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Federal Agency and Organization Element to Which Report is Submitted:	4900
Federal Grant or Other Identifying Number Assigned by Agency:	1312333
Project Title:	Scaling Up Success: Using MATE's ROV Competitions to Build a Collaborative Learning Community that Fuels the Ocean STEM Workforce Pipeline
PD/PI Name:	Jill M Zande, Principal Investigator Candiya Mann, Co-Principal Investigator Deidre Sullivan, Co-Principal Investigator
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Accomplishments

* What are the major goals of the project?

The information included within this report covers the period from May 16, 2017 through June 30, 2018.

Our ITEST Scale-Up project, *Scaling up Success: Using MATE's ROV Competitions to Build a Collaborative Learning Community that Fuels the Ocean STEM Workforce Pipeline*, expands the best practices that we identified, based on evaluation data and regional reporting, as most effective in reaching, engaging, and supporting student and teacher participation in STEM. The project's overarching goal is to encourage multi-year student participation in an effort to deepen student interest and learning and reinforce pathways leading to the STEM workforce. Our hypothesis is that for each additional year a student participates in engineering design challenges such as the MATE ROV competition, their likelihood of going to college increases, their likelihood of declaring a STEM major increases, and their likelihood of entering the STEM workforce increases. The following four goals (and the activities described beneath each) provide the foundation for our work:

1. Increase middle and high school students' interest in STEM and STEM careers as well as their knowledge of STEM and understanding of how science and engineering work together to solve real-world problems.
 - 1a. Add a SCOUT+ competition class so students can gradually step up their knowledge and skills.
 - 1b. Create a support system for students who move on to the next grade and find there are no robotics activities.
 - 1c. Provide opportunities for students to interact with working professionals as well as student mentors to support their learning and provide examples of STEM careers.
 - 1d. Document and share inspirational stories of successful students and working professionals to help students visualize themselves in pathways to STEM careers.
2. Provide teachers with professional development, instructional resources, and mentors to support and sustain the delivery of STEM learning experiences and career information.
 - 2a. Develop a continuum of curriculum that is tied to the Next Generation Science Standards (NGSS) and includes online complementary resources.
 - 2b. Develop a progression of ROV "kits" that complement the curriculum.
 - 2c. Designate regional teacher "leaders."
 - 2d. Offer week-long professional development workshops focused on the curriculum and kits.
 - 2e. Offer regional professional development and student-focused workshops.
 - 2f. Increase preparedness of near-to-peer student and industry mentors.
3. Increase parental involvement in order to support and encourage students to pursue STEM education and careers.
 - 3a. Create an online parents' resource center and listserv.
 - 3b. Form regional parental advisory committees that provide feedback and advice.
4. Track students longitudinally to document how participation impacts their education and career path.
 - 4a. Improve our current student tracking system.
 - 4b. Use the videos described under Goal 1d to document student education and career pathways.

The evaluation report for this grant year is included within the supplemental documents.

*** What was accomplished under these goals (you must provide information for at least one of the 4 categories below)?**

Major Activities:

1a. Add a NAVIGATOR (SCOUT+) competition class. Fourteen of the 21 U.S.-based (includes Puerto Rico and Guam) regional competition programs received ITEST funding this year: Carolina, Coastal Carolina, Florida, the Great Lakes, the Mid-Atlantic, Monterey, New England, Northern Gulf Coast, Ohio, Oregon, Pennsylvania, Shedd Midwest, Southeast, and Wisconsin. Nine of those regionals offered a NAVIGATOR class; eight definitely plan to offer it again next year. The remaining five regionals reported that they did not (and do not plan to) offer it because currently there is no demand.

1b. Create a support system for students. Students and parents looking to start or continue with the ROV competition were connected with the following resources: 1) the regional coordinator nearest them; 2) the new "Getting Started with MATE Underwater Robotics" section of the MATE web site; 3) MATE's bank of online instructional materials, including building instructions, curriculum modules, how-to videos, and technical reports from previous competitions; 4) the MATE store for access to ROV kits, practice boards, and more; 5) the mission fly-throughs and safety inspection tutorials; and 6) access to MATE's online forums, which include a technical help and competition FAQs board. Again this year we conducted Facebook Live events where we walked viewers through the mission props for each competition class and allowed them to ask questions along the way. We also gave regional winning teams a look at "what to expect in Federal Way." These were popular with teams as well as regional coordinators; a number of them noted this within their ITEST regional reports. While no formal survey was conducted this year to assess user satisfaction and usage of the online resources, comments shared via post-competition surveys indicate that parents found the resources to be helpful. (See the Year 5 Evaluation Report for further details.)

1c. Provide opportunities for students to interact with mentors. All 14 regionals that participated in ITEST reported connecting teams with mentors. The mentors were industry professionals; high school, community college, university, or graduate students; or teams mentoring other teams. Regionals facilitated connections in creative ways; for example, several hosted competition season "kick-off" events that included veteran judges. Another uses a "Virtual Engineer Mentor" unit to match teams with engineers in an online environment. Another engaged returning competition students and teachers to mentor teachers starting new teams. All 14 regionals utilized industry professionals as mentors, judges, or technical support during the competition events.

2b. Develop a progression of ROV kits. We continued to improve the four ROV kits that support a progression of learning: 1) AngelFish (REV 3) (simple electronics); 2) PufferFish (REV 7) (simple-intermediate electronics); 3) TriggerFish (REV 3) (intermediate electronics runs in analog); and 4) Barracuda

(REV 1) (Runs in Digital with microcontrollers (intermediate electronics with computer programming). In 2017, the TriggerFish underwent a major redesign. The new design moves all of the components to one printed circuit board (PCB) for a more compact and streamlined appearance. Everything is now housed in a durable watertight control box with a detachable tether. We also increased the ruggedness of the design to aid in reusability.

The new Barracuda has Bluetooth capabilities and two relay switches and can be controlled via a smart phone (if desired) and the relay switches allow for the addition of more advanced tools such as robotic arms. The TriggerFish REV 3 can easily be upgraded to the Barracuda by replacing the PCB and adding additional components; again, the kit was designed with the progression of learning in mind.

A description of these ROV kits can be found here www.marinetech.org/store/. The new designs will be posted to the site as they become available for purchase.

We provided (at no cost) 166 ROV kits along with lab packs, textbooks, and power supplies and building supplies to the 17 regionals that participated in ITEST activities in Year 5 to support their teacher workshops and student outreach. In addition to the kits provided through ITEST, we sold 913 ROV kits and 283 textbooks this past year (7/1/18 to 6/30/18). Three hundred and forty-five practice circuit boards and 281 Simple Circuits Lab kits were also purchased.

A great deal of time and testing has gone into the development of our kits, not only to enhance the learning experience, but also to maximize production efficiency. We continue to update and improve these kits with new versions, but the foundational technology will continue to remain the same for the foreseeable future.

The four kits support the student learning objectives outlined in the MATE Underwater Robotics student learning outcomes document www.marinetech.org/files/marine/files/Curriculum/PufferFish/MATE%20UWRobotics%20Learning%20Objectives_16.pdf. These learning objectives provide knowledge and skills in engineering design (aligned with the Next Generation of Science Standards) along with electrical, mechanical, physical science, and computer science knowledge and skills. These knowledge and skill areas are foundational to robotics and automation that are vital to every sector of the U.S. economy. The ROV design and building experience, coupled with the comprehensive competition experience, produces well-rounded students that are conversant in project management (including managing failure), teamwork, communication (oral and written), leadership, entrepreneurship, and the application of technology and science to solve real-world problems.

In addition to the ROV kits and textbooks, we offer a variety of other materials, such as camera waterproofing kits, hydraulic kits, lab packs, and replacement parts for all of our ROVs, through the SeaMATE store. In addition to the MATE competition, we also sell competition kits for in-school competitions such as the Spanish Galleon Competition Kit. This kit includes a competition manual, prop building instructions, a teacher's guide, and assessments (i.e. scoring rubrics). Not all teachers and students can or plan to participate in a MATE competition. Further, if a regional competition cannot accommodate multiple teams per school, a school runoff may be required. The Spanish Galleon kit is designed to provide a competition experience to all students, whether or not they are able or intend to attend a MATE event.

One of the major barriers to participation, outlined in the 2015 I-Corps for Learning study conducted by MATE, was lack of access to easy-to-order materials from a single vendor that would accept school purchase orders. We have devoted considerable time and effort to increasing ease of access and to scaling our store operations; we will continue to enhance the online ordering experience with better documentation, videos, and enhanced product photos.

(1d and other Major Activities are Continued under Key Outcomes or Other Achievements)

Specific Objectives:

See **What are the major goals of the project?** above.

Significant Results:

Over the course of Grant Year 5, our project:

- Supported 14 regionals with ITEST funds.
- Offered a NAVIGATOR competition class in 9 regions.
- Continued progress towards creating a multi-year student support system that consists of professional development instructional resources, mentors, parents, and more. In last year's report, we redefined this goal: that the overall number of multi-year participants will increase by at least 10% each year over the duration of the grant.

From Year 1 to Year 2, the number of multi-year students increased from 1,345 to 1,537, an increase of 14%. From Year 2 to Year 3, the number of multi-year students increased from 1,537 to 2,038, an increase of 33%. From Year 3 to Year 4, the number of multi-year students increased from 2,016 to 2,118, an increase of only 5%. We did not reach our goal.

In February 2018, the registration data for Year 4 was cleaned and a new approach was taken to compiling the numbers. Comparing Year 4 to Year 5 using this new approach, the number of multi-year students decreased from 1,472 to 1,433. We did not reach our goal, but rather lost ground (3%).

Additional information, including a rationale for the decrease in numbers, is included within **Changes in approach and reason for change**.

Note: Again this year, we used registration data, rather than post-competition surveys, for these numbers because registration data is more comprehensive (i.e., more students register via the Active system than complete post-competition surveys).

- In our analysis of post-competition surveys, we did find several statistically significant differences between the first year and multi-year competition participants. For example, multi-year participants were statistically significantly more likely to report their participation in the ROV program resulted in higher levels of awareness of and interest in pursuing STEM careers, gains in interest in taking STEM courses, improvements in STEM knowledge and skills, increased 21st Century skills, and the receipt of awards, honors, and new educational and career opportunities.
- Provided students with access to student and industry mentors in all 14 regions that participated in ITEST this year.
- Produced a summary video highlighting the 2017 international ROV competition (see <https://vimeo.com/237992212>). In addition, collected footage during the 2018 international competition that is currently being compiled into a video highlighting that event.
- Offered 4 ROV kits that complement MATE instructional resources as well as other building materials and resources (e.g., soldering practice board).
- Eleven regions utilized teacher leaders as resources for coordinators and other teachers. Several of these regions had more than one teacher leader.
- Offered 1 workshop that provided 32 hours of professional development to 20 participants.
- Offered 46 regional professional development “teachers only” and 283 “teacher-student” workshops that provided an average of 12 hours of instruction to 546 teachers and 2,716 “others,” which includes parents, other family members, etc. Taking into account the teachers’ participation in competition events, the number of hours increases to 20+. At least 107 of those teachers implemented the ROV project as part of an in-school course or curriculum.
- Offered 127 “student only” and 283 “teacher-student” regional workshops, such as topic-specific hands-on instruction, information sessions, and pool practice days, that engaged nearly 16,000 students; 9,515 in an after school setting, 5,077 as part of a community organization or event, and 1,316 during school. More than 2,000 of those students attended regional ROV competitions.
- Provided mentors with access to information and resources to support their role in the classroom and streamline communication. In the post-competition survey, among the teachers who indicated that a mentor came to their site (N=98), 91% percent noted that their mentors were adequately prepared to help them and their students through the ROV design and building process.
- Surveyed 397 parents attending 14 competition events and engaged 22 as members of regional advisory committees. It is estimated that more than 50 parents participated in regional professional development workshops; countless others attended community-wide events where regional partners exhibited. In addition, directed parents to our online resources, including the “Getting Started with MATE Underwater Robotics” section (see www.marinetech.org/getting-started/) and invited them to join our e-mail listserves to support their involvement and improve communication.
- 102 organizations, 297 industry professionals, and 122 others (e.g. community members) supported the grant activities. The activities were also supported by 67 high school, 24 community college, 51 university undergraduate, and 23 graduate students as well as 14 community college and 43 university faculty members. (The total number of organizations supporting the work increased dramatically (76% increase) from Year 4 to Year 5. However, the total number of individuals decreased in all categories from Year 4 to Year 5, likely due to two fewer regionals participating in ITEST this past year.)
- Benefitted from the guidance and oversight of 10 regional advisory committees (that include, industry professionals, teachers, district administrators, and a total of 22 parents, among other members).
- Ten regionals held advisory committee meetings, either in-person or via teleconference call or webinar, or collaborated with members in smaller groups in order to gather feedback to help improve and steer the future direction of their regional programs.
- Continued to use Active to collect both team and student competition registration information. Used this data, along with post-competition surveys, to help us to determine 1) how many students were involved for multiple years and 2) how their long-term participation influenced their interest in pursuing STEM courses and careers.
- Continued to improve the utility of MATE web resources and used social networking tools to increase communication and collaboration. Our media and communications specialist (hired via the MATE grant) continued to maintain a comprehensive social media strategy (FB, Twitter, Flickr, YouTube, etc.). This has resulted in increased “likes” and engagement on Facebook and Twitter (defined as the number of times people engaged with posts through likes, comments, shares, replies, retweets, etc.). For example, on July 28, 2018 the competition Facebook page had 14,752 “likes,” an increase of more than 8,492 “likes” from July 27, 2017; MATE’s Twitter engagement rate in June 2018 hit an all-time high of 27.85%, compared to 18.90% in June 2017.
- Maintained a live videostream during the 2018 international competition (see www.marinetech.org/live-videostream/ for video archives) and used Twitter (#MATE2018) to communicate with the public. We also livestreamed the entire awards ceremony (see our competition FB page for a recording). OpenROV and Blue Robotics supported the livestream with equipment (ROVs, underwater cameras) and personnel. (OpenROV is co-founded by former MATE competitor Eric Stackpole. In addition to Eric, the company employs other former MATE competition students, as does Blue Robotics.)
- Disseminated information about the ROV competition program via 100+ publications and more than 40 conferences, meetings, and workshops, including the National Science Teachers Association and National Marine Educators Association’s annual conferences.
- Used surveys and other instruments to evaluate progress and increase effectiveness and impact.

NOTE: The final 2017 competition student survey results, which include the 2017 international competition, are included within the Year 5 Evaluation Report.

Key outcomes or Other achievements: **(Continued from Major Activities)**

1d. Document and share inspirational stories. The video highlighting the 2017 MATE international competition is filled with student interviews where the students describe the impact that the competition has had on their education and careers choices (see <https://vimeo.com/237992212>).

Again in 2018, we organized a MATE competition alumni panel discussion and Q&A during the MATE international competition. This year's panel was organized and facilitated by a alumnus who currently works for Sea-Bird Scientific. Six alumni participated, answering questions from the audience, which included students, teachers, mentors, and parents. Video of the panel will soon be available here - <https://www.marinetech.org/live-videostream/>.

In addition, footage collected during the 2018 international ROV competition is currently being compiled a summary video highlighting the event. This video, as well as the recording of the alumni panel, will be released later this fall. We plan to organize another alumni panel during the 2019 international competition.

Further, we continued to disseminate a monthly electronic newsletter. Features include "Share Your MATE Journey," which highlights competition alumni student success stories. The newsletter is currently distributed to a contact database of 18,000 individuals; links to current and past issues are also posted to the MATE web site (see www.marinetech.org/mate-newsletters/).

2a, 2d, and 2e. See What opportunities for training and professional development has the project provided?

2c. Designate regional teacher "leaders." Eleven of the 14 regionals participating in ITEST had at least one local teacher leader; several had more than one. These teacher leaders led or assisted with professional development workshops and student outreach; mentored other teachers in starting ROV programs at their schools; connected teachers and students with industry and student mentors; helped teams decipher the MATE competition manuals and fielded questions about participating in the event; presented at conferences and workshops; and/or participated on regional advisory committees. We will continue to encourage regional coordinators to utilize teachers experienced with ROV design and building and the MATE competition as resources for themselves and other teachers in their regions.

2f. Increase preparedness of student and industry mentors. Regional coordinators continued to engage high school, undergraduate, and graduate students as well as community college and university faculty, industry professionals, and community members as mentors and volunteers at workshops and competition events. More than 640 students, faculty, industry professionals, and community members supported grant activities this year.

Through the regional coordinators, mentors also had access to the information and training modules reported in Year 1 as well as the online resources described under "**What was accomplished under these goals?**" **1b.**

The results of the 2018 post-competition teacher survey speak to mentor preparedness. For 23% of the post-competition teacher survey respondents (N=331), a classroom/club mentor came to their site to help their teams. The majority of those teachers (57%) responded that the mentor helped them incorporate robotics into their course or club to 'a great extent;' (91%) indicated that their mentors were adequately prepared to help them and their students through the ROV design and building process.

3a. Create an online parents' resource center. The Parent Resource Center page is located within the competition section of the MATE web site (see www.marinetech.org/parent-resource-center/). The resource center includes a "welcome" note targeted to parents as well as links to information and resources. It also includes links to the "Gallery" page that contains videos from the international and regional competitions. Recently added are links to information such as competition timeline and costs, student learning objectives for ROV building, and "Getting Started with MATE Underwater Robotics," a section aimed at helping newcomers navigate finding information (e.g. what kit to purchase, what competition class to enter, etc.) on the MATE web site.

A document with highlights of previous evaluation data and alumni survey results that demonstrate the positive impact of the program is also located on the resource center; a document with highlights of the 2018 evaluation data will be added in September.

3b. Form regional parental advisory committees. Ten of the regions participating in Year 5 ITEST have advisory committees. Nine of those include at least one parent; seven of those nine include two or more parents. In addition to parents, the advisory committees include staff of the lead organization, industry members, parents, teachers, and/or students. Ten regionals held advisory committee meetings, either in-person or via teleconference call or webinar, or collaborated with members in smaller groups in order to gather feedback to help improve and steer the future direction of their regional programs. We will continue to encourage all regional coordinators to assemble advisory committees and to utilize these committees for guidance and feedback on regional activities.

4a. Improve our current student tracking system. Again this year we used Active, a low-cost, commercially available system, to collect both team and student competition registration information. We used the student registration data to determine that 32% of the student registrants had competed for multiple years.

See the Year 5 Evaluation Report for further details; also see **Changes in approach and reason for change** as well as **Actual or Anticipated problems or delays and actions or plans to resolve them** for information on how we are using this data in our work with the and the National Student Clearinghouse Washington State Education Research Data Center.

4b. Use the videos described under 1d. See 1d above.

* What opportunities for training and professional development has the project provided?

2a. Develop a continuum of curriculum. In 2016 we started to transition our educational resources to Google Slides for quick and easy updating. We also started using the Canvas Learning Management System for learning resource dissemination; this system provides much greater control over who is and how they are using our educational resources.

We currently have five active courses in Canvas; there is one course for each competency/ROV kit level plus the Diving into Underwater Sensors and Arduino course. In addition to better control, this system allows us to respond to participants' questions far more efficiently because it retains a log of the questions and answers within its discussion board. These courses contain presentations, handouts, quizzes and worksheets. The Canvas courses are currently available to individuals who participated in our workshops during the past 18 months; to date, 600 educators are enrolled in one or more of these courses.

2d. Offer week-long professional development workshops. The eighth annual ITEST Summer Institute, Introductory Level ROV Building: The PufferFish ROV, took place July 18 -21, 2017 at the University of Arizona, Tuscon. This institute introduced 20 participants to the PufferFish ROV control system. Participants learned the fundamentals of engineering design, project management, and ROV building and experienced a variety of hands-on science, technology, and engineering activities that can be integrated into a class or afterschool activity to reinforce foundational knowledge and skills. Along with MATE staff, one engineer co-taught the institute to ensure that best engineering design practices were applied to all building activities; the instruction followed the format of the NGSS for engineering design. Instructional materials from this institute can be requested via a password for a Canvas login to the course. One hundred percent of the teachers rated the workshop as one of the best they ever attended.

We offered the online workshop Diving into Underwater Sensors and Arduino for the third year. Twenty-six participants are enrolled in this 30-hour course that covers the hardware and software development environments for sensor interface and programming. After learning the basics of Arduino programming, the participants build and collect digital data from six sensors commonly used in the underwater environment. See www.marinetech.org/files/marine/files/Workshops/Diving%20into%20Sensors%20Course%20Outline.pdf for the course outline.

The goal of sensors course is to provide a foundation for the hardware and software required to migrate to the Barracuda ROV. This course was inspired and designed based upon feedback from workshop participants on new skills and information they would like to learn from both our ITEST and ATE grant-funded work. This course is funded, in part, with program income generated from SeaMATE store sales.

2e. Offer regional workshops. Forty-six "teacher-only" professional development workshops and 283 "teacher-student" workshops were offered to a total of 546 teachers and 2,716 "others," which includes parents, other family members, and community members, for example. The following is a breakdown by grade level:

Grade 3-5: 108; Grade 6-8: 222; Grade 9-12: 166; postsecondary: 6; Informal educators: 44; Other: 2,716

The workshops ranged from ½-day ROV design and building activities (where the focus was on frame design, motor placement, and buoyancy) to multi-day events (where the focus was building control boxes). The number of hours of instruction for each teacher ranged from 2½ to 37; the average was 12. The workshops were offered during school, after school, on weekends, in the evening, and/or during the summer.

One hundred twenty-seven "student only" and 283 "teacher-student" workshops were offered to 16,000 students. Of these students, 9,515 were impacted in an after school setting, while 5,077 and 1,316 were impacted as part of a community organization/event or during school, respectively. The following is a breakdown by grade level:

Grade 3-5: 1,017; Grade 6-8: 9,382; Grade 9-12: 1,348; postsecondary: 84; Other (e.g. home school not defined by grade level or community event where grade levels are not known): 4,179

(NOTE: Some students were reported in more than one category.)

The workshops covered topics from basic ROV design and building to simple electronics and AngelFish and PufferFish ROV kit assembly. Information and competition season "kick-off" sessions, pool practice days, "entrepreneurial showcases," and "demo nights," among others, were also offered. The number of individual student contact hours ranged from 1½ to 40; the average was 11.

All 14 regions that participated in ITEST reported that they used MATE's ROV kits in their workshops; all of these regions reported that the kits were helpful. Seven regions reported that they used the Canvas online course management system; 13 used the instructions for kit assembly. Several regionals made suggestions for improving the kits and the layout and accessibility of the curriculum; we will review and discuss those suggestions during the September 2018 regional coordinators' meeting, and make the necessary improvements. Ten regions reported that they used the practice boards, 8 used the simple circuits kits, and 4 used the new Spanish Galleon mini-competition kit. Six indicated that they used the MATE textbook as a resource for themselves and their teachers.

Positive feedback from regional coordinators about the support they received from MATE included:

[The] videos are well done, succinct, and were readily available resources that shortened the classroom lesson preparation for educators. – Pennsylvania regional coordinator

We use the practice boards and simple circuit kits with our BCC STEM Club students as a fun and interactive activity to draw in new students. – New England regional coordinator

* How have the results been disseminated to communities of interest?

Between the MATE Center, its regional partners, and ROV competition participants, well over 100 abstracts, journal papers, newspaper articles, web sites, television news stories, and other publications featured ITEST grant activities. Examples of these are included within the products section of this report.

In addition, between the MATE Center and its regional partners, information about the ITEST project was presented at more than 40 conferences, meetings, community events, workshops, and other events. These included the following:

- National Marine Educators Conference, June 25-29, 2017, Charleston, SC.

- SAWDC Worlds of Opportunity, September 20-21, 2017, Mobile, AL.

- Connecticut Boy Scout Jamboree, October 7, 2017, CT.
- Skidaway Institute of Oceanography Marine Science Day, October 14, 2017, Savannah, GA.
- North Carolina Science Teachers Association Conference, October 19-20, 2017, Greensboro, NC.
- Virginia Association of Science Teachers Annual Conference, November 16-18, 2017, Roanoke, VA.
- Society of Manufacturing Engineers, February 24, 2018, Cherry Hill, NJ
- Underwater Intervention Conference and Exhibition, organized by the Marine Technology Society's ROV Committee and the Association of Diving Contractors International and held February 6-8, 2018 in New Orleans, LA.
- 2018 MAKER X, April 28, 2018, Columbus, OH.
- Newport News Public Schools STEM Community Day, June 2, 2018, Newport News, VA.

See also **Significant results** for information about our use of social media.

*** What do you plan to do during the next reporting period to accomplish the goals?**

During the next reporting period that will cover July 1, 2018 through our one-year, no-cost extension we will:

- Hold a regional coordinators meeting September 12-13, 2018 to build community and increase regional fidelity, share best practices and lessons learned, and more.
- Continue to add a NAVIGATOR competition class to regionals, based on the regional demand and feedback from stakeholders.
- Continue to provide students with access to student and industry mentors who are prepared to support learning and provide career guidance.
- Document student success stories via video (interviews during the competition) and use these stories for evaluation purposes.
- Continue to disseminate and make the PufferFish Summer Institute curriculum available via the Canvas content management system to educators and regional partners.
- Continue to improve our ROV kits, curriculum, and instructional materials.
- Continue to encourage MATE regionals to identify and utilize regional teacher leaders to function as resources for coordinators and other teachers.
- Report on the final professional development workshop (PufferFish Summer Institute) supported by ITEST that took place in July 2018.
- Report on any regional professional development workshops supported by ITEST that take place during our one-year, no-cost extension.
- Report on any regional workshops, such as topic-specific hands-on instruction, information sessions, and pool practice days, supported by ITEST that take place during our one-year, no-cost extension.
- Continue to engage parents in our activities and on advisory committees.
- Continue to encourage regionals to create and meet with regional advisory committees to provide guidance and oversight.
- Continue to use the student competition registration system in conjunction with the post-competition surveys to determine 1) how many students are involved for multiple years and 2) how their long-term participation influences their interest in pursuing STEM courses and careers.
- Administer a survey of MATE competition alumni to measure the impact of the competition on their education and careers. This will be our second survey of alumni; the first survey was launched in June 2015.
- Continue to use social networking tools to increase communication and collaboration.
- Use surveys and other instruments to evaluate progress.

Please also see the **Major Activities, Key Outcomes or Other achievements**, and the **What opportunities for training and professional development has the project provided?** sections.

Supporting Files

Filename	Description	Uploaded By	Uploaded On
ITEST 2017-2018 Evaluation Report 2018-08-09 Final.pdf	ITEST Year 5 (2017-2018) Evaluation Report	Jill Zande	08/09/2018

Products

Books

NOAA Community (2017). *NOAA Education Accomplishments Report ADVANCING NOAA'S MISSION THROUGH EDUCATION* Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; OTHER:

Book Chapters

Inventions

Journals or Juried Conference Papers

Connor Tingley, George Serwin, Rohan Tull, Jenya Kirsch Posner, Celvi Lisy, Lily Bresee, Keaton Viadro, and Chip Morimoto (2018). Turning an International Competition into a Valuable Learning Experience. *Journal*. . Status = PUBLISHED; Acknowledgment of Federal Support = Yes

Daniel Lam, Ethan Stillman, Anthony Carielle, Andrew McCorkie, and Ahmed Fouad (2017). A High School Road to Success in an International Engineering Competition. *Journal*. . Status = PUBLISHED; Acknowledgment of Federal Support = Yes

Deidre Sullivan, Nandita Sarkar, Tami Lunsford (2018). Preparing the Next Generation of Marine Technicians: MATE's At-Sea Internship Program. *Journal*. 52 (1), . Status = PUBLISHED; Acknowledgment of Federal Support = Yes

Licenses

Other Conference Presentations / Papers

Rachel McDonald (2018). *Growing a Marine Technology Program for Middle and High School Students*. Underwater Intervention. . Status = PUBLISHED; Acknowledgment of Federal Support = Yes

Tina Miller-Way and Rachel McDonald (2017). *ROVing the Gulf of Mexico: Bringing Engineering Design and the Ocean to Your Classroom*. Alabama Association of Gifted Children. . Status = PUBLISHED; Acknowledgment of Federal Support = Yes

Other Products

Audio or Video Products.

The 2017 competition video summarizes the 2017 international competition event, which took place June 23-25, 2017. The video is housed on both the MATE Center's YouTube and Vimeo accounts and can be accessed here <https://vimeo.com/237992212>

Educational aids or Curricula.

Building instructions, instructional resources, and other activities that complement the ROV kits we developed - see <http://www.marinetech.org/curriculum/>.

Educational aids or Curricula.

ROV kits, practice boards, and more building resources - see <http://www.marinetech.org/store/> for a description of the kits, boards, and other resources.

Educational aids or Curricula.

We used the Canvas online course management system to host all of the presentations, assignments, and quizzes delivered as part of our 2017 PufferFish Summer Institute. We can send an invitation to view the course upon request (e-mail to dsullivan@mpc.edu).

Data and Research Materials (e.g. Cell lines, DNA probes, Animal models).

NOTE: The Year 5 evaluation report is included within the Supplemental Documents.

During negotiation, additional information was requested regarding the data management plan to ensure how products of the research (reports, instruments, and data) would be made accessible to other researchers.

Action 2D: Please what was accomplished during Year 5 pertaining to the work you proposed in your responses, including:

sharing of evaluation reports, evaluation instruments, de-identified data sets, and website analytics at the project website and ITEST's STEM Learning Resource Center.
If the goals/objectives were not fully accomplished during Year 4, please include what changes will be made to your plan and timeline to achieve these goals/objectives.

Our Year 4 annual and evaluation reports have been submitted to STELAR; our 2016-2017 post-competition survey instruments have been posted to our project's page on ITEST STELAR web site.

The web page <http://www.marinetech.org/itest> currently contains project and evaluation reports from our ITEST Strategies work and Years 1-4 of our ITEST Scale-Up (Year 5 will be posted upon completion and NSF approval).

The 2014-2017 survey instruments, 2014-2017 survey results (2018 survey results will be posted upon completion of final analysis), and information on how to obtain datasets and web site analytics data are also included there. Visitors to the MATE web site can find instructions on how to access this information on the "about MATE" page (see <http://www.marinetech.org/about/>); once they have created a login, they can access the information.

Online Newspaper Article.

July 4, 2018

The Alpena News – Alpena, MI

Building their own ROV

<http://www.thealpenanews.com/news/local-news/2018/07/building-their-own-rov/>

Online Newspaper Article.

June 5, 2018

The Alpena News – Alpena, MI

Getting some hands-on experience

<http://www.thealpenanews.com/news/local-news/2018/06/getting-some-hands-on-experience/>

Online Newspaper Article.

May 10, 2018

True North Radio Network – Alpena, MI

AHS ROV team advances to international competition in Washington

<http://www.truenorthradionetwork.com/index.php/2018/05/14/ahs-rov-team-advances-to-international-competition-in-washington/>

Online Newspaper Article.

May 12, 2018

The Alpena News – Alpena, MI

Getting ready

<http://www.thealpenanews.com/news/local-news/2018/05/getting-ready-8/>

Online Newspaper Article.

May 25, 2018

The Alpena News – Alpena, MI

Underwater exploration

<http://www.thealpenanews.com/news/local-news/2018/05/underwater-exploration/>

Online Newspaper Article.

May 8, 2018

The Alpena News – Alpena, MI

Sanctuary to host ROV competition

<http://www.thealpenanews.com/news/local-news/2018/05/sanctuary-to-host-rov-competition/>

Online Newspaper Article.

Glynn Middle underwater robotics team heads to region competition.

https://thebrunswicknews.com/news/local_news/glynn-middle-underwater-robotics-team-heads-to-region-competition/article_30035b87-6841-5c73-9262-1288392597c7.html

Online Newspaper Article.

June 1, 2018

The Petoskey News-Review – Petoskey, MI

Local schools earn awards at regional ROV competition

https://www.petoskeynews.com/news/local/local-schools-earn-awards-at-regional-rov-competition/article_6cfb9f03-b39c-559e-b774-f1c85d11ae41.html

Online Newspaper Article.

May 10, 2018

WBKB TV, Ch. 11 – Alpena, MI

MATE ROV Competition Comes Home to Great Lakes Maritime Heritage Center

<http://www.wbkb11.com/rov-competition-comes-home-to-great-lakes-maritime-heritage-center>

Online Newspaper Article.

Mt. Olive News. July 2018.

Mt. Olive Students Compete in International Underwater Robotics Competition

By Bethany Zorn

Online Newspaper Article.

The Wahkiakum County Eagle. 2018

Robotics Club demonstrates Robots to Seniors

By Jessica Vik

<http://www.waheagle.com/story/2018/02/15/wahkiakum-people/robotics-club-demonstrates-robots-to-seniors/14154.html>

Other.

ITW, twice annually. July 2017- June 2018.

Other.

International Coastal clean-up day. July 2017-June 2018

Other.

Loachapoaka STEM career event. Loachapoaka, AL. December 3, 2017. ROVs displayed on table and tubs for driving. 3 sessions, 45 minutes each. 7-12th grade.

Other.

SAWDC Worlds of Opportunity, Mobile, AL. Career fair for the entire 8th grade from all of the southern Alabama counties. September 20-21, 2017. Table display and 2 ROV driving tubs. 80 schools participated. 9am – 1:30 pm each day.

Other.

Shedd's Annual Gala. July 2017- June 2018.

Other.

Shedd's High School Marine Biology program. July 1017- June 2018.

Other.

Shedd's Summer Road Trip, twice annually. July 2017- June 2018.

Other.

South's BEST Robotics, Auburn, AL, December 2, 2017. Exhibit only: Table display, ROV driving tub and program pamphlets.

Other.

South's BEST Robotics, Auburn, AL, December 2, 2017. Exhibit only: Table display, ROV driving tub and program pamphlets.

Other.

University of North Alabama Scout ROV Competition. Talked to the teams about MATE, Northern Gulf Coast Regional Competition and Teacher Workshops (ours and MATE's). April 21, 2018.

TV News.

<http://6abc.com/community/calendar/#?i=23>

TV News.

Students compete in underwater robotics competition

<https://www.wsav.com/news/local-news/students-compete-in-underwater-robotics-competition/1135705979> Students compete in underwater robotics competition.

TV News.

Gray's Reef hosts local R.O.V. competition.

<http://www.wbrc.com/story/38011344/greys-reef-hosts-local-rov-competition>

TV News.

Gray's Reef hosts local R.O.V. competition.

<http://www.wtoc.com/story/38011344/grays-reef-hosts-local-rov-competition>

TV News.

Middle school robotics club could spark career passion.

https://thebrunswicknews.com/opinion/daily_editorial/middle-school-robotics-club-could-spark-career-passion/article_78d6ffe-1962-5421-915a-8147b37ed07a.html

TV News.

Savannah Rotary clubs assist in annual Gray's Reef regional competition.

<http://www.savannahnow.com/entertainmentlife/20180426/savannah-rotary-clubs-assist-in-annual-grays-reef-regional-competition>

Other Publications

Deborah Marshall and Roger Lagesse, Department of Career & Technical Education, Granby High School (2018). *Five Years Later...Granby High School's Girls in Engineering Program*. ITEEA (International Technology and Engineering Educators Association). Status = PUBLISHED; Acknowledgement of Federal Support = Yes

Patents

Technologies or Techniques

Thesis/Dissertations

Ian Black. *Establishing Interest In And Understanding Of The Marine Environment: An Educational And Cooperative Approach Utilizing An Open Source CTD*. (2018). Oregon State University. Acknowledgement of Federal Support = Yes

Websites

<https://www.mtoliveboe.org/announcements/?MATE-Club-to-Compete-in-Seattle-575>

2018 Oregon Regional MATE ROV Competition in Lincoln City

<https://lincolncityhomepage.com/rov-competition-at-lincoln-city-community-center/>

Breaking Waves Oregon Sea Grant: Coastal science serving Oregon

<http://blogs.oregonstate.edu/breakingwaves/2018/05/02/beaverton-students-qualify-international-underwater-robotics-contest-washington/>

CMAST Youth Programs

<https://www.facebook.com/CMASTYouth/>

Oostburg High School Robotics Team

<http://oostburgrov.weebly.com/>

Oregon Regional MATE ROV Program

<https://www.facebook.com/OregonRegionalMATEROV/>

More images.

<https://photos.google.com/share/AF1QipN63nIbT0I8EOe5dkO1xG-bBqwLEZoHlwjRvTmR-jsFtnXIKfYmOBjVPeNdnoyhKA?key=X1otZWJFU3NVYW1wbUxyWHRFVUNEOU9wSTZZMG1B>

Oregon Underwater Robotics Competition

<http://stemoregon.org/oregon-underwater-robotics-competition-april-28/>

Pre-competition coverage.

Oregon underwater robotics competition connects students with marine technology in the Pacific Northwest

<http://blogs.oregonstate.edu/oregoncoaststem/2018/04/25/rov2018/>

Oregon Coast STEM Hub

World-Class Science, Technology, Engineering and Math Education on the Oregon Coast.

Robotic teams wind down after contests

<http://www.thedalleschronicle.com/news/2018/may/08/robotic-teams-wind-down-after-contests/>

The Dalles Chronicle.

School of Freshwater Sciences

<http://uwm.edu/freshwater/community-outreach/rov-competition/>

Southern Tides December 2017

https://issuu.com/southerntidemagazine.com/docs/southern_tides_december_2017

The Science House

<https://www.facebook.com/TheScienceHouse/>

UWM Foundation

<https://uwm.foundation/>

Underwater Robots

<https://www.servomagazine.com/magazine/article/underwater-robots>

Magazine

Wausau Area Teams

<http://www.snapshotscience.org/underwater-robotics-club>

Participants/Organizations

What individuals have worked on the project?

Name	Most Senior Project Role	Nearest Person Month Worked
Zande, Jill	PD/PI	5
Mann, Candiya	Co PD/PI	1
Sullivan, Deidre	Co PD/PI	5

Name	Most Senior Project Role	Nearest Person Month Worked
Consi, Tom	Faculty	1
Miller-Way, Tina	Faculty	1
Abella-Bowen, Meghan	Community College Faculty	1
Fraser, Scott	Community College Faculty	2
Courtney, Dennis	Other Professional	1
Garcia, Francisco	Other Professional	1
Goodwin, Cait	Other Professional	1
Goshorn, Andy	Other Professional	1
Khan, Chris	Other Professional	2
Kill, Debbi	Other Professional	1
Klein, Marty	Other Professional	1
Manley, Justin	Other Professional	1
Michel, Drew	Other Professional	1
Naholowaa, Leah Beth	Other Professional	1
Richards, Chuck	Other Professional	1
Rosato, Maria	Other Professional	1
Sinclair, Timandra	Other Professional	1
Spence, Lisa	Other Professional	1
Sutton, Liz	Other Professional	1
White, Jane	Other Professional	1
Wilkening, Betsy	Other Professional	1
Chun, Mark	Technician	1
Gardner, Matt	Technician	3
Jakubiak, Chris	Technician	1
Lockhart, Charles	Technician	1

Name	Most Senior Project Role	Nearest Person Month Worked
Rupan, Rick	Technician	1
Stahr, Fritz	Technician	1
Thompson, Wes	Technician	1
Watanabe, Darryl	Technician	1
Baryal, Emran	Technical School Student	1
Baryal, Nouman	Technical School Student	1
Bray, Jessica	Technical School Student	1
Camberos Diaz, Maria	Technical School Student	1
Charan, Savneet	Technical School Student	1
Hagood, Andrew	Technical School Student	1
Hartley, Caitlin	Technical School Student	1
Mora, Matthew	Technical School Student	1
Narain, Rakhi	Technical School Student	1
Satrio, Amanda	Technical School Student	1
Simpson, Dylan	Technical School Student	1
Anderson, Judy	Consultant	1
Dohm, Lynn	Consultant	1
Loomis, Kathryn	Consultant	1
Baird, Kaitlin	Other	1
Bruening, Andy	Other	1
Coffman, Ike	Other	1
Crews, Tracy	Other	1
Curley, Pat	Other	1
Dubose, Katherine	Other	1
Gamble, Rachel	Other	1

Name	Most Senior Project Role	Nearest Person Month Worked
Hill, Susie	Other	1
Medina, Aymette	Other	1
Mires, Calvin	Other	1
Morris, Velda	Other	1
Moulton, Erica	Other	1
Norwick, Sadie	Other	1
Patterson, Jody	Other	1
Sheppard, Edward	Other	1
Swan, Kim	Other	1
Waters, Sarah	Other	1

Full details of individuals who have worked on the project:
Jill M Zande

Email: jzande@marinetech.org

Most Senior Project Role: PD/PI

Nearest Person Month Worked: 5

Contribution to the Project: PD/PI

Funding Support: NSF

International Collaboration: No

International Travel: No

Candiya Mann

Email: candiya@wsu.edu

Most Senior Project Role: Co PD/PI

Nearest Person Month Worked: 1

Contribution to the Project: Co-PD/PI

Funding Support: NSF

International Collaboration: No

International Travel: No

Deidre Sullivan

Email: dsullivan@mpc.edu

Most Senior Project Role: Co PD/PI

Nearest Person Month Worked: 5

Contribution to the Project: Co PD/PI

Funding Support: NSF

International Collaboration: No

International Travel: No

Tom Consi

Email: consi@uwm.edu

Most Senior Project Role: Faculty

Nearest Person Month Worked: 1

Contribution to the Project: Tom is one of the coordinators of the MATE Wisconsin regional ROV contest.

Funding Support: University of Wisconsin-Milwaukee.

International Collaboration: No

International Travel: No

Tina Miller-Way

Email: tmiller-way@disl.org

Most Senior Project Role: Faculty

Nearest Person Month Worked: 1

Contribution to the Project: Tina is one of the coordinators of the MATE Northern Gulf Coast regional ROV contest.

Funding Support: Dauphin Island Sea Lab.

International Collaboration: No

International Travel: No

Meghan Abella-Bowen

Email: meghan.abella.bowen@bristolcc.edu

Most Senior Project Role: Community College Faculty

Nearest Person Month Worked: 1

Contribution to the Project: Meghan is one of the coordinators of the MATE New England regional ROV contest.

Funding Support: Bristol Community College.

International Collaboration: No

International Travel: No

Scott Fraser

Email: sfraser@lbcc.edu

Most Senior Project Role: Community College Faculty

Nearest Person Month Worked: 2

Contribution to the Project: Scott is a regional coordinator as well as a technical and safety advisor for the MATE Center.

Funding Support: NSF and Long Beach City College.

International Collaboration: No

International Travel: No

Dennis Courtney

Email: dcourtney@streamworkseducation.org

Most Senior Project Role: Other Professional
Nearest Person Month Worked: 1

Contribution to the Project: Dennis is the coordinator of the MATE Great Smoky Mountain regional ROV competition.

Funding Support: Eastman Foundation

International Collaboration: No
International Travel: No

Francisco Garcia

Email: fgarcia@usacs.com

Most Senior Project Role: Other Professional
Nearest Person Month Worked: 1

Contribution to the Project: Francisco is the coordinator of the MATE Oahu regional ROV contest.

Funding Support: N/A

International Collaboration: No
International Travel: No

Cait Goodwin

Email: Cait.Goodwin@oregonstate.edu

Most Senior Project Role: Other Professional
Nearest Person Month Worked: 1

Contribution to the Project: Cait is one of the coordinators of the MATE Oregon regional ROV contest.

Funding Support: Oregon Sea Grant.

International Collaboration: No
International Travel: No

Andy Goshorn

Email: andy@marinetech.org

Most Senior Project Role: Other Professional
Nearest Person Month Worked: 1

Contribution to the Project: Andy is one of the coordinators of the MATE Oahu regional ROV contest.

Funding Support: US Coast Guard

International Collaboration: No
International Travel: No

Chris Khan

Email: ckhan@mpc.edu

Most Senior Project Role: Other Professional
Nearest Person Month Worked: 2

Contribution to the Project: Chris is the MATE Center's budget and office manager. He also oversees the SeaMATE store inventory and production of kits.

Funding Support: NSF.

International Collaboration: No
International Travel: No

Debbi Kill**Email:** dkill@shaw.ca**Most Senior Project Role:** Other Professional**Nearest Person Month Worked:** 1**Contribution to the Project:** Debbi is the lead score keeper at the MATE international and develops master score sheets for regional use.**Funding Support:** N/A**International Collaboration:** Yes, Canada**International Travel:** No

Marty Klein**Email:** mklein@mit.edu**Most Senior Project Role:** Other Professional**Nearest Person Month Worked:** 1**Contribution to the Project:** Marty provides financial and in-kind support to the MATE ROV competition.**Funding Support:** N/A.**International Collaboration:** No**International Travel:** No

Justin Manley**Email:** jmanley@mit.edu**Most Senior Project Role:** Other Professional**Nearest Person Month Worked:** 1**Contribution to the Project:** Justin supports the MATE international ROV competition as the chief judge.**Funding Support:** N/A.**International Collaboration:** No**International Travel:** No

Drew Michel**Email:** rovdrew@earthlink.net**Most Senior Project Role:** Other Professional**Nearest Person Month Worked:** 1**Contribution to the Project:** Drew is the president of the Marine Technology Society and provides in-kind support to the MATE ROV competition.**Funding Support:** N/A.**International Collaboration:** No**International Travel:** No

Leah Beth Naholowaa**Email:** lonaholowaa@gdoe.net**Most Senior Project Role:** Other Professional**Nearest Person Month Worked:** 1**Contribution to the Project:** Leah Beth is the coordinator of the MATE Guam regional ROV competition.

Funding Support: Guam Department of Education

International Collaboration: Yes, Guam

International Travel: No

Chuck Richards

Email: chuck@carichards.com

Most Senior Project Role: Other Professional

Nearest Person Month Worked: 1

Contribution to the Project: Chuck is the chair of the Marine Technology Society's ROV Committee and provides in-kind support to the MATE ROV competition.

Funding Support: N/A

International Collaboration: No

International Travel: No

Maria Rosato

Email: mrosato@e3-robotics.org

Most Senior Project Role: Other Professional

Nearest Person Month Worked: 1

Contribution to the Project: Maria is the lead coordinator of the MATE Carolina regional ROV contest.

Funding Support: E3 Robotics

International Collaboration: No

International Travel: No

Timandra Sinclair

Email: tsinclair@marinetech2.org

Most Senior Project Role: Other Professional

Nearest Person Month Worked: 1

Contribution to the Project: Timmie assists with competition team and participant registration.

Funding Support: N/A

International Collaboration: No

International Travel: No

Lisa Spence

Email: TXMATEROV@gmail.com

Most Senior Project Role: Other Professional

Nearest Person Month Worked: 1

Contribution to the Project: Lisa is one of the coordinators of the MATE Texas regional ROV contest.

Funding Support: NASA.

International Collaboration: No

International Travel: No

Liz Sutton

Email: emsutton@uwm.edu

Most Senior Project Role: Other Professional

Nearest Person Month Worked: 1

Contribution to the Project: Liz is one of the coordinators of the MATE Wisconsin regional ROV contest.

Funding Support: University of Wisconsin-Milwaukee

International Collaboration: No

International Travel: No

Jane White

Email: twin2121@hotmail.com

Most Senior Project Role: Other Professional

Nearest Person Month Worked: 1

Contribution to the Project: Jane is one of the coordinators of the MATE Pennsylvania regional ROV contest.

Funding Support: USGS

International Collaboration: No

International Travel: No

Betsy Wilkening

Email: ewilkening1@email.arizona.edu

Most Senior Project Role: Other Professional

Nearest Person Month Worked: 1

Contribution to the Project: Betsy is the coordinator of the MATE Arizona regional ROV (pilot) competition.

Funding Support: University of Arizona

International Collaboration: No

International Travel: No

Mark Chun

Email: mchun@ifa.hawaii.edu

Most Senior Project Role: Technician

Nearest Person Month Worked: 1

Contribution to the Project: Mark is one of the coordinators of the MATE Big Island regional ROV contest.

Funding Support: University of Hawaii Institute for Astronomy.

International Collaboration: No

International Travel: No

Matt Gardner

Email: mgardner@marinetech.org

Most Senior Project Role: Technician

Nearest Person Month Worked: 3

Contribution to the Project: Matt is the competition's technical manager and an instructor for teacher and student workshops.

Funding Support: NSF.

International Collaboration: No

International Travel: No

Chris Jakubiak**Email:** chrisjakubiak@hotmail.com**Most Senior Project Role:** Technician**Nearest Person Month Worked:** 1**Contribution to the Project:** Chris is one of the coordinators of the MATE New England regional ROV contest.**Funding Support:** University of Massachusetts-Dartmouth.**International Collaboration:** No**International Travel:** No

Charles Lockhart**Email:** scout3801@gmail.com**Most Senior Project Role:** Technician**Nearest Person Month Worked:** 1**Contribution to the Project:** Charles is one of the coordinators of the MATE Big Island regional ROV contest.**Funding Support:** University of Hawaii Institute for Astronomy.**International Collaboration:** No**International Travel:** No

Rick Rupan**Email:** rupan@uw.edu**Most Senior Project Role:** Technician**Nearest Person Month Worked:** 1**Contribution to the Project:** Rick is one of the coordinators of the MATE Pacific Northwest regional ROV contest.**Funding Support:** University of Washington.**International Collaboration:** No**International Travel:** No

Fritz Stahr**Email:** stahr@uw.edu**Most Senior Project Role:** Technician**Nearest Person Month Worked:** 1**Contribution to the Project:** Fritz is one of the coordinators of the MATE Pacific Northwest regional ROV contest.**Funding Support:** University of Washington.**International Collaboration:** No**International Travel:** No

Wes Thompson**Email:** thompson.wes@gmail.com**Most Senior Project Role:** Technician**Nearest Person Month Worked:** 1**Contribution to the Project:** Wes is one of the coordinators of the MATE Pacific Northwest regional ROV contest.

Funding Support: Boeing Corp.

International Collaboration: No

International Travel: No

Darryl Watanabe

Email: watanabe@ifa.hawaii.edu

Most Senior Project Role: Technician

Nearest Person Month Worked: 1

Contribution to the Project: Darryl is one of the coordinators of the MATE Big Island regional ROV contest.

Funding Support: University of Hawaii Institute for Astronomy.

International Collaboration: No

International Travel: No

Emran Baryal

Email: baryalemran@gmail.com

Most Senior Project Role: Technical School Student

Nearest Person Month Worked: 1

Contribution to the Project: Emran provides support for ROV kitting.

Funding Support: NSF

International Collaboration: No

International Travel: No

Nouman Baryal

Email: mbaryal0133@mpc.edu

Most Senior Project Role: Technical School Student

Nearest Person Month Worked: 1

Contribution to the Project: Nouman provides support for ROV kitting.

Funding Support: NSF

International Collaboration: No

International Travel: No

Jessica Bray

Email: jessicarbray@gmail.com

Most Senior Project Role: Technical School Student

Nearest Person Month Worked: 1

Contribution to the Project: Jessica provided support for ROV kitting.

Funding Support: NSF

International Collaboration: No

International Travel: No

Maria Camberos Diaz

Email: mcamberos8591@mpc.edu

Most Senior Project Role: Technical School Student

Nearest Person Month Worked: 1

Contribution to the Project: Maria provides support for ROV kitting.

Funding Support: NSF

International Collaboration: No

International Travel: No

Savneet Charan

Email: scharan2776@mpc.edu

Most Senior Project Role: Technical School Student

Nearest Person Month Worked: 1

Contribution to the Project: Savneet provides support for ROV kitting.

Funding Support: NSF

International Collaboration: No

International Travel: No

Andrew Hagood

Email: ahagood4025@mpc.edu

Most Senior Project Role: Technical School Student

Nearest Person Month Worked: 1

Contribution to the Project: Andrew provides support for ROV kitting.

Funding Support: NSF

International Collaboration: No

International Travel: No

Caitlin Hartley

Email: chartley1223@gmail.com

Most Senior Project Role: Technical School Student

Nearest Person Month Worked: 1

Contribution to the Project: Caitlin provided support for ROV kitting and general accounting.

Funding Support: NSF

International Collaboration: No

International Travel: No

Matthew Mora

Email: matt.mora95@gmail.com

Most Senior Project Role: Technical School Student

Nearest Person Month Worked: 1

Contribution to the Project: Matthew provides support for ROV kitting.

Funding Support: NSF

International Collaboration: No

International Travel: No

Rakhi Narain**Email:** rnarain2304@mpc.edu**Most Senior Project Role:** Technical School Student**Nearest Person Month Worked:** 1**Contribution to the Project:** Rakhi provides support for ROV kitting.**Funding Support:** NSF**International Collaboration:** No**International Travel:** No

Amanda Satrio**Email:** dsatrio7756@mpc.edu**Most Senior Project Role:** Technical School Student**Nearest Person Month Worked:** 1**Contribution to the Project:** Amanda provides support for ROV kitting.**Funding Support:** NSF**International Collaboration:** No**International Travel:** No

Dylan Simpson**Email:** dsimpson3066@mpc.edu**Most Senior Project Role:** Technical School Student**Nearest Person Month Worked:** 1**Contribution to the Project:** Dylan provides support for ROV kitting.**Funding Support:** NSF**International Collaboration:** No**International Travel:** No

Judy Anderson**Email:** judy@andagraphicstudio.com**Most Senior Project Role:** Consultant**Nearest Person Month Worked:** 1**Contribution to the Project:** Judy is a graphic artist and works on MATE brochures, etc.**Funding Support:** NSF.**International Collaboration:** No**International Travel:** No

Lynn Dohm**Email:** lynnd@nellygrp.com**Most Senior Project Role:** Consultant**Nearest Person Month Worked:** 1**Contribution to the Project:** Lynn handles MATE competition PR and social media as well as the MATE electronic newsletter.

Funding Support: NSF.

International Collaboration: No

International Travel: No

Kathryn Loomis

Email: kaloomis@marinetech.org

Most Senior Project Role: Consultant

Nearest Person Month Worked: 1

Contribution to the Project: Kathryn coordinates venue logistics for the MATE Monterey Bay regional and international ROV competitions.

Funding Support: NSF.

International Collaboration: No

International Travel: No

Kaitlin Baird

Email: Kaitlin.Baird@bios.edu

Most Senior Project Role: Other

Nearest Person Month Worked: 1

Contribution to the Project: Kaitlin is the coordinator of the MATE Bermuda regional ROV contest.

Funding Support: Bermuda Institute of Ocean Sciences (BIOS)

International Collaboration: Yes, Bermuda

International Travel: No

Andy Bruening

Email: abruening@pastfoundation.org

Most Senior Project Role: Other

Nearest Person Month Worked: 1

Contribution to the Project: Andy is one of the coordinators of the MATE Buckeye (Ohio) regional ROV contest.

Funding Support: PAST Foundation

International Collaboration: No

International Travel: No

Ike Coffman

Email: icoffman@technologydude.com

Most Senior Project Role: Other

Nearest Person Month Worked: 1

Contribution to the Project: Ike is one of the coordinators of the MATE Texas regional ROV contest.

Funding Support: N/A

International Collaboration: No

International Travel: No

Tracy Crews

Email: tracy.crews@oregonstate.edu

Most Senior Project Role: Other
Nearest Person Month Worked: 1

Contribution to the Project: Tracy is the coordinator of the MATE Oregon regional ROV contest.

Funding Support: Oregon Sea Grant.

International Collaboration: No
International Travel: No

Pat Curley

Email: pwcurlley@ncsu.edu

Most Senior Project Role: Other
Nearest Person Month Worked: 1

Contribution to the Project: Pat is the coordinator of the MATE Coastal Carolina regional ROV contest.

Funding Support: North Carolina State University.

International Collaboration: No
International Travel: No

Katherine Dubose

Email: katherine@tutushouse.org

Most Senior Project Role: Other
Nearest Person Month Worked: 1

Contribution to the Project: Katherine is one of the coordinators of the MATE Big Island regional ROV contest.

Funding Support: Earl's Garage

International Collaboration: No
International Travel: No

Rachel Gamble

Email: rachel.b.gamble@gmail.com

Most Senior Project Role: Other
Nearest Person Month Worked: 1

Contribution to the Project: Rachel is one of the coordinators of the MATE Northern Gulf Coast regional ROV contest.

Funding Support: Dauphin Island Sea Lab.

International Collaboration: No
International Travel: No

Susie Hill

Email: rebecca.hill@norfolk.gov

Most Senior Project Role: Other
Nearest Person Month Worked: 1

Contribution to the Project: Susie is the coordinator of the MATE Mid-Atlantic regional ROV contest.

Funding Support: Nauticus, National Maritime Center.

International Collaboration: No
International Travel: No

Aymette Medina**Email:** aymette@gmail.com**Most Senior Project Role:** Other**Nearest Person Month Worked:** 1**Contribution to the Project:** Aymette is the coordinator of the MATE Puerto Rico regional ROV contest.**Funding Support:** Learning By Doing.**International Collaboration:** No**International Travel:** No

Calvin Mires**Email:** cmires@pastfoundation.org**Most Senior Project Role:** Other**Nearest Person Month Worked:** 1**Contribution to the Project:** Calvin is the coordinator of the MATE Buckeye regional ROV contest.**Funding Support:** PAST Foundation**International Collaboration:** No**International Travel:** No

Velda Morris**Email:** vmvrobot@gmail.com**Most Senior Project Role:** Other**Nearest Person Month Worked:** 1**Contribution to the Project:** Velda is the coordinator of the MATE Pennsylvania regional ROV contest.**Funding Support:** Urban STEM Strategy Group.**International Collaboration:** No**International Travel:** No

Erica Moulton**Email:** erica.moulton@gmail.com**Most Senior Project Role:** Other**Nearest Person Month Worked:** 1**Contribution to the Project:** Erica is the coordinator of the MATE Florida regional ROV contest.**Funding Support:** N/A**International Collaboration:** No**International Travel:** No

Sadie Norwick**Email:** snorwick@sheddaquarium.org**Most Senior Project Role:** Other**Nearest Person Month Worked:** 1**Contribution to the Project:** Sadie is one of the coordinators of the MATE Midwest regional ROV contest.

Funding Support: John. G. Shedd Aquarium.

International Collaboration: No
International Travel: No

Jody Patterson

Email: jody.patterson@noaa.gov
Most Senior Project Role: Other
Nearest Person Month Worked: 1

Contribution to the Project: Jody is the coordinator of the MATE Southeast regional ROV contest.

Funding Support: NOAA.

International Collaboration: No
International Travel: No

Edward Sheppard

Email: edward.b.sheppardjr@uscg.mil
Most Senior Project Role: Other
Nearest Person Month Worked: 1

Contribution to the Project: Ed is one of the coordinators of the MATE Oahu regional ROV contest.

Funding Support: U.S. Coast Guard

International Collaboration: No
International Travel: No

Kim Swan

Email: kswan@marinetech.org
Most Senior Project Role: Other
Nearest Person Month Worked: 1

Contribution to the Project: Kim is one of the coordinators of the MATE Monterey Bay regional ROV contest.

Funding Support: NSF ITEST.

International Collaboration: No
International Travel: No

Sarah Waters

Email: sarah.a.waters@noaa.gov
Most Senior Project Role: Other
Nearest Person Month Worked: 1

Contribution to the Project: Sarah is the coordinator of the MATE Great Lakes regional ROV contest.

Funding Support: NOAA.

International Collaboration: No
International Travel: No

What other organizations have been involved as partners?

Name	Type of Partner Organization	Location
Bermuda Institute of Ocean Sciences (BIOS)	Other Organizations (foreign or domestic)	Bermuda
Bristol Community College	Academic Institution	Fall River, MA
NOAA's National Marine Sanctuary Program	Other Organizations (foreign or domestic)	Washington, DC
Nauticus, the National Maritime Center	Other Nonprofits	Norfolk, VA
North Carolina State University	Academic Institution	Morehead City, NC
Oceaneering International	Industrial or Commercial Firms	Morgan City, LA
Oregon Sea Grant	State or Local Government	Newport, OR
PAST Foundation	Other Nonprofits	Columbus, OH
STREAMWORKS	Other Nonprofits	Kingsport, TN
St. Pete Makers	Other Nonprofits	St. Petersburg, FL
U.S. Coast Guard	Other Organizations (foreign or domestic)	Honolulu, HI
University of Arizona	Academic Institution	Tucson, AZ
Dauphin Island Sea Lab	Academic Institution	Dauphin Island, AL
University of Hawaii Institute for Astronomy	Academic Institution	Hilo, HI
University of Massachusetts - Dartmouth	Academic Institution	North Dartmouth, MA
University of Washington	Academic Institution	Seattle, Washington
University of Wisconsin	Academic Institution	Milwaukee, WI
Urban STEM Strategy Group	Other Nonprofits	Philadelphia, PA
E3 Robotics	Other Nonprofits	Greensboro, NC
Guam Department of Education	School or School Systems	Guam
John G. Shedd Aquarium	Other Nonprofits	Chicago, IL
Learning By Doing	Other Nonprofits	Ponce, Puerto Rico
Long Beach City College	Academic Institution	Long Beach, CA
Marine Technology Society	Other Nonprofits	Washington, DC
NASA	Other Organizations (foreign or domestic)	Houston, TX

Full details of organizations that have been involved as partners:

Bermuda Institute of Ocean Sciences (BIOS)**Organization Type:** Other Organizations (foreign or domestic)**Organization Location:** Bermuda**Partner's Contribution to the Project:**

In-Kind Support

Facilities

Collaborative Research

More Detail on Partner and Contribution: BIOS is the lead coordinator of the MATE Bermuda regional ROV contest .

Bristol Community College**Organization Type:** Academic Institution**Organization Location:** Fall River, MA**Partner's Contribution to the Project:**

In-Kind Support

Facilities

Collaborative Research

More Detail on Partner and Contribution: Bristol Community College is one of the lead coordinators of the MATE New England regional ROV contest.

Dauphin Island Sea Lab**Organization Type:** Academic Institution**Organization Location:** Dauphin Island, AL**Partner's Contribution to the Project:**

In-Kind Support

Facilities

Collaborative Research

More Detail on Partner and Contribution: Dauphin Island Sea Lab is the lead coordinator of the MATE Northern Gulf Coast regional ROV contest.

E3 Robotics**Organization Type:** Other Nonprofits**Organization Location:** Greensboro, NC**Partner's Contribution to the Project:**

Financial support

In-Kind Support

Facilities

More Detail on Partner and Contribution:

Guam Department of Education**Organization Type:** School or School Systems**Organization Location:** Guam**Partner's Contribution to the Project:**

In-Kind Support

Facilities
Collaborative Research

More Detail on Partner and Contribution:

John G. Shedd Aquarium**Organization Type:** Other Nonprofits**Organization Location:** Chicago, IL**Partner's Contribution to the Project:**

In-Kind Support
Facilities
Collaborative Research

More Detail on Partner and Contribution: The John G. Shedd Aquarium is the lead coordinator of the MATE Midwest regional ROV contest.

Learning By Doing**Organization Type:** Other Nonprofits**Organization Location:** Ponce, Puerto Rico**Partner's Contribution to the Project:**

In-Kind Support
Facilities
Collaborative Research

More Detail on Partner and Contribution: Learning By Doing is the lead coordinator of the MATE Puerto Rico regional ROV contest.

Long Beach City College**Organization Type:** Academic Institution**Organization Location:** Long Beach, CA**Partner's Contribution to the Project:**

In-Kind Support
Facilities
Collaborative Research

More Detail on Partner and Contribution: Long Beach City College is the lead organization on the MATE Southern California regional ROV contest.

Marine Technology Society**Organization Type:** Other Nonprofits**Organization Location:** Washington, DC**Partner's Contribution to the Project:**

Financial support
In-Kind Support

More Detail on Partner and Contribution: The Marine Technology Society has been a strong supporter of the MATE Center and the ROV competition in particular. In addition to funds, MTS members contribute time and technical expertise and competition coordinators, judges, technical support, team mentors, and more.

NASA

Organization Type: Other Organizations (foreign or domestic)

Organization Location: Houston, TX

Partner's Contribution to the Project:

In-Kind Support

Facilities

Collaborative Research

More Detail on Partner and Contribution: NASA is one of the lead coordinators of the MATE Texas regional ROV contest.

NOAA's National Marine Sanctuary Program

Organization Type: Other Organizations (foreign or domestic)

Organization Location: Washington, DC

Partner's Contribution to the Project:

In-Kind Support

Facilities

Collaborative Research

More Detail on Partner and Contribution: NOAA's National Marine Sanctuary Program - Thunder Bay National Marine Sanctuary is the lead coordinator of the MATE Great Lakes regional ROV contest; the Gray's Reef National Marine Sanctuary is the lead coordinator of the MATE Southeast regional ROV contest.

Nauticus, the National Maritime Center

Organization Type: Other Nonprofits

Organization Location: Norfolk, VA

Partner's Contribution to the Project:

In-Kind Support

Facilities

Collaborative Research

More Detail on Partner and Contribution: Nauticus, the National Maritime Center is the lead coordinator of the MATE Mid-Atlantic regional ROV contest.

North Carolina State University

Organization Type: Academic Institution

Organization Location: Morehead City, NC

Partner's Contribution to the Project:

In-Kind Support

Facilities

Collaborative Research

More Detail on Partner and Contribution: North Carolina State University's Center for Marine Sciences and Technology - Science House is the lead coordinator of the MATE Coastal Carolina regional ROV contest.

Oceaneering International

Organization Type: Industrial or Commercial Firms

Organization Location: Morgan City, LA

Partner's Contribution to the Project:

Financial support

In-Kind Support

Collaborative Research

More Detail on Partner and Contribution: Oceaneering International provides funding as well as mentoring and technical support to the MATE ROV competition.

Oregon Sea Grant

Organization Type: State or Local Government

Organization Location: Newport, OR

Partner's Contribution to the Project:

In-Kind Support

Facilities

Collaborative Research

More Detail on Partner and Contribution: Oregon Sea Grant is the lead coordinator of the MATE Oregon regional ROV contest.

PAST Foundation

Organization Type: Other Nonprofits

Organization Location: Columbus, OH

Partner's Contribution to the Project:

In-Kind Support

Facilities

Collaborative Research

More Detail on Partner and Contribution: The PAST Foundation is the lead coordinator of the MATE Buckeye regional ROV contest.

STREAMWORKS

Organization Type: Other Nonprofits

Organization Location: Kingsport, TN

Partner's Contribution to the Project:

In-Kind Support

Facilities

Collaborative Research

More Detail on Partner and Contribution:

St. Pete Makers

Organization Type: Other Nonprofits

Organization Location: St. Petersburg, FL

Partner's Contribution to the Project:

In-Kind Support

Facilities

Collaborative Research

More Detail on Partner and Contribution: St. Pete Makers is the lead coordinator of the MATE Florida regional ROV contest.

U.S. Coast Guard

Organization Type: Other Organizations (foreign or domestic)

Organization Location: Honolulu, HI

Partner's Contribution to the Project:

In-Kind Support
Facilities
Collaborative Research

More Detail on Partner and Contribution: The U.S. Coast Guard base on Oahu is one of the lead coordinators of the MATE Oahu regional ROV contest.

University of Arizona

Organization Type: Academic Institution

Organization Location: Tucson, AZ

Partner's Contribution to the Project:

In-Kind Support
Facilities
Collaborative Research

More Detail on Partner and Contribution:

University of Hawaii Institute for Astronomy

Organization Type: Academic Institution

Organization Location: Hilo, HI

Partner's Contribution to the Project:

In-Kind Support
Facilities
Collaborative Research

More Detail on Partner and Contribution: The University of Hawaii Institute for Astronomy is the lead coordinator of the MATE Big Island regional ROV contest.

University of Massachusetts - Dartmouth

Organization Type: Academic Institution

Organization Location: North Dartmouth, MA

Partner's Contribution to the Project:

In-Kind Support
Facilities
Collaborative Research

More Detail on Partner and Contribution: University of Massachusetts - Dartmouth is one of the lead coordinators of the MATE New England regional ROV contest.

University of Washington

Organization Type: Academic Institution

Organization Location: Seattle, Washington

Partner's Contribution to the Project:

In-Kind Support
Facilities
Collaborative Research

More Detail on Partner and Contribution: The University of Washington is the lead coordinator of the MATE Pacific Northwest regional ROV contest.

University of Wisconsin

Organization Type: Academic Institution
Organization Location: Milwaukee, WI

Partner's Contribution to the Project:

In-Kind Support
 Facilities
 Collaborative Research

More Detail on Partner and Contribution: The University of Wisconsin is the lead coordinator of the MATE Wisconsin regional ROV contest.

Urban STEM Strategy Group

Organization Type: Other Nonprofits
Organization Location: Philadelphia, PA

Partner's Contribution to the Project:

In-Kind Support
 Facilities
 Collaborative Research

More Detail on Partner and Contribution: The Urban STEM Strategy Group is the lead coordinator of the MATE Pennsylvania regional ROV contest.

What other collaborators or contacts have been involved?

The MATE regional competition network includes programs in Canada, Hong Kong, Scotland/UK, Russia, Egypt, Turkey, and Indonesia. While the organizations that coordinate MATE programs in these regions do not benefit directly from ITEST grant funds, they do leverage the ITEST-supported activities and products. They also share their best practices and lessons learned with the competition network. These organizations (and the points of contact at each) are listed below:

Paul Brett, Marine Institute of Memorial University of Newfoundland and Labrador, St. John's, NL, Canada

Mike Duggan and Peter Oster, Nova Scotia Community College, Halifax, NS, Canada

Robin Bradbeer and Paul Hogan, Pearl Technologies, Ltd., Hong Kong as well as Philip Chui, Institute of Engineering and Technology, Hong Kong

Graeme Dunbar, John Still, David Howie, and Steve Allardyce, The Robert Gordon University, Aberdeen, Scotland

Sergey Mun, The Center for Robotics Development, Maritime State University, Vladivostok, Russia

Mahmoud Abdel Aziz, Hadath for Innovation and Entrepreneurship, Cairo, Egypt

Dr. Ihab El-Aff, EngTechs Engineering & Technology, Izmir, Turkey

Dhadhang SBW, Sekolah Robot Indonesia, Surabaya, Indonesia

Impacts**What is the impact on the development of the principal discipline(s) of the project?**

A number of prior reports have identified significant problems in educating, recruiting, and retaining U.S. workers for scientific, technological, and operational careers. Such workers are critical for building and operating much of the nation's infrastructure and for sustaining growth and innovation. The lack of appropriately educated workers is especially pronounced in ocean fields, such as deep water ocean exploration; the engineering of specialized tools and instruments for remote, harsh environments; and the management and use of ocean resources (particularly, renewable resources). The graying trend in the marine workforce adds to the urgency of educating new technical professionals that will adapt and excel in the rapidly advancing ocean workplace.

Workforce studies previously conducted by the MATE Center and funded by the Office of Naval Research identified more than twenty STEM-based ocean occupations that are currently limiting the growth of ocean industries because of the lack of qualified personal. At the top of the list are the following occupations: electronics/marine technicians; engineers (electrical, mechanical, civil/structural); and computer scientists (software

application developers, computer programmers, hardware developers).

However, these are not "just" engineers, technicians, and computer scientists; these are professionals that understand ocean applications within their field. For example, ROV technicians in support of ocean operations must have an understanding of ocean science in addition to engineering and computer science since all commercial ROVs possess computer-controlled systems and must be maintained, repaired, and modified in remote locations far from port. These skills sets are transferable to almost every sector of the economy that uses robotics, automation, and computer-controlled systems.

Every year, the ocean attracts thousands of students to pursue degrees in biology because that is a discipline that most students associate with ocean careers. However, the opportunity and compensation in ocean-related engineering, technology, and computer science fields is much greater than the biological sciences. Combining STEM education with ocean applications via the MATE ROV competition network provides students with a pathway to achieve their goals, including the gainful employment that is so critical to engaging students from economically disadvantaged environments. For the ocean occupations in greatest need of qualified individuals, the early education and career preparation is similar. This includes applied math, critical and creative thinking, and design and innovation, which, during the competitions, are presented in an engaging environment that simulates the high-performance workplace.

What is the impact on other disciplines?

Covered above under "What is the impact on the development of the principal discipline(s) of the project?"

What is the impact on the development of human resources?

The work of this project supports the development of a diverse ocean STEM workforce, outlining and allowing students to see a career pathway from upper elementary school to middle and high school to college and into the workplace. It is also providing valuable workplace experience; all of the ROV kits funded by this grant are assembled, packaged, and shipped by community college students (Please see the ACCOMPLISHMENTS section for details.)

The findings of the alumni survey demonstrate the impact on workforce development. This survey, which was launched in June 2015, gathered data on students' education and employment. Four hundred thirty-two student alumni responded. A sampling of results is presented below; for additional details, please see the Year 3 Evaluation Report.

- Among the 220 alumni who earned a college degree, 85% earned a degree in a STEM discipline.
- Among the 236 current college and university students, 85% are studying towards a STEM degree.
- Among the employed alumni (N=320), 73% are currently working a STEM-related job, and 22% currently or previously worked a job related to ROVs or other underwater technologies.
- Two-thirds (67%, N=432) of the alumni credit the ROV competition with influencing their educational or career path "to a great extent" or "somewhat".
- The ROV competition played a role in alumni attaining employment (37%), admittance into educational programs/college/university (36%), internships (30%), awards (21%), and scholarships (21%).

We plan to launch a second competition alumni survey this fall, employing new strategies (e.g., social media, the newly created MATE Alumni LinkedIn Group) for reaching more past participants.

What is the impact on physical resources that form infrastructure?

Progress on the MATE workshop continued, with additional space secured for inventory, all of which improved the working environment for the community college students who assemble the MATE ROV kits (see the "MATE store" referenced in ACCOMPLISHMENTS).

What is the impact on institutional resources that form infrastructure?

Nothing to report.

What is the impact on information resources that form infrastructure?

Nothing to report.

What is the impact on technology transfer?

The MATE ROV kits are sold through our SeaMATE online store (www.marinetech.org/store/). In addition to the kits provided through ITEST, schools, camps, museums, and parents across the country are also buying kits directly from us; from July 1, 2017 to June 30, 2018, we sold more than \$458,000 worth of ROV related items (ROV kits, textbooks, and ROV supplies).

What is the impact on society beyond science and technology?

Through the impacts described under ACCOMPLISHMENTS, the work of this project is helping to prepare and create a more scientific- and technology-literate society.

Please also see the Leveraging ITEST Activities/Funding, Using ROVs Outside the Competition, Broader Impacts on Teachers and Institutions sections of the Year 5 Evaluation Report.

Changes/Problems

Changes in approach and reason for change

In our grant proposal, we set a goal to improve multi-year participation (as a percentage of total students) by 5% a year over the duration of the grant. After three years of evaluating the data, we realize that the way that we defined that goal did not take into consideration the full picture. As the competition network continues to expand, by definition, it draws in new, first-time competitors. For example, between Year 1 and Year 2, we added 1 new regional program and between Year 2 and Year 3, we added 3 new regional programs. So, while the percentage of multi-year students declined slightly from Year 1 to Year 2 (42% in Year 1 vs. 40% in Year 2), the number of multi-year students increased from 1,345 to 1,537, an increase of 14%. And, while the percentage of multi-year students declined slightly from Year 2 to Year 3 (40% in Year 2 vs. 38% in Year 3), the number of multi-year students increased from 1,537 to 2,016, an increase of 32%.

In Year 3's annual report, we proposed a revision to that goal: that the overall number of multi-year participants will increase by at least 10% each year over the duration of the grant.

From Year 3 to Year 4, the number of multi-year students increased from 2,038 to 2,118, an increase of only 5%. We did not reach our goal. However, we have a very likely explanation for this.

In 2016 and prior years, the answer choices to the question "how many years have you participated in the MATE competition?" were:

- This is my first year!

- 1

- 2

- 3

- 4

- 5

Etc.

We recognized that there could be some confusion on which choice is most appropriate for a first-year, first-time student - i.e., do you answer this is my first year or 1? So, in 2017 (Year 4), we revised the answer choices to:

- This is my first year!

- 2

- 3

- 4

- 5

Etc.

This revision likely accounts for the small increase in overall multi-year students from Year 3 to Year 4.

We also investigated this further and, in February 2018, the registration data for Year 4 was cleaned and a new approach was taken to compiling the numbers. Comparing Year 4 to Year 5 using this new approach, the number of multi-year students decreased from 1,472 to 1,433. We did not reach our goal, but rather lost ground (3%).

Digging deeper, we see that this decrease can be attributed to decreases in multi-year student within several of our regional events. It is likely that these decreases represent high school students who have graduated and either entered the workforce or moved onto a post-secondary institution where there currently isn't a MATE team.

We will continue to explore this during our one-year, no-cost extension.

NSF's expectation is that the scope of activities will include elaborations and/or revisions that are discussed in pre-award negotiations. The Annual Report and Evaluation Report submitted do not specifically address several NSF questions/ requests and PI elaborations/revisions that were included in the pre-award negotiations.

During negotiation, additional information was requested about the mechanism by which implementation fidelity (or adaptation) of the ROV intervention across regions would be documented.

Action2B1: Please clarify what was accomplished during Year 3 pertaining to the work you proposed in your responses, including:

- conducting face-to-face observations of a subset of the regional efforts.

In Year 5 we were not able to conduct face-to-face observations of any regional contests. (Note: One Co-PI attends the Pacific Northwest regional each year; the PI and other Co-PI coordinate the Monterey regional contest.) However, we did send a MATE staff member to assist with the regional on Oahu. He ensured consistency and branding. And a MATE mentor/volunteer worked closely with the inaugural regional on Guam to ensure fidelity – from prop construction to judging and more.

In addition, we are planning to hold another regional coordinators meeting during our one-year, no-cost extension. Currently 22 regional coordinators and 6 MATE staff are planning to attend the meeting, which will take place in Monterey September 12-13, 2018.

As with previous regional coordinator meetings, the overarching goal of this meeting is to strengthen the MATE competition community as well as to discuss strategies for sustainability, especially with the ITEST grant ending. In addition, during the meeting we will 1) debrief the 2018 competition season and provide a preview of 2019 mission tasks; 2) share best practices and lessons learned; 3) discuss changes and improvements for next year; and 4) provide professional development on a 2019 competition “prop.” Our evaluator will also share the results of the 2018 competition surveys.

We believe that these discussions and activities will further help to build community and increase regional fidelity across the network.

Action 2B2: Please clarify whether you have you have considered or established any mechanism for studying the artifacts from the professional development and/or competition experiences for assessing implementation across regions in the event observations were not conducted?

See Action 2B1.

Actual or Anticipated problems or delays and actions or plans to resolve them

NSF’s expectation is that the scope of activities will include elaborations and/or revisions that are discussed in pre-award negotiations. The Annual Report and Evaluation Report submitted do not specifically address several NSF questions/ requests and PI elaborations/revisions that were included in the pre-award negotiations.

During negotiation, additional information was requested about the instruments and processes used to collect outcome data and the technical quality of those instruments, with the clear purpose of moving the research/evaluation beyond self-report.

Action 2A: Please clarify what was accomplished during Year 5 pertaining to the work you proposed in your responses that intended to:

- improve the internal consistency of existing surveys by adding questions and standardizing the question constructs;

In Year 4, we worked with Dr. Min Li to improve the consistency and validity of the four existing post-competition surveys: student, instructor, parent, and judge/volunteer. It was determined that the changes made at her suggestion in the prior year had effectively improved consistency and validity.

- compare survey data against students’ NSC data to provide an additional form of survey validation;

Please see the Year 5 Evaluation Report for information regarding our work with the National Student Clearinghouse (NSC).

- employ a process for validating competition scoring rubrics and determining and/or establishing methods for ensuring inter-rater reliability of competition scoring such that they may be used as an indicator of student learning; and

In Year 5, we continued our work with Dr. Min Li on the alignment study of competition scoring rubrics. The alignment study focuses on how the scoring (i.e. “coding”) categories can be mapped back to (1) the competition manual in terms of how the students are mentored or guided and (2) the standards from the engineering portion of the NGSS, 21st Century Skills, and College Readiness documents.

Dr. Li’s report was not available at the time of our annual report’s submission. Her report will be submitted separately, directly to our NSF Program Officer, when available.

We did not conduct validity studies in Year 5 to decide whether scores assigned by judges are comparable to Dr. Li’s evaluation. We will conduct those studies during our one-year, no-cost extension.

- design, pilot, and assess psychometric quality for NGSS-aligned pre-post knowledge tests (and for the above competition scoring), with the assistance of Dr. Min Li.

Please see “What opportunities for training and professional development has the project provided?” 2a and the Year 5 Evaluation Report.

During negotiation, additional information was requested regarding other study designs that might be employed, such as interrupted time series design and/or use of state longitudinal data, to collect more reliable estimates of the average impact of the intervention.

Action 2C: Please clarify what was accomplished during Year 1 pertaining to the work you proposed in your responses, including:

- employing the “modified time series design” that included one pretest of knowledge and attitudes, several interim knowledge tests (quizzes at the end of each module), post- and follow up tests of knowledge and attitudes with possible triangulation with competition scores.

Please see “What opportunities for training and professional development has the project provided?” 2a and the Year 5 Evaluation Report.

Changes that have a significant impact on expenditures

Nothing to report.

Significant changes in use or care of human subjects

Nothing to report.

Significant changes in use or care of vertebrate animals

Nothing to report.

Significant changes in use or care of biohazards

Nothing to report.

Special Requirements

Responses to any special reporting requirements specified in the award terms and conditions, as well as any award specific reporting requirements.

Nothing to report.