percent of the girls reported that they knew "a lot" about these careers. Likewise, *growth* in career awareness was similar between the genders, though boys reported slightly larger gains. For example, all of the boys (100%) reported that they knew more about marine careers after the program, compared to 92 percent of the girls.

Interest in STEM Careers: The male students were more interested in pursuing a career in marine science, technology, or engineering than the female students (male: 51%; female: 33%). Interest in these careers grew due to the ROV program for both males and females, though this effect was stronger for the boys (male: 75% were more interested; female: 58%).

Interest in STEM Topics: The ROV program resulted in increased interest in learning about STEM topics for both the male and female students; however, these effects were stronger for the male students in most topics. The students reported that the ROV project made them want to learn more about ocean science (male: 77%; female 65%). They also reported that the ROV project increased their desire to take the following courses:

- Math (male: 46%; female: 20%)
- Science (male 75%; female: 68%)
- Computer Science (male: 56%: female: 24%)
- Engineering (male: 22%; female: 8%)
- Hands-on courses or clubs (male: 71%; female: 48%)

Female students were slightly more likely than the male students to indicate that they want to learn more about undersea volcanoes (male: 65%; female: 69%).

STEM Knowledge: One indicator of STEM knowledge was the self-reports of the level of knowledge of undersea volcanoes. Student knowledge about undersea volcanoes increased in both male and female students. Before the program, only 10 percent of males and 8 percent of females indicated that they knew "a lot" about undersea volcanoes. After the program, 45 percent of males and 31 percent of females reported that they knew "a lot". Again, this result was stronger in the males.

Results by Minority Status

Overall, positive results were found in both the white and minority students: increased awareness of and interest in STEM careers, increased interest in studying STEM topics, and increased STEM knowledge. In general, the ROV program appeared to generate stronger gains in the white students; however, minority students reported stronger desire to take courses in math and engineering.

Awareness of STEM Careers: Prior to participation in the ROV program, the level of awareness about careers in marine science, technology and engineering was similar, regardless of ethnicity. Eleven percent of the white students and twelve percent of the minority students reported that they knew "a lot" about these careers. Likewise, *growth* in career awareness was similar, though white students reported slightly larger gains. For example, all of the white students (100%) reported that they knew more about marine careers after the program, compared to 94 percent of the minority students.

Interest in STEM Careers: The white students were more interested in pursuing a career in marine science, technology, or engineering than the minority students (white: 52%; minority: 41%). Interest in these careers grew due to the ROV program for both white and minority students, though this effect was stronger for the white students (white: 87% were more interested; minority: 55%).

Interest in STEM Topics: The ROV program resulted in increased interest in learning about STEM topics for both white and minority students. These effects were stronger for the white students in most topics. However, minority students were more likely to state that the ROV program increased their desire to take courses in math and engineering, and their desire to take computer science courses was equal to that of the white students.

The students reported that the ROV project made them want to learn more about ocean science (white: 85%; minority 65%). They also reported that the ROV project increased their desire to take the following courses:

- Math (white: 37%; minority: 41%)
- Science (white 85%; minority: 63%)
- Computer Science (white: 48%: minority: 49%)
- Engineering (white: 9%; minority: 29%)
- Hands-on courses or clubs (white: 74%; minority: 59%)

White students were more likely than the minority students to indicate that they want to learn more about undersea volcanoes (white: 73%; minority: 52%).

STEM Knowledge: One indicator of STEM knowledge was the self-reported level of knowledge about undersea volcanoes. Student knowledge about undersea volcanoes increased in both white and minority students. Before the program, only 7 percent of the white students and 13 percent of the minority students indicated that they knew “a lot” about undersea volcanoes. After the program, 45 percent of the white students and 35 percent of the minority students reported that they knew “a lot”. Again, this result was stronger in the white students.

CONCLUSIONS

Overall, the MATE Center successfully implemented the first nine months of ITEST grant activities, delivering professional development workshops and supporting the expansion of the SCOUT class ROV competition among the middle school audience. Prior to the ITEST grant, the MATE Center had a robust ROV competition network among high schools, community colleges and universities. The missing link in the pipeline was the middle schools.

Research shows that middle school is the time when many students become disengaged with school in general and with STEM subject matter. Results from this evaluation suggest that the MATE Center has achieved their goal of offering a hands-on, engaging activity for students that helps grow their interest in school and in STEM. This is especially important in school districts that have removed technology and shop classes due to budget constraints, such as those in Massachusetts. Comments from parents were extremely encouraging in this regard. As one parent in the Pacific Northwest wrote, “this program kept my highly disillusioned, turned-off, gifted child in school.” Other parents noted that their children were “excited to go to school on days that when the ROV club met” and “more involved in school”.

In addition to increasing engagement in school, it appears that the ROV program successfully contributed to gains in student awareness of marine STEM careers and interest in pursuing a marine STEM career, increased interest in learning more about STEM topics, and improved STEM knowledge and skills and SCANS skills.

One of the goals of the evaluation is to examine differential impacts of the grant implementation strategies on underrepresented populations. While socio-economic status was not available, this year’s evaluation included some preliminary analysis by gender and minority status. Gains were seen in all of the expected outcomes, regardless of student gender or minority status. However, male students and white students showed stronger gains than female students or minority students in most areas. This finding is not unexpected; in fact, it is consistent with other research on student interest in STEM.

The MATE Center placed a strong emphasis on reaching out to underrepresented populations in the first year of the grant. This is a topic of longstanding efforts on behalf of the Center. For instance, through other funding sources, the Center has studied recruitment of diverse students to STEM internship opportunities. The ITEST PI and regional coordinators expressed their views that reaching out to the diverse audiences is an area that will receive continual attention throughout the grant. Future evaluations will monitor both the effectiveness of the recruitment strategies and the differential outcomes.

APPENDIX: DETAILED EVALUATION PLAN AND PROTOCOLS

The appendix includes the following items:

- Detailed evaluation plan
- Student post-competition survey protocol
- Faculty/mentor pre-post workshop survey protocol
- Faculty/mentor post-competition survey protocol
- Parent/guardian post-competition survey protocol
- Faculty/mentor follow-up survey protocol
- Regional coordinator interview protocol