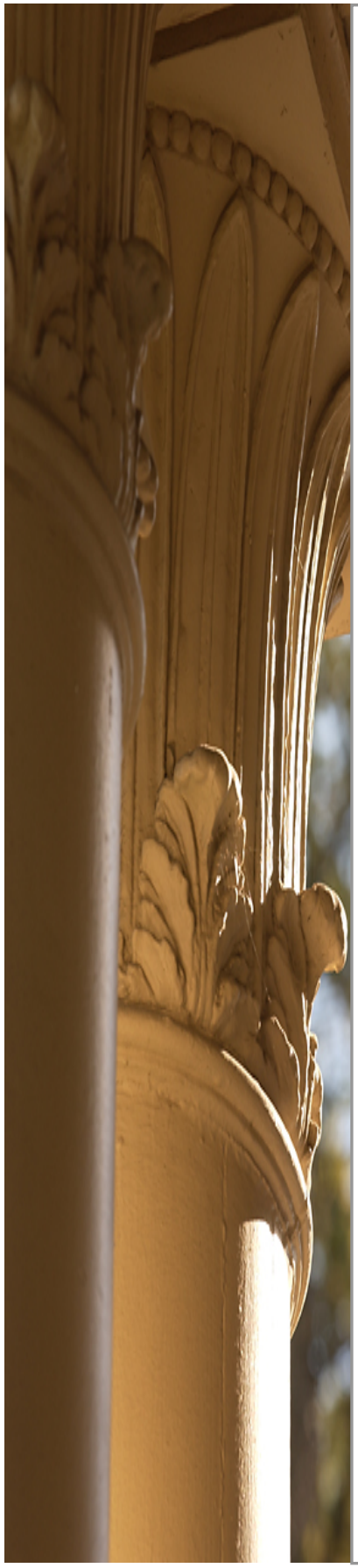

Evaluation of Innovative Technology Experiences for Students and Teachers (ITEST) Year Two Grant Activities

For

The Marine Advanced Technology Education (MATE) Center

August 2011

Submitted by:

SESRC

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The Marine Advanced Technology Education (MATE) Center

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August 2011

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SPONSORSHIP

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ABOUT SESRC

The Social and Economic Sciences Research Center (SESRC) at Washington State University is a recognized leader in the development and conduct of survey research.

SESRC-Puget Sound Division provides technical services and consultation to assist clients in acquiring data, understanding what data means, and applying that information to solving problems. The SESRC Puget Sound Division specializes in research design, data collection and analysis, using both qualitative and quantitative methods. The Division also provides interpretive reports, policy studies, presentations and consulting services directly to individual clients, organizations and consortia.

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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

AUGUST 2011

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 July 1st, 2010 and June 30th, 2011, the second year of the grant. Year-to-year comparisons will be included in next year's final, summative report. This report describes the project implementation as well as the preliminary findings for each of the research questions. The implementation is discussed by project objective, while the evaluation findings are reviewed by project strategy. This structure mirrors the evaluation design.

Project Implementation

In the second year of the grant, the MATE Center made progress in implementing all four grant objectives.

Objective 1: Build the support infrastructure for an entry-level ROV competition class

In the second year of the grant, the MATE Center continued its roll-out of targeted support for the entry-level (SCOUT) ROV competition class, from four to eight regions that cover the country from coast-to-coast: Monterey Bay, Pacific Northwest, New England, Southern California, Florida, Mid Atlantic, Oahu and the Great Lakes.

Teacher and student workshops were offered in all regions. The MATE Center provided additional support for the teachers through its week-long beginner-level Summer Institute, held in Monterey, California, July 12th-18th, 2010.

An important component of the support for the SCOUT class was the middle school, ROV-focused STEM curriculum. In collaboration with the MATE Center, the Shedd Aquarium drafted the curriculum, which was distributed to teachers throughout the ROV competition network.

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

The MATE Center researched and assessed existing career resources for middle and high school audiences. They also beta tested the *Exploring Ocean Careers* course with high school students. This course was developed by the MATE Center with an initial focus on serving community college students. In the next year of the grant, the Center plans to complete the following tasks:

- Transition the course to the ROVER (ROV Education and Resources) website, making it publicly available,
- Link the high quality external career resources to the website, and
- Perform advance work towards the goal of creating ROV competition-focused career videos for middle school students.

Objective 3: Build a cyberlearning center

The ROVER website was launched in September 2010. It contains links to a growing selection of external career and instructional resources, acts as a gateway to the MATE Center's other social media efforts and hosts the competition registration system.

Objective 4: Evaluate and track project participants

In the second year of the grant, interview and survey protocols from the first year were refined and new data collection tools were developed and administered to a variety of project stakeholders. Analysis of the multiple data sources provided findings on the project's movement towards the expected outcomes. This report demonstrates the progress made towards Objective Four.

Findings

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

Project Strategy 1: Provide Professional Development

- **Increased Confidence Facilitating STEM Learning Experiences:** At the regional workshops, the percentage of teacher respondents who rated themselves as "very comfortable" facilitating STEM learning experiences for students rose from 40% in the pre-workshop surveys (N=45) to 54% in the post- surveys (N=39). After the training, 95% indicated that they felt less concerned about designing and building an ROV.
- **Strengthened Commitment to Participate in the Program:** As a result of the workshops, all of the teacher respondents (100%, N=39) stated that they felt more committed to participating in the competition.
- **Increased Awareness/Understanding of Ocean STEM Careers:** In the follow-up survey conducted six months after the week-long Summer Institute, all of the respondents indicated that the Institute helped them understand the knowledge and skills needed for marine occupations (100%, N=8 out of the 13 total attendees) and the current technologies used in the marine field (100%).

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

- **Increased Awareness of STEM Careers:** After building their ROV, 80% of the students surveyed (N=267) indicated that they knew more about careers in marine STEM.
- **Increased Interest in STEM Careers:** Roughly two-thirds of the students (64%, N=267) stated that their ROV project made them more interested in a marine career, and 65% of the teachers (N=56) observed an increase in their students' interest in pursuing a STEM career.
- **Increased Interest in STEM:** Two thirds of the students (66%, N=267) indicated that their ROV project made them want to learn more about ocean STEM. Eighty-one percent (81%, N=56) of the teachers and 91% of the parents (N=130) observed greater interest among the students in learning STEM.

- **Increased STEM Knowledge & Skills:** The majority of the teachers (91%, N=56) observed improvements in their students' STEM knowledge and skills. Parents (N=130) reported that building an ROV contributed to improving their children's grades in engineering/robotics (54%), science (40%), math (32%) and computers (24%).
- **Increased SCANS Skills:** Ninety-five percent (95%, N=56) of the teachers observed increases in their students' skills in team building, problem solving, and/or critical thinking. Sixty percent (60%, N=130) of parents reported that their children were better able to work with others; 60% indicated that their child's self confidence improved; and 30% marked that their child was better organized.
- **Increased Parental Support of Their Children's Interest in STEM:** Eighty-two percent (82%, N=130) 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.
- **Overall Rating of MATE Center Support:** After the competition season, 61% of the teachers (N=56) rated the support provided by MATE as excellent, and 31% provided a rating of good, an overall positive rating of 92%.
- **Review of Curriculum Materials:** Preliminary feedback about the curriculum, provided by teachers testing the beta version, has been extremely positive, with reviewers indicating that the curriculum materials are at the appropriate level for a middle school audience.

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

This strategy is still in the early implementation stages so no evaluation findings are available yet.

Project Strategy 4: Build ROVER, a Cyberlearning Center

- **Increased Access to Career and Instructional Resources:** The website is populated with an extensive and growing selection of links to internal and external resources: 701 at last count.
- **Use of Website and Resources:** There are many indications that the website and resources are being used, including the website user registration survey (N=703), Twitter followers (104), Facebook "likes" (134), Flicker photos (1,850 photos with 2,921 views), YouTube videos (123 videos with 30,133 views) and ROV competition registrations (2,173).

Broader Impacts

The MATE Center's ITEST activities have been leveraged in ways that were unanticipated during the writing of the proposal. These "broader impacts" fall into three main categories:

1. Leveraging ITEST activities/funding to raise additional funding by regional coordinators, teachers, schools, and student teams
2. Using ROVs and ROV-based activities outside of the competition by teachers and students
3. Involving college students to mentor middle school ROV teams in several competition regions

Student Findings by Demographics

According to the demographic data in the surveys (N=267), the students were about one-third female (35%), half (50%) were of minority backgrounds, 44% came from high poverty areas, and 5% reported that they had disabilities requiring accommodations.

Overall, there were few statistically significant differences by gender, ethnicity, disability status or socioeconomic status, indicating that the ROV program was effective in producing positive results for under-represented students as well as the students who traditionally participate in STEM learning opportunities.

In many cases, the significant differences were in the measures of STEM knowledge, interest, and awareness *prior* to participation in the program, which is not surprising if the under-represented students had less exposure to the subject matter before joining the program.

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 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 July 1st, 2010 and June 30th, 2011, the second year of the grant. Year-to-year comparisons will be presented in next year's final, summative report. The results are presented below in two chapters. The first chapter, *Project Implementation,* describes how the ITEST grant has been implemented in the second year. The second chapter, *Findings*, discusses the 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?
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?

Project Strategy	Research Questions
	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.

ROV Competitions

At the ROV competitions, input was solicited from as many stakeholders as possible, including students, teachers, parents, and judges/volunteers. In the second year of the grant, the competition survey method changed from a mix of online and paper with hand data entry to all paper surveys in a "scannable" format. Data entry was completed by scanning the surveys and entering the written comments by hand. Data analysis was performed with the Statistical Package for the Social Sciences (SPSS).

Student, teacher, and parent surveys were administered at the Monterey, Florida, Great Lakes, Pacific Northwest, Southern California and New England regional events. The ITEST events at the Oahu region happened after the close date for this report so they are not included. Surveys were not administered in the Mid-Atlantic region.

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

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 more than 3,000 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.

TEACHERS

Teachers 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 more than 700 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 and skills, SCANS skills, and interest in STEM careers, and related topics.

In the first year of the grant, a separate web survey was conducted in order to ask the teachers participating in the ITEST grant-funded activities some additional questions. (The post competition surveys are administered to all regional event participants, not only the ITEST program participants.) The web survey had a very low response rate so in the second year of the grant, the web survey was discontinued, and a few additional questions were added to the post-competition survey. The new questions asked the respondents to rate the ROV program and the support they received and to report on the obstacles they faced.

PARENTS

In contrast to the student and teacher surveys, which have been conducted for years at MATE ROV competitions, year one of the grant was the first time parent input was solicited. Parents responded enthusiastically and seemed to appreciate the opportunity to provide input. The surveys were implemented again in the second year of the grant. Next year, there are plans to translate the survey into Spanish in order to promote even wider participation by family members in the evaluation, especially in regions with large Spanish-speaking populations, such as Florida and Southern California.

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.

JUDGES

In the second year of the grant, input was solicited for the first time from industry representatives serving as judges at the competitions. In order to minimize the surveying burden on the regional coordinators, this survey was only conducted at the international competition. At the next regional coordinator meeting, the coordinators will be invited to use this survey as well, on an optional basis. This survey collects information on the judges' experience at the competition, whether they feel it was a worthwhile use of their time, the skills of the students they observed, their opinions on the usefulness of the competition in preparing future employees and their demographics.

Regional Workshops

PRE AND POST TEACHER WORKSHOP SURVEYS

Pre and post paper surveys were administered to teacher workshop attendees in the Monterey, Pacific Northwest, New England and Florida 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 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.

Summer Institute

IMMEDIATE FEEDBACK AND SIX-MONTH FOLLOW-UP SURVEYS

The evaluation of the Summer Institutes was a two-step process, collecting feedback from the participants immediately after the Institute (using the Institute feedback surveys) then again a few months later (using the Institute follow-up surveys). The feedback survey had a response rate of 77% (10 out of 13), and the follow-up survey had a response rate of 62% (8 out of 13). The follow-up surveys intend to measure the Institutes' longer-term impact and, in particular, to compare participants' actions once they returned to their classrooms with the intentions they had expressed at the close of the Institute.

Curriculum

TEACHER CURRICULUM FEEDBACK SURVEY

The draft curriculum was distributed to the teachers throughout the competition network, and their opinions about the curriculum were solicited through a feedback form. This survey asked them how they used the curriculum, their level of experience in leading science and technology activities, who they taught with the curriculum, and how they would rate the curriculum overall, the appropriateness of the

content for the middle school audience, the guidelines and background materials for teaching the content, if the curriculum uses appropriate strategies to meet the needs of diverse audiences, and if the curriculum is free of bias. Responses to the feedback form were still being collected at the close of the evaluation period.

Other Data Sources

Additional data sources informing the evaluation include the annual reports turned in by the regional coordinators to the ITEST grant PI, observations of the Pacific Northwest regional competition and the regional coordinators meeting, review of participation data, unsolicited letters sent to the regional coordinators and the MATE Center from students, parents and teachers, and document review, including the curriculum and supporting technical materials and the MATE Center's annual report.

Challenges of the Evaluation and Lessons Learned

SURVEY METHODS

In the first year of the grant, the survey implementation was somewhat uneven, and the data did not cover all of the regions because some of the regional coordinators did not administer them. With the quick project ramp-up, regional coordinators were pulled in many different directions, and occasionally, survey implementation was forgotten.

In the second year of the grant, several strategies combined to produce much better data. This effort began with the regional coordinators meeting in September of 2010. This meeting was the kick-off for the second year of the grant. The evaluator shared the results of the first year of evaluation and stressed the importance of the data collection activities. The regional coordinators received a complete set of data collection instruments, along with training on how and when to implement each.

In addition to improving the coordinators' awareness of the data collection expectations, the survey administration method was revised as well. To reduce the burden on the regional coordinators, the post-competition surveys were changed to a format suitable for scanning the resulting data. The surveys were printed at the MATE Center's head office at Monterey Peninsula College and mailed to the regional coordinators with a pre-filled UPS label and box to return the completed surveys to the evaluator for processing.

This method was very effective, and post-competition surveys were returned by all but one ITEST region.[2] [3] This survey method also reduced the data entry burden on the MATE Center's administrative

[2] This survey method was used for the entire MATE competition network, including the non-ITEST regions and the international regions. Over 1,600 student surveys and 350 teacher surveys were returned from the entire competition network in the 2011 season, far surpassing the completion numbers from prior years.

assistant, resulted in a quick turn-around for creating the dataset, and resulted in cleaner, more comprehensive data suitable for more sophisticated analysis.

The downside to this method was the increased costs in printing, shipping, and data entry. Some of the increased costs were one-time expenses, such as transforming the surveys into the format for scanning.

The survey methods for the workshop pre and post surveys were not changed from last year, and there is room for improvement in the survey implementation. Workshop surveys were only returned from four of the eight ITEST regions. Next year, regional coordinators will again be reminded of the importance of collecting this data.

DEMOGRAPHIC DATA

Last year, student demographic data was collected by asking the regional coordinators to request the data directly from the schools or clubs that sent ROV teams. This method proved to be very cumbersome, sparked privacy concerns among the participating organizations, and resulted in very uneven data of poor quality.

In the second year of the grant, the evaluation moved to an approach relying entirely on self-reported demographics using the post-competition surveys. This approach has the advantage of allowing the surveys to be anonymous while still providing the ability to analyze the results by the demographic factors. It has the disadvantage of only measuring the students who made it to the competition.

The first year of the evaluation only included demographic analysis by gender and ethnicity. In the second year, disability status and socio-economic status were added. In general, socio-economic status is a sensitive subject. Schools do not like to share information on students' eligibility for Free and Reduced Price Lunch (FRPL), and asking students how much money their family makes raise privacy issues (assuming the students even knew the answer to the question). In order to avoid triggering concerns from schools and parents, the evaluation used the students' home zip codes as a proxy for socioeconomic status. The zip codes were matched to US Census data on the percentage of families with children under 18 living in poverty. Students living in zip codes with greater than national average for families living in poverty were marked as living in high poverty areas. Unfortunately, the 2010 Census data on poverty will not be released until December 2011, thus the 2000 Census data was used for this year's analysis. Next year, the analysis will be performed with the latest poverty data.

In addition, the teacher survey was revised to include more demographic data, and this information was also asked of judges. The goal of these questions is to show the percentage of under-represented role models that the students come into contact with through the program.

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[3] It is not clear if the surveys in the Mid-Atlantic region were not administered or were not returned to WSU-SESRC for coding and analysis.

OTHER CHALLENGES

Within the ROV program, the regional coordinators have considerable latitude in how they implement the competition activities. 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.

One new challenge in the second year of the grant was evaluating the ROVER website usage. This was the first year of the new website, and the webmaster did not discover until the end of the grant year that the Google Analytics software was not capturing usage statistics. As a result, the evaluation relied on peripheral website and resource usage statistics. The software is working correctly now, and better usage information will be available in the third year of the grant. Unfortunately, the lack of data for the second year means that it will not be possible to show usage trends over the course of the grant.

Other basic challenges of the evaluation include the fact that the program does not have direct access to the students prior to the competition so true pre-post comparisons are not possible; the program takes place in multiple regions across the country, each which brings different strengths and weaknesses that can affect the results, and the grant activities involve a subset of participants in a larger program, which brings the challenge of identifying the ITEST participants.

PROJECT IMPLEMENTATION

This chapter reviews the progress towards implementing each of the four grant objectives. Each of the 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.

SUPPORT FOR ENTRY-LEVEL ROV COMPETITION CLASS

In the second year of the grant, the MATE Center continued its roll-out of targeted support for the entry-level (SCOUT) ROV competition class. In the first year, four regions participated in the grant: Monterey Bay, Pacific Northwest, New England and Southern California. In the second year, these four regions continued their SCOUT support activities, and four more regions began their SCOUT support efforts: Florida, Mid Atlantic, Oahu and Great Lakes.

Through the more than 200 student workshops, classroom visits, and outreach activities, over 1,900 students were involved with the program. The support for the SCOUT class included 15 regional teacher workshops and one Summer Institute. Each of these will be described in turn below.

Regional Workshops for Teachers and/or Students

Regional coordinators have the flexibility to specialize the workshops in their region to the particular needs of their audience. That said, the workshops tend to cover a core, basic set of knowledge and skills. Generally, the competition season begins with a workshop for the new teachers only. This workshop allows the teachers to build their own ROV that they take with them to use as a teaching tool. They go back to their classes/clubs and assemble a team of students. Their students are welcome to come to the rest of the workshops. Indeed, some students come on their own, without their teacher/mentor. The follow-on workshops tend to cover subjects such as wiring and waterproofing. The regional coordinators also help to arrange for pool practice time. While these sessions are not “workshops” per se, they are valuable learning experiences and the coordinators are generally on-hand to offer one-on-one troubleshooting.

Summer Institute

The year one ITEST Summer Institute took place July 12th – 18th, 2010. The goal of the Institute is 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 Institute.

The majority (60%) of Institute participants taught in middle schools or junior high schools, and most of them taught science (80%). Participants came with a wide range of teaching experience, from one year to 26 years. The participants report that they teach an unduplicated count of just over 1,000 students per year.

Figure 1: Grades/Levels Taught by Institute Participants

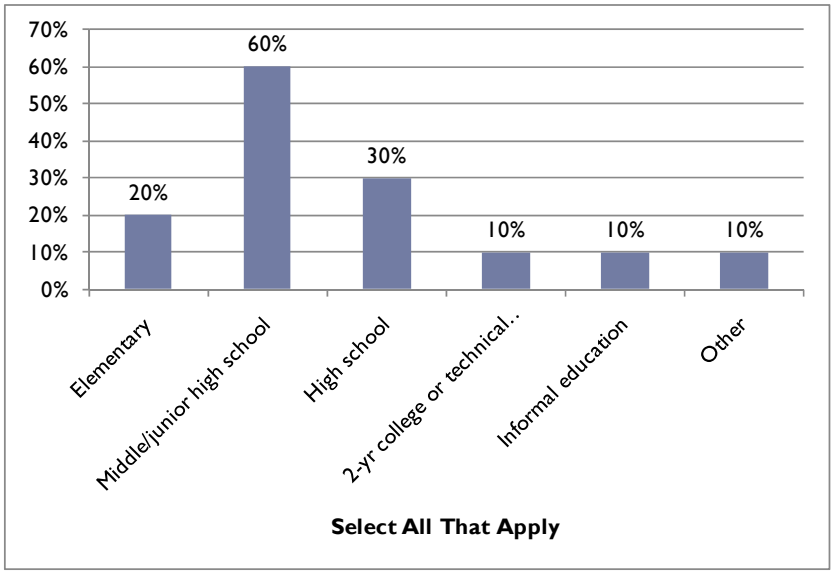
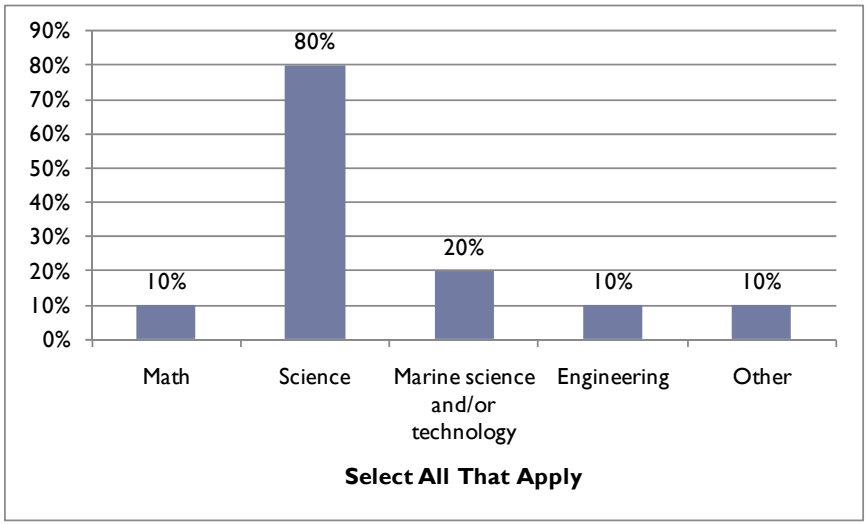


Figure 2: Subjects Taught by Institute Participants



ROVER MIDDLE SCHOOL CURRICULUM

In collaboration with the MATE Center, the Shedd Aquarium took the lead in drafting the ROVER middle school STEM curriculum. This ROV-focused curriculum is a collection of chapters that can be implemented as stand-alone activities/modules or as a full course.

An in-depth review of the curriculum was conducted by an elementary/middle school science program coordinator and a retired middle school science teacher. After their feedback was incorporated into the curriculum, a beta version was distributed by the regional coordinators to the teachers attending workshops throughout the ROV competition network. Their feedback was solicited via a feedback form. In year three of the grant, the feedback will be incorporated into the curriculum, and a revised version will be released.

OBJECTIVE TWO

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

Originally, the MATE Center planned to achieve Project Strategy Three, modifying career guidance resources to better suit middle and high school students, through updating the *Exploring Ocean Careers* course and website. As the preparatory research for this update was completed, it became clear that a different approach would be more effective to providing career guidance resources for these two audiences, as discussed below.

High School Students: The *Exploring Ocean Careers* course is set up so that all students complete the first few chapters, which help them assess their skills and which careers might be the best for them. Next, they read (or listen to) only the chapters that apply to their target careers. The MATE Center has begun beta testing this course with high school students, to very positive reviews.

It appears that for the high school audience, modification of the online course is not necessary; however, the MATE Center would like to increase access to the course. Thus, in the next grant year, the course will be migrated from Moodle, which limits access to users with this particular software, to the MATE website. The entire course will be open to the public, with the exception of the quiz banks, which will be shared with teachers who deliver the course for academic credit.

Middle School Students: When considering how best to modify the *Exploring Ocean Careers* course, the MATE Center began by interviewing middle school teachers. The teachers posited that career videos would be the most effective way to reach this audience, since videos require a shorter attention span and provide action and excitement.

The MATE Center researched existing marine career videos and rated them. Overall, they found that a wide variety of high quality videos were already available from sources such as ATE TV and ABC TV.

However, they also discovered that these resources were not widely known among middle and high school teachers. To facilitate access to these videos, they plan to link them to the MATE Center website.

Next Steps: The MATE Center Director, Deidre Sullivan, states that through research completed over the past year, she "came to the conclusion that we could get more impact by doing something different than adjusting the course for the middle school student."

In the next year, they will link the existing, external career materials to the ROVER website, transition the *Exploring Ocean Careers* course to the ROVER website to be publicly available, and perform advance work towards the goal of creating career-focused videos that highlight the career paths possible through participating in the ROV competition. The videos that will show ROV competition students how participating in the competition could lead step-by-step to various careers. The videos will highlight present and past competitors and show how involvement in the competition impacted their lives (e.g., college admittance, employment, etc.).

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.

The ROVER (ROV Education and Resources) website was launched in September 2010. It contains links to a growing selection of external career and instructional resources, acts as a gateway to the MATE Center's other social media efforts and hosts the competition registration system. Plans for next year include implementing the Mentor Hotline (a referral system for technical help) and seeding the discussion forums with interesting questions and comments to help encourage a vibrant online community to use the tools established in year two of the grant.

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 second year of the grant, interview and survey protocols from the first year were refined and new data collection tools 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 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 Seattle in conjunction with the MTS/Institute for Electrical and Electronics Engineers (IEEE) Oceanic Engineering Society (OES) Oceans Conference on September 24th, 2010. This meeting allowed the regional coordinators who participated in the first year of the grant implementation to share their experiences and lessons learned. In addition, the MATE Center used this meeting to train the coordinators in how to better reach out to and support under-represented students in their competitions.

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.

FINDINGS

This chapter reviews the project strategies and associated research questions. Evaluation results from all applicable data sources are summarized under each research question. A discussion of results by gender, ethnicity, socioeconomic status and disability status is included at the end of the chapter.

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

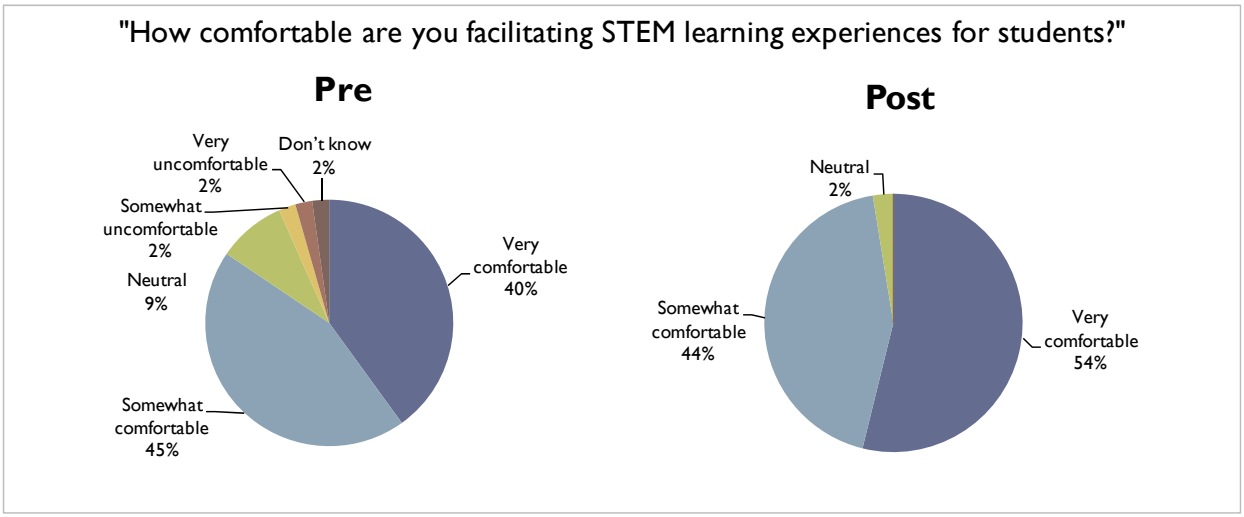
Research Question 1.1. Did the teachers gain confidence facilitating STEM learning experiences through the workshops?

Pre and post workshop surveys, post competition surveys, and Summer Institute feedback surveys demonstrate that the participants gained confidence facilitating STEM learning experiences through the training and support provided by MATE.

The pre-workshop surveys show that there is a need for the workshops. Before the training, half of the respondents (50%, N=45) stated that they had concerns about mentoring students in designing and building an ROV. Over half of the teachers (56%) indicated that they were concerned that they might not have the necessary technical skills and expertise.

The percentage of respondents who rated themselves as "very comfortable" facilitating STEM learning experiences for students rose from 40% in the pre-workshop surveys to 54% (N=39) in the post-workshop surveys.

Figure 3: Level of Teacher Confidence Facilitating STEM Learning Experiences: Pre and Post Workshops



When asked if the training addressed their concerns about designing and building an ROV, 95% indicated that they felt less concerned. Overall, 87% of the respondents rated the usefulness of the training as "excellent", and 13% gave it a rating of "good".

After the competition season, teachers rated the support provided by MATE. Sixty-one percent (61%, N=56) gave a rating of excellent, and 31% rated it as good. Nine percent (9%) indicated that the support was fair, and no respondents marked that the support was poor or very poor. Open-ended comments included the following:

> *The workshops provided by MATE allowed me to overcome my lack of technical skills. I feel so much more comfortable coaching because of the support from MATE.*

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, 77% of the respondents marked that they intended to mentor a team. (The other 23% marked "maybe"). All of the respondents (100%) indicated that as a result of the training, they felt more committed to participating in the competition. One workshop participant from the New England region wrote a letter after the event describing the effect the workshop had on her:

> *Thank you so much for my training and supplies this past Saturday. I had a wonderful time, and I feel very excited about starting an after school club next fall. You are correct, more kids need to think "science" when they think about what they want to be, and a project like this can show them that they can do it and have fun, too.*

Results from the Summer Institute follow-up surveys indicate that the Institute was also effective at motivating teachers to participate in the competition. In the six-month follow-up surveys, one participant indicated described the support provided by MATE in the following words: "The Summer Institute provided many if not all the resources I need to put a group/club together and gather the resources to move forward in training and competition."

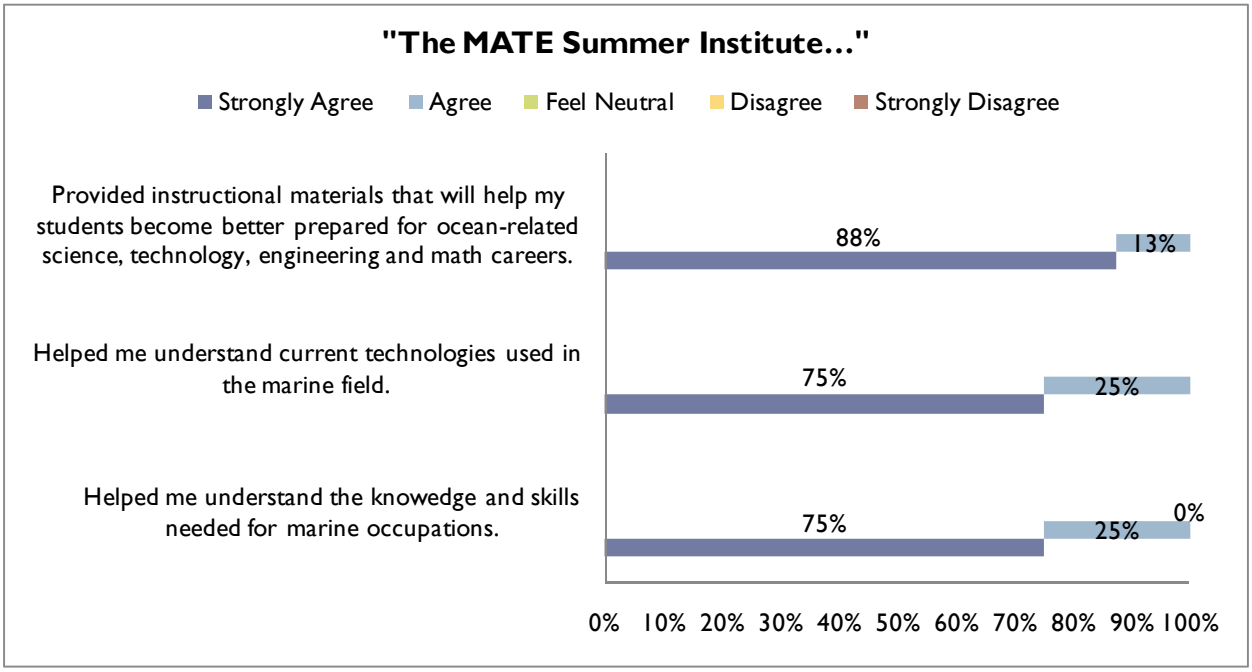
Research Question 1.3. Did attendance at the Summer Institutes lead to greater awareness/understanding of ocean STEM careers?

In the follow-up survey conducted six months after the Summer Institute, all of the respondents indicated that the Institute helped them understand the knowledge and skills needed for marine occupations (100%, N=8) and the current technologies used in the marine field (100%). All of the

respondents agreed that the Institute provided instructional materials that will help their students become better prepared for ocean-related science, technology, engineering and math careers (100%). Open-ended comments from the Institute participants include the following:

> *The experience opened my eyes to the Marine Biology field not only in California but in Florida as well.*
>
> *It gave me a new perspective on electronics and marine science. It was relevant to my students who lived off the coast with the oil spill. It brought the real world in my classroom and opened the mind of my students to future career possibilities.*
>
> *I have used the info we received at the Institute to apply for grants and share my knowledge with students and their parents about ROV's and where the future of jobs will be in this area.*
>
> *The collective effort of this program has embedded in me a sense that I can accomplish the goal to introduce students to this field.*

Figure 4: 2010 Summer Institute: Affect on Ocean STEM Career Awareness, Percentage of Respondents Agreeing or Disagreeing with Statements



Survey results demonstrate that in the months following the Institute, all of the respondents implemented what they learned by modifying their courses (100%) and teaching strategies (100%). The information gained at the Institute was disseminated by the participants sharing what they learned with their students (100%) and other instructors (100%).

Overall, the Institute received very positive marks, with 85% of the respondents rating the usefulness of the Institute as good (29%) or excellent (57%) in the months following the experience. Participant comments include the following:

> *This was a fantastic experience which helped me not only become aware of careers in marine science which are applicable to students but also the physical science where I am weak in knowledge. I will be implementing a lot of this in next year's oceans unit as well as career possibilities for our students, who are surrounded by the marine industry but yet are not aware of what they need to approach those fields. Thank you for a great week!*

> *This was the best training I have ever attended - Thank you so much for taking on a newbie who was clueless when it came to circuitry - it was the best experience - thank you so much!*

Project Strategy 2: Support the Development of the SCOUT (Entry Level) ROV Class[4]

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, 80% of the students (N=267)[5] indicated that they knew more about careers in marine science, technology, and engineering. Indeed, almost one-quarter (23%) marked that they knew "a lot more". Sixty-four percent (64%) stated that their ROV project made them more interested in a marine career. (Overall, 34% of the students were interested in having a career in marine science, technology, or engineering; 53% were not sure, and 13% were not interested in a career in this field.) Students mentioned wanting careers such as marine biologist, computer programmer, electrical engineer, and mechanical engineer.

Among the teachers/mentors who completed post-competition surveys (N=56), about two-thirds of the respondents (65%) indicated that they had observed that their students were more interested in

[4] 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."
[5] All student survey results presented in this report chapter are based on a total of 267 completed surveys.

pursuing a STEM career. Eighty-eight percent (88%) agreed that the ROV program provided a valuable venue to help prepare their students for a career in marine science and technology.

Increased Interest in STEM: Two-thirds of the students (66%) 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 engineering (54%), science (42%), math (37%), computer science (33%), and other hands-on classes or club activities like robotics, electronics and shop courses (52%). Additionally, 52% of the students wanted to learn more about deepwater oils spills, including how ROV's are used.

In the post-competition survey, 88% of the teachers/mentors indicated that their students were more interested in learning about science, technology, engineering and math. This follows patterns of prior surveys of teachers/mentors.

Parents concurred with the other sources reporting increased student interest in STEM. Ninety-one percent (91%) of the parents surveyed (N=130)[6] 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:

Even more enthusiastic about marine sciences

More interest in science and physical sciences

More interested in technology

More interested in robotics

Increased STEM Knowledge and Skills: Most students entered with no knowledge about ROV's. Over half of the students (55%) did not know what an ROV was before entering this program, and for over three-quarters of the students (80%), this was their first time building an ROV. One indication of increased STEM knowledge is that before beginning their research for the

[6] All of the parent survey results are based on 130 completed surveys.

ROV Program Testimonials

Students

I loved learning about designing a system that works underwater.

I really liked it. It helped me learn how to work as a team and try something new.

It was an awesome time…having fun learning and with friends to learn with you.

It was really fun to watch the results of my hard work.

I love ROV. It has inspired me to learn.

Parents

Channeling frustration into redesign and eventual success has been a great life lesson learned through ROV!

My kids were already very strong students in all subjects, but this project really inspired them to do more. They really enjoyed all the workshops and put in lots of time on their own, even though they didn't do this with school guidance.

Faculty/Mentors

I've been so happy to see my students excited to spend more time at school.

It was remarkable…how a few 4th grade students evolved a basic idea into a fully functioning ROV with little help from me.

A great way to interest students in design, engineering, teamwork and cooperation.

competition, only 19% of the students indicated that they knew "a lot" about deepwater oil spills. After completing their research, 44% marked that they knew "a lot". Students also gained research skills as part of the competition. Forty-eight percent (48%) used the Internet to conduct research, including websites for organizations including NOAA, The New York Times, Lockheed Martin, and National Geographic. Additionally, 55% interviewed teachers or parents, and 17% used print resources, such as journals and newspapers. Twelve percent (12%) interviewed working professionals.

Among the teachers/mentors who completed post-competition surveys, 91% of the respondents reported that they observed improvements in their students' STEM knowledge and skills. Parents reported that building an ROV contributed to improving their child's grades in engineering/robotics (54%), science (40%), math (32%) and computers (24%).[7]

Increased SCANS skills: In the post-competition surveys, 95% of the teachers/mentors mentioned that they observed increases in their students' skills in team building, problem solving, and/or critical thinking. Teachers/mentors saw skill development in many areas, as evidenced by their written comments:

> *Wow what amazing experience for all my students. Phenomenal benefits for them included skill building in every aspect of their education- science, engineering, interpersonal skills, meeting deadlines, cost analysis, team work, construction, electrical wiring, research, communication, presentation skills - verbal and visual, journaling, empathy, thinking about their futures and the environment… and more.*

When parents were asked what changes they have seen in their child as a result of their involvement in the ROV project, 60% reported that their children were better able to work with others; 60% indicated that their child's self confidence had improved, and 30% marked that their child was better organized. In the open-ended comments, parents noted other changes that they observed in their children:

> *A higher determination to expand his knowledge and see through it until completion of project*
>
> *Better at meeting deadlines*
>
> *Better leadership skills*
>
> *Taking more responsibility. Developing leadership skills*
>
> *More patience, improved problem solving skills*
>
> *Thinking more about future careers*

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

Overall Opinions of ROV Program:

Overall, parents rated their children's experience building and competing with an ROV extremely positively. Seventy-nine percent (79%) rated it as excellent, 19% gave a rating of good, and 2% marked fair. When asked how valuable the competition has been for the educational development of their child, almost two-thirds indicated that it was extremely valuable (65%), one-third stated that it was quite valuable (33%), and one respondent apiece rated it as somewhat valuable and slightly valuable. No respondents marked that it was not at all valuable.

Teachers/mentors gave uniformly positive ratings of the usefulness of the competition, with 80% stating that it was excellent and 20% indicating that it was good. As one teacher stated, "This program provides clear, exciting, and achievable goals that really engaged our team. The combination of hands on and research are great." Teachers/mentors also rated the support provided by the MATE program highly (61% excellent, 30% good, and 9% fair).

Students also rated their experiences building and competing with their ROV very positively, with close to half rating their experience as excellent (46%), and 42% providing a rating of good. Ten percent (10%) thought their experience was fair, and less than 1% gave the experience a poor or very poor rating.

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-two percent (82%) 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. Eight percent (8%) marked that the program participation did not affect how they picture their child's future, and 10% were not sure. Eighty-five percent (85%) of the parents stated that they feel they have at least some influence on their child's career choice.

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

Curriculum materials: Overall, feedback about the curriculum has been extremely positive, with reviewers indicating that the curriculum materials are at the appropriate level for a middle school audience. Comments from reviewers include the following:

> *I thought the curriculum was perfectly suited to the middle school audiences we serve. Most are at a relatively low level academically, but a few excel. The curriculum was thorough enough to reach both ends of the spectrum and to allow opportunities for each student to explore and learn in the directions of their own interest.*
>
> - Science Program Coordinator

Overall I really like this curriculum because it is well thought out and easy to use. I will do all of the lessons with my club. I will also adapt Biomimicry and Hydrodynamics to use with my life science classes. I hope I get to see the final copy!

- Middle School Science Teacher

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. Another professional development opportunity for these teachers is the MATE Center's week-long Summer Institute.

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, all of the teachers (100%) at the workshops 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 the program.

It appears that the workshops were an important component in supporting the teachers. In the post-competition surveys, teachers who attended workshops were significantly more likely to rate the overall support provided by the ROV program as excellent (65%), compared to those who did not attend a workshop (45%).

I am extremely impressed with MATE's support in ROV competition. I plan on expanding ROV construction into a year long after school club as well as further into maritime curriculum.

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

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

As noted above in the implementation section, the MATE Center has decided to take a different approach to enhancing the career information available to middle school and high school students. They have taken the preliminary steps by assessing and rating the available career videos. Next year, they will link these materials to the ROVER website, transition the *Exploring Ocean Careers* course to the ROVER website to be publicly available, and perform advance work towards the goal of creating career-focused videos that highlight the career paths possible through participating in the ROV competition.

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?

While the MATE Center has not yet produced new career guidance tools specifically focused on the middle school audience, career information was disseminated through the Summer Institute and presentations conducted within schools and regional workshops.

Project Strategy 4: Build ROVER, a Cyberlearning Center

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

Increased Access to Career and Instructional Resources

One of the goals of the ROVER website is to be a portal for existing career and instructional resources in this field. Towards this end, the website has been populated with the following links. Many of these links lead to collections of resources, so the actual numbers of resources that can be accessed through the links is much greater than the number of links.

Links to MATE Resources:

- 5 ROV Competition FAQs
- 3 Help Videos

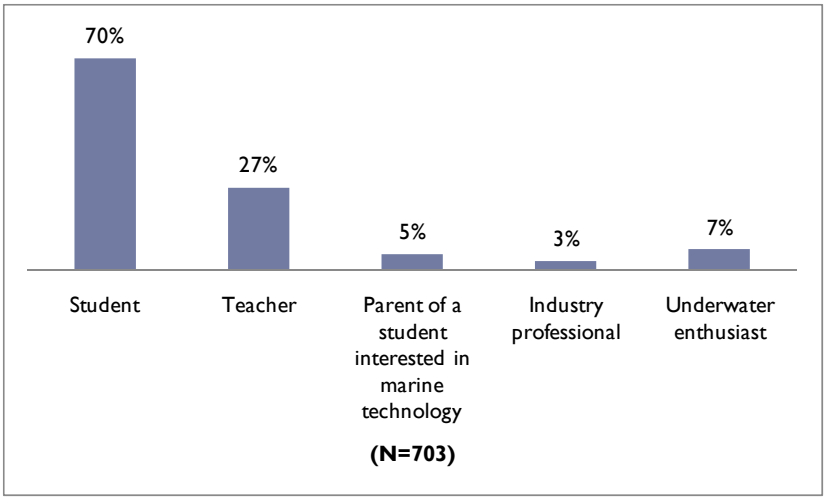
Links to External Resources

- 434 ROV Videos
- 10 ROV Images
- 9 ROV News Sources
- 28 ROV How-to Books, Information and Articles
- 6 ROV Blogs
- 4 ROV Online Communities
- 42 ROV Building Supplies/Suppliers
- 16 Archived ROV Competition Information Links
- 9 ROV Internships, Scholarships, & Opportunities
- 39 ROV General Links
- 22 ROV Competition Press Coverage Links
- 11 ROV Team/School Links
- 63 Glossary Entries

Increased Use of Website and Resources

Unfortunately, the Google Analytics system that should have been monitoring the website usage was not working, and this failure was not discovered until the end of the international competition in June of 2011. However, there are some other sources of data that indicate usage of the website and other MATE online resources, including the following: website user registration survey, Twitter followers, Facebook "likes", Flicker photo views, and YouTube videos.

Figure 5: ROVER Website Users, September 2010 – June 2011

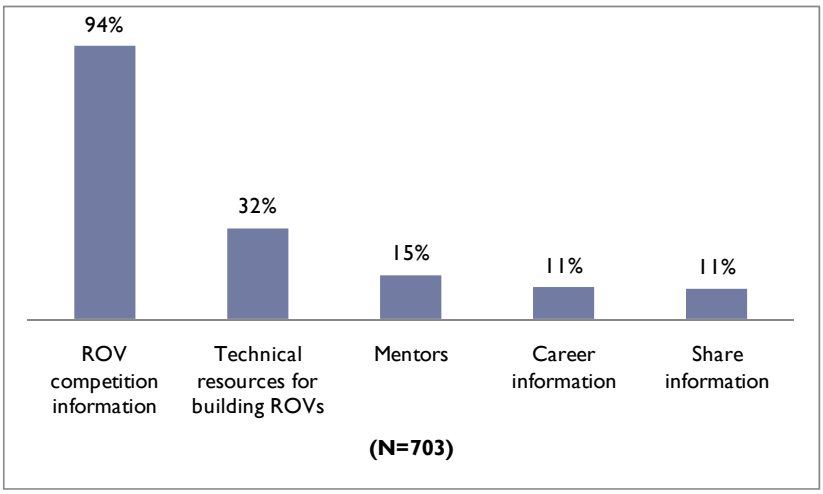


Additionally, the ROV competition registration was handled entirely through the ROVER website, which was an effective way to drive traffic to the site.

When visitors viewed the website for the first time, they were invited to complete a short registration survey that asked about what type of stakeholder they were (student, parent, teacher, industry professional or underwater enthusiast), how they've been involved with the MATE Center, and their reason for registering with the site. The survey was completed by 704 users between the website's launch in September 2010 and the international competition at the end of June 2011.

By far, the main resource that website users were seeking when they first visited the site was ROV competition information (94%), followed by technical resources for building ROVs.

Figure 6: ROVER Website, Reasons for Registering, September 2010 – June 2011



Beyond the website registration survey, other sources of usage data include the following:

- Twitter: 104 followers (http://twitter.com/#!/matecenter())
- Facebook: 134 "likes" (http://www.facebook.com/pages/MATE-Center/226625134802)
    - Maximum active users in a single month: 95
- Flickr: 1,850 pictures of ROVs and participants (http://www.flickr.com/photos/matecenter)
    - Total views: 2,921
- Youtube channel: 123 videos (http://www.youtube.com/MATECenter)
    - Total upload views (since May 2007): 30,133
    - Channel views: 4,052
    - Subscribers: 54
- 2011 ROV Competition Registration: 2,173 registrants total (1,905 students; 259 teachers/mentors; 9 judges)
- 2011 International ROV Competition Live Feed: During the international competition, a live video feed was streamed on the website. The live feed was so popular that the large number of viewers crashed the server twice.

The next evaluation report, with Google Analytics capturing data throughout the year, will provide a much clearer picture of usage of the website and of the career and instructional 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?

The evaluation plan called for user satisfaction pop-up surveys to be included in the website. Since this was the first year of the new website, the web programmer was busy updating features and populating the resources so a decision was made to incorporate the registrant survey but wait on the user satisfaction survey until next year. To this point, MATE staff report that the website rollout went smoothly and only a few user issues were reported. Some school computer networks had firewall issues with the site, and some bugs were reported early on within the registration process. These issues were quickly corrected. In the next grant year, user satisfaction surveys will be implemented so the evaluation will have direct data to report on this evaluation question.

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

The website has several different components that are intended to increase communication between students, educators, industry professionals and parents, including several discussion boards. In addition, there are several other methods for these stakeholders to communicate, such as posting photos to the MATE flickr stream, videos to the YouTube channel or comments on the Facebook page.

The most well-used discussion board on the ROVER website is the ROV competition FAQ page. In the 2010-2011 competition year, there were 191 posts. One quarter of the posts (26%) were from student competitors; 4% were from faculty/mentors; slightly over half (52%) were from MATE staff; and 18% had an undesignated role. The rule of thumb for discussion board usage is that there are 10 "lurkers" (users reading the posts) for every one user who posts a question or comment.[8] Next year, MATE staff intend to place more effort into generating ongoing discussions in all of the discussion boards by regularly posting questions and information.

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

The ROVER website supported teams' ability to build an ROV and participate in the competitions through the online registration system, FAQ discussion board, and links to instructional materials (see above "Increased Access to Career and Instructional Resources").

[8] See "Participation Inequality: Encouraging More Users to Contribute" at http://www.useit.com/alertbox/participation_inequality.html

Broader Impacts

The MATE Center's ITEST activities have been leveraged by regional coordinators and participants in ways that were unanticipated during the writing of the proposal. Thus, they don't fit under any particular evaluation question. Since the evaluation was not set up to monitor these activities, the findings presented here should be considered preliminary. Next year, the evaluation tools will be modified to capture more of this data.

These "broader impacts" fall into three main categories:

4. Leveraging ITEST activities/funding to raise additional funding by regional coordinators, teachers, schools, and student teams
5. Using ROVs and ROV-based activities outside of the competition by teachers and students
6. Involving college students to mentor middle school ROV teams in several competition regions

Leveraging ITEST Activities/Funding

Faculty who led ROV teams and/or attended the Summer Institute reported that they have applied for and won funding from grants and school boards and have received equipment donations from local industry. Examples include the following:

> *I applied for, and was awarded, a NASA Summer of Innovation grant. The amount was for $2000. The purpose is to pay for a workshop for Cub Scouts and Boy Scouts to learn about the Marine Technology Field and to design and build an ROV. We are going to have some professionals from the Marine Technology field come and talk to the boys as well as taking a field trip to Nauticus Museum. The culmination is for the boys to design, build and test 2 (possibly 3) ROV's complete with cameras.*
>
> *I received a Dean Memorial Legacy Grant from the State of California 4-H Program in the amount of $800 to be used for tools and equipment.*
>
> *I have full support of my school and its board to develop ROV programs as I wish. I even have a small budget.*

Additionally, ROV competition regions outside of the United States have leveraged news of the ITEST grant raise additional funds.

Using ROVs outside the Competition

Many faculty have reported using ROVs or ROV-based activities outside of the competition, incorporating these tools and topics into their classes or clubs in order to bring science to life. Examples include the following:

> *The ITEST funded project helped us leverage this film project with the Great Lakes Stewardship Initiative. In the end, the students talk about both preparing for the MATE competition and using ROVs to study zebra mussels/shipwrecks. http://vimeo.com/25825942, password: syrup*
>
> *My marine science class built ROV's and have acquired an underwater video camera which we have attached to a ROV to monitor marine life in our area.*
>
> *My kids had a blast! They are planning on building an ROV this summer to take down the river with them!*
>
> *I am using my ROV group to promote this new science area for our local 4-H program. We are planning demonstrations at 4 different events in the spring and summer.*
>
> *I am once a week exploring a field of marine science with the students and companies and government agencies that rely on this skill and education.*
>
> *It [the Summer Institute] opened my experiences I could share with my students - we followed SCINI when it went to the Arctic and even took data from the Arctic to graph in the classroom. Having the students view my pictures from MBARI and seeing their teacher there and then SCINI on the news - brought home the relevance.*

College Students as Middle School ROV Team Mentors

In several regions, the regional coordinator matched up college students – in many cases, former ROV competitors themselves – with middle school ROV teams to work with them throughout the competition season. College students also acted as helpers at the workshops. In some cases, the college students received a small stipend (though they stated that they would have done the work without it), and in other cases, they received service learning credit, Presidential Volunteer Service Awards, or simply volunteered their time with no recompense. This arrangement worked well for the regional coordinators, college students and middle school students and teachers.

Involving college students as mentors helped the regional coordinator ensure that the middle school teams had the one-on-one support that many of them needed. Since over half of the teachers at the workshops (56%) were concerned about having the technical skills and expertise, the additional technical support was a boon for many of them.

Anecdotal reports suggest that the involvement of college students as mentors can lead to profound experiences for both the college and middle school students. Many sources reported that the middle school students found the college students to be approachable representatives of science. These young adults modeled the paths that the middle school students could take to a STEM career. One service learning college student described his conversations with his team as follows:

> *I was further prepared to . . . talk to them about the importance of what they are doing and how it connects back to what they are currently learning in their classes. To my surprise, the students responded with questions about college and studying marine science. Although they did not know how to start the conversation, they were interested and wanted to know more about that application and connection of ROV building with their future.*

The college students indicated that acting as a mentor was a valuable experience for them because it helped improve their science communication, deepened their own knowledge, and acted as a valuable resume builder. Their descriptions of their experiences were filled with adjectives like "exciting", "ecstatic", "amazed".

Breakdowns by Demographics

Background: Demographics of Students, Teachers and Industry Representatives

According to the demographic data in the surveys (N=267), the students were about one-third female (35%), half (50%) were of minority backgrounds [9], 44% came from high poverty areas[10], and 5% reported that they had disabilities requiring accommodations. [11]

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. Half of the teachers (50%) working with ITEST teams were female, and 20% were of minority backgrounds.[12]

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[9] 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.

[10] High poverty areas were defined as zip codes where the percentage of families with children under age 18 in poverty was higher than the nationwide average of 13.6%. This calculation is based on data from 1999 reported in 2000; poverty data from the 2010 Decennial Census will be released in December 2011 and will be used in next year's evaluation.

[11] 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.

[12] The teacher survey did not ask about disability or socioeconomic status.

This was the first year of the evaluation to incorporate a survey that collected demographic information from the industry representatives who serve as judges at the competitions. In order to minimize the surveying burden on the regional coordinators, this survey was only administered at the international competition. While SCOUT teams do not participate in the international competition, it is believed that the demographic breakdown of the judges at the SCOUT regional competitions is very similar to that of the international competition judges. Among the judges, 32% were female, 19% were of minority ethnic backgrounds, and 7% had disabilities that required accommodations.[13] Next year, demographic information will be collected on the ITEST competition judges as well.

Analysis of Student Demographics

In the last report, preliminary results presented the trends by gender and ethnicity only. This year, the analysis took a different approach. Rather than simply look at trends, the changes in survey administration methods helped us produce a dataset more suitable for more sophisticated analysis. Thus, we looked for statistically significant differences between the under-represented students and the students who more typically participate in these types of STEM events.

This new analysis begged the question: how should success be defined? In consultation with project managers, the evaluators decided that the measure of successfully engaging under-representative students would be that their results were not statistically different from the other students' results. In other words, the under-represented students made the same gains as the other students.

Findings by Student Demographics

Overall, there were few statistically significant differences by gender, ethnicity, disability or socioeconomic status, indicating that the ROV program is effective in producing positive results for under-represented students as well as the students who traditionally participate in STEM learning opportunities.

In many cases, the significant differences were in the measures of knowledge, interest, and awareness *prior* to participation in the program, which is not surprising if the under-represented students had less exposure to the subject matter before joining the program.

This section discusses the measures where there were statistically significant differences between the under-represented students and the other students. The analysis focuses on the following topics:

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

[13] The judges' survey did not ask about socioeconomic status.

In an interesting finding outside of these topics, students with disabilities were significantly more likely to indicate that participating in the program had opened new opportunities for them (students with disabilities: 33%; without disabilities: 13%).

Awareness of STEM Careers

Students were asked to rate their level of awareness of marine science, technology, engineering and math (STEM) careers before building their ROV. They were then asked if they knew more about STEM careers after building their ROV, and if so, how much more.

- **Gender:** Prior to building their ROVs, male students were more likely (11%) than the female students (4%) to know a lot about STEM careers. Both male and female students made strong gains in their career awareness, and that difference disappeared in the post-program ratings. There were no statistically significant differences in their awareness of STEM careers after the program.
- **Ethnicity:** There were no significant differences between the responses of the minority and the white students. Both groups reported increased STEM career awareness.
- **Socioeconomic status:** Students living in high poverty areas had no differences in their pre-program ratings, but they were less likely (73%) than the other students (84%) to state that their awareness of STEM careers increased after the program. Interestingly, among the students who marked that they knew more after the program, there were no significant differences between the low and high poverty students in the *amount* more that they knew.
- **Disability status:** There were no significant differences between the responses of the students with and without disabilities. Survey results showed improved career awareness in both groups.

Interest in STEM Careers

The survey asked students if their ROV project made them more interested in a marine career, less interested, or didn't affect their level of interest. Across the board, students indicated that their ROV project had made them more interested in a marine career. There were no significant differences by gender, ethnicity, socio-economic status, or disability status.

Interest in STEM Topics

The survey explored interest in STEM topics in two different ways. First, the survey asked if the students' ROV project made them want to learn more about marine science, technology and engineering. Next, the students were asked if their ROV project increased their desire to take any of a list of courses. Students could mark as many courses as they wished out of a list including math, computer science, engineering, science, and hands-on classes or club activities.

Regardless of gender, ethnicity, socioeconomic status and disability status, students marked that the ROV project made them want to learn more about marine science, technology, and engineering. There

were no statistically significant differences between the under-represented students and the other students in this topic.

There were statistically significant differences in the courses that the students marked:

- **Gender:** There were no differences between the genders in their increased desire to take math, science, or hands-on classes or clubs. However, male students were more likely than females to state that the project increased their desire to study computer science (male: 37%, female: 25%) or engineering (male: 67%, female: 31%).
- **Ethnicity:** There were no significant differences between the responses of the minority and the white students.
- **Socioeconomic status:** There were no significant differences between the responses of the students living in high and low poverty areas.
- **Disability status:** Students with disabilities were less likely than other students report an increased desire to take engineering courses (students with disabilities: 17%; without disabilities: 56%) or hand-on classes (students with disabilities: 25%; without disabilities: 54%). There were no differences by disability status in the students' increased desire to take math, computer science, or science.

STEM Knowledge

There were no statistically significant differences in the gains in knowledge about deepwater oil spills between the under-represented students and the other students. However, under-represented students were less likely to say that they knew what an ROV was *before* they built one, indicating a lack of exposure to the topic before joining the program:

- **Gender:** Female: 34%; male: 53%
- **Ethnicity:** Minority: 37%; white: 54%
- **Socioeconomic status:** Students in high poverty areas: 37%; low poverty areas: 51%
- **Disability status:** No statistically significant difference

CONCLUSIONS

Overall, the MATE Center successfully implemented the second year of ITEST grant activities, expanding the SCOUT class ROV competition from four to eight regions across the country. Activities supporting the entry-level ROV competition included conducting student and teacher workshops and a week-long Summer Institute, drafting a new ROV-focused STEM curriculum, assessing existing STEM career materials for middle school students, and launching the new ROV Education and Resources website.

Evaluation results continue to show strong positive outcomes for both teachers and students. For the second year, the professional development activities were effective in increasing teachers' understanding of ocean STEM careers, strengthening their commitment to lead middle school teams in the ROV competition, and improving their confidence in facilitating STEM learning experiences.

Input from students, teachers and parents all pointed to the strong gains made by students. Involvement in the ROV competition generated greater awareness and interest in pursuing STEM careers, increased interest in studying STEM topics, improved STEM knowledge and skills, and increased teamwork, critical thinking and problem solving skills.

Parents were passionate supporters of their children's involvement in the program, with comments such as "I think the ROV program is unique hands-on application of science/technology. Equally important is learning to work together, problem-solve, etc. This program is awesome!!!" Educational research has stressed the importance of family support in a students' choice to follow a STEM career path. Evaluation results show that the ROV program impacted the participants' parents as well, making it easier for them to picture their child in a STEM career.

For the first time in the 10 years of the MATE Center's ROV competition, this evaluation was able to dig deeper into the effectiveness of the competition for under-represented students: females, minority ethnicities, students living in high poverty areas and students with disabilities. Overall, the evaluation found that the program was effective in producing positive results for under-represented students as well as the students who traditionally participate in STEM learning opportunities.

In the third and final year of the grant, the program will continue its roll-out to an additional four regions, bringing the total to 12. This will provide the evaluation with a larger sample size and an additional year's trend data. The final evaluation report will be summative, tracing the trends and impacts of the program across the three years of the grant and its plans for sustainability in future years.

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APPENDIX: DETAILED EVALUATION PLAN AND PROTOCOLS

The appendix includes the following items:

- Detailed evaluation plan
- Competition
    - Student post-competition survey protocol
    - Faculty/mentor post-competition survey protocol
    - Parent/guardian post-competition survey protocol
    - Judge/volunteer post-competition survey protocol
- Workshops
    - Faculty/mentor pre-post workshop survey protocol
- Summer Institute
    - Summer Institute feedback and six-month follow-up survey protocols
- Curriculum
    - Curriculum feedback survey protocol