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Report of the ITEST Billion Oyster Project Evaluation Findings Year 2

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I. INTRODUCTION

The ITEST Billion Oyster Project (BOP) is comprised of four pillars of activities. *Pillar 1: STEM Hubs*, oyster restoration research sites and community reefs located in the New York Harbor throughout New York City*; Pillar 2: Near-Peer Mentoring* to engage students in oyster restoration research and raise awareness of STEM careers in marine and environmental sciences; *Pillar 3: Professional Development for Teachers* in oyster restoration content and research for students; and *Pillar 4: Advanced Research Methods* for *teachers to support students* who choose to pursue oyster-related research at a higher level.

In Year 2, the NYC lockdown of schools during the COVID-19 pandemic in March 2020 had an impact on the implementation of activities in all four pillars. The following report summarizes the strengths, challenges, and modifications in adapting implementation to the remote learning environment to achieve the project's objectives: developing student engagement in project-related STEM activities; instilling student learning of STEM content related to oyster science restoration; and raising student awareness of STEM careers in marine and environmental sciences.

II. EVALUATION METHODOLOGY

The evaluator proposed to gather data to answer the evaluation questions and to assess the effectiveness and impact of project implementation on participants. The evaluation focused primarily on assessing the project's design and delivery of professional learning for teachers. The project's interventions for teachers were designed to prepare them to achieve the BOP student objectives: increased student engagement, student learning, and student interest in STEM careers.

Evaluation Questions

The following are the questions that the evaluation was designed to address.

Evaluation Question 1: How well was the project implemented?

Evaluation Question 2: How well did the project work in supporting teachers and STEM professionals/scientists/ mentors to motivate students in developing interests, skills, knowledge, and career awareness in restoration science and related fields?

Evaluation Question 3: How well did the project work in supporting students to engage in STEM, increase career awareness, and motivate them to pursue STEM interests, skills, and follow formal educational pathways in the New York City public school system?

Evaluation Question 4: To what extent was the research plan effective in identifying the impacts of the program?

Evaluation Activities

In Year 2, the evaluation activities designed to evaluate the project's effectiveness and impact on student engagement, student learning, and student interest in STEM careers and to address the evaluation questions included the following:

- Quarterly Meetings with project staff, and other meetings as needed
- Biweekly meetings with evaluation and research staff (21)
- Designing, Editing, Revising, Updating Evaluation Instruments
    - *Student Survey evaluation questions*
    - *Protocol for project staff interviews*
    - *Protocol for scientist interviews*
    - *Protocol for teacher interviews*
    - *Protocol for The Mark research staff interviews*
    - *Combined Professional Development and ORS Training Survey*
    - *Year-End Teacher Survey*
    - *Professional Development Survey*
    - *Near-Peer Mentor Survey*
    - The *Observation Checklist for High-Quality Professional Development*[1]
- Collecting evaluation data from program activities and staff participants*:
        - interviews with project scientists (4)
        - interviews with project staff (7)
        - interviews with The Mark researchers (2)
        - observations of professional development sessions (12)
        - observations of Advanced Research Methods sessions (2)
        - observations of scientist meetings (2)
        - observations of Symposium student project presentations (10)

- Analyzing data collected
- Reporting outcomes

*Note: All proposed evaluation activities in Year 2 were modified to adapt to the remote learning environment dictated by the onset of the COVID-19. All evaluation activities – meetings, surveys, focus groups, and observations of program activities as proposed - were conducted online. Instead of the proposed focus groups for project staff and scientists, the evaluator conducted individual telephone or zoom interviews. Teacher interviews were not conducted due to reduced program activities in the early COVID-19 months (Spring 2020) and the challenges for teachers of adapting, creating, and delivering virtual curriculum and instruction in Fall 2020. Teachers will be interviewed in the next reporting period (January-March 2021) Otherwise, all proposed evaluation activities were conducted.

Data Collection

Collection of evaluation data over the course of Year 2 was designed to answer the evaluation questions and to assess student engagement, student learning, and interest in STEM careers.

Survey data was collected primarily from teacher participants of *Pillar 3: Professional Development for Teachers*. *Pillar 4:Advanced Research Methods for Teachers* was only partially implemented and with few participants yield no data. Administration of the Year-End Teacher Survey in June 2020 for Pillar 3 posed problems. The contact list provided by project staff for distribution of the survey included more than 900 names from previous and current iterations of BOP, community group participants and everyone else who had anything to do with the project. All 900+ received email notices with the survey link, which put recipients in the position of having to determine whether the survey was meant for them. A current contact list specific to ITEST Years 1 and 2 participants was not available. Project staff recognized the importance of building a current and viable contact list and was working to address this in the latter part of Year 2.

There were no plans in the proposal to include a comparison group for the BOP teacher participants and therefore the outcomes were not analyzed for statistical significance. *Pillar 1: STEM Hubs*, and *Pillar 2: Near-Peer Mentoring* were student activities, not teacher professional learning activities so were outside the purview of the proposed survey data collection activities.

Pre and post student evaluation survey data for *Pillars 1: STEM Hubs, 2: Near-Peer Mentoring, and Pillar 4: Advanced Research Methods* was to be collected by researchers through evaluation questions added to the student survey administered by The Mark. However, Pillars 2 and 4 were only partially implemented, so yielded few or no student survey responses. *Pillar 1: STEM Hubs,* however, generated 14 responses from the student survey. A student comparison group was also surveyed on these questions.

Observation data was collected throughout the year for activities in all four pillars;

Interview data was collected from BOP project staff, scientists, and The Mark researchers.

The outbreak of the COVID-19 pandemic did not limit data collection but modifications were made to accommodate the virtual environment, such as substituting telephone or zoom interviews of individual project staff, scientists, and researchers rather than convening focus groups. There were improvements in data collection as well. Collection of teacher professional learning surveys for Pillar 3 was more effective than it had been before COVID-19 because project staff facilitators set aside time at the conclusion of online sessions for teachers to complete and submit the surveys. Observations of project activities were also more accessible and therefore more frequent due to the ease of accessing them online.

III. EVALUATION FINDINGS

OVERALL PROJECT ACCOMPLISHMENTS

The evaluator found that the project's implementation in Year 2 contributed to promoting the projects goals to increase STEM student engagement, student learning, and student interest in STEM careers. Pillars 1 and 3 designed and delivered onsite and virtual interventions that were effective in preparing teachers to engage students in exploring and learning content related to oyster restoration research in the New York Harbor. Prior to and during COVID-19, project staff facilitating Pillar 1 STEM Hub class field site visits and a series of professional learning activities in Pillar 3 modelled and explored 'best' pedagogical practices and activities that were designed to support teachers to engage students in STEM learning. Aspects of these sessions provided opportunities for raising students' awareness about careers in STEM marine sciences, such as encouraging students to see themselves as scientists while they are collecting data at ORS sites and promoting students' awareness of the possibility that they themselves could become scientists in the future conducting similar kinds of research. Evidence of the success of these activities is discussed below and in the following sections of the report.

It should be noted that the project staff's ability to adapt and even to thrive in the COVID-19 environment by creating virtual content and activities to promote student engagement, student learning, and student interest in STEM careers. While taking time in the first months of COVID-19 isolation to get the lay of the land and consider possible remote learning alternatives to what is essentially a hands-on student research oriented project that takes place at the NY Harbor waterfront, project staff became more creative as the year progressed in identifying substitutes for onsite field visits and expanding teacher learning activities.

The use of technology enabled staff facilitating onsite field oyster restoration activities in Pillars 1 and 3 to develop and use pre-prepared videos, create live on-site video connections to oyster restoration station monitoring sites for teachers and students facilitated by project staff, teach "classroom" lessons on zoom, create webinars and zoom professional development for teachers with activities created specifically for remote teaching and learning experiences, develop lessons and curriculum with toolkits and activities for students to do at home, and facilitate mentor/mentee zoom discussions and activities, all of which contributed to building student engagement, student learning, and interest in STEM careers. The project also created a *virtual* BOP Annual Student Research Project Symposium in June 2020 that elicited 72 student project presentations – a much greater number than in previous years with live presentations.

The virtual environment provided greater opportunities for staff to interact individually with both teachers and students, and with mentors and mentees which appeared to encourage greater participation in project activities, and subsequently the building of a continuing community of teachers participating consistently in whatever teaching and learning opportunities that BOP project offered. The virtual approach accomplished what several project staff had recommended as the way forward in the post COVID-19 future – finding ways to provide more individual hand-holding and follow-up that will build teachers' confidence, as well as their capacity and skills to do oyster restoration research with students, and encourage greater and more consistent teacher participation in BOP activities to develop and promote teachers' capacity to increase STEM student engagement, student learning, and interest in STEM careers.

The professional learning experiences for Fall 2020 were designed to do that by planning a progression of workshops for 20-21 that will constitute a cohort of teacher participants with deepening knowledge and skills which would be utilized in facilitating the student research projects at the 2021 Symposium.

SIGNIFICANT RESULTS, BY PILLAR

PILLAR 1: STEM Hubs Results

BOP facilitated 26 onsite and remote student activities in this pillar, which were designed to promote student engagement, learning and interest in STEM Careers. Over nine virtual classroom lessons were facilitated in schools, along with 16 live outdoor field day activities during COVID-19.

Observations of several onsite STEM Hub activities facilitated by project staff prior to the onset of COVID-19 indicated that the STEM Hub student activities, were effective in engaging students in STEM engagement and student learning. "Classroom" practices identified by evaluators as effective in achieving those objectives were almost all utilized by project staff in these sessions. The evaluator noted the students' engagement as they

eagerly collected and recorded water quality data and oyster mortality and measurement data from the oyster restoration station. They were clearly familiar with the research protocols, had used them before, and were capable of conducting them on their own in small groups. Some sessions were co-facilitated by STEM graduate students who shared their career path with students.

Middle school and high school students who participated in BOP ITEST Pillar 1 through STEM Hubs, classroom sessions or other events hosted by BOP had the option of responding to four questions on the student survey about their perceptions of their scientific skills as well as their interest in STEM careers after their participation. Fourteen students who said they had attended a Billion Oyster Project oyster activity in the past twelve months responded to the survey.
The findings suggest that participating in BOP does increase student knowledge about STEM careers and improves their perceptions of their scientific skills compared to those with less involvement in BOP programming.

Observations of several onsite STEM Hub activities prior to COVID-19 indicated that the student ORS research activities, facilitated by project staff, were effective in engaging students in STEM engagement and student learning. Practices utilized by project staff were identified by evaluators on the *BOP Observation Checklist* as effective in achieving those objectives. The evaluator noted the students' engagement as they eagerly collected and recorded water quality data and oyster mortality and measurement data from the oyster restoration station in small groups. They were clearly familiar with the research protocols, had used them before, and were capable of conducting the research and data collection activities on their own. Some sessions were co-facilitated by STEM undergraduate or graduate students who informally shared their career path with students as they worked together to collect and record data for the oyster restoration stations at the STEM Hub sites.

PILLAR 2: NEAR-PEER MENTORING RESULTS

This pillar was not fully implemented and operational, before or during COVID-19, until November 2020. A pre-post survey administered to mentors in the Spring 2020 semester had limited responses. Observations of several mentor-mentee sessions in December indicated that this pillar had identified an implementation model that could work to build student career interest in Year 3. A second pre-survey was made accessible to the new cadre of mentor students in December; only one mentor responded. The evaluator is working with project staff to increase pre-survey participation in January 2021. (A fuller explanation of the new model can be found in this report in *Section IV: Implementation Findings*.)

PILLAR 3: PROFESSIONAL DEVELOPMENT FOR TEACHERS RESULTS

The key findings for Pillar 3 from three data collection activities are presented below: 1) Observations of Professional Learning Activities; 2) *Year-End Teacher Survey* administered in June 2020; 3) *Professional Learning Participant Survey* administered at the conclusion of professional learning activities throughout Year 2. Detailed evaluation reports of the findings for this pillar are attached in the Appendix at the end of this report.

Findings from Observations of Professional Learning Activities

In observations of 12 BOP professional learning activities in Year 2, the evaluator found that the Billion Oyster Project provided high-quality professional learning opportunities for teachers. The majority of items identified as characteristics of high-quality facilitation on the *BOP Observation Checklist Protocol* (See Appendix.) were observed in all sessions. The less effective practices in facilitation were in the organizational aspects of sessions related to materials provided to participants prior to sessions. This practice is easily addressed by providing an agenda, readings or other materials to participants when they register for sessions.

BOP project staff successfully shifted the activities in this pillar from in-person sessions to a full schedule of virtual sessions in Fall 2020 in response to the COVID-19 pandemic. Based on these observations, the quality of professional learning opportunities did not decrease with the change to remote learning. The observation data supports the results from teacher surveys which indicated that teachers viewed these sessions as high-quality activities and they plan to attend more BOP professional learning sessions in the future. (*See below for findings from teacher surveys.)*

Findings from Teacher Year-end Survey

Overall, survey data collected from BOP participating teachers in June 2020 (during COVID-19), at the end of the school year, showed they were positive about the amount of support and resources, as well as the oyster-related knowledge and practices they learned in BOP professional learning activities in Pillar 3. The majority reported the sessions enabled them to promote student engagement, student learning, and interest in STEM careers. Respondents were most positive about the extent to which the BOP activities increased their own awareness of what is happening with oyster restoration in the NY Harbor.

Oyster Research Station (ORS) and Oyster Tank Training Activities. Participants in the Oyster Research Station training activities were most positive about the extent to which the training had increased their own comfort level with being around the waterfront and conducting field site research with students. They felt more confident engaging with students in field science and

research after participating in ORS activities than they did prior to participation. Oyster Tank training participants had more positive responses to statements about the impact of BOP in increasing their awareness of oyster restoration in New York Harbor, increasing their comfort level with field research, and guiding students in field research.

Student Symposium Research Projects. Twenty-four percent of participants reported that their students engaged in research projects in Spring 2020 that they presented at the BOP Symposium in June. All the teachers who reported their students prepared and presented projects at the Symposium attended either an ORS training or an Oyster Tank Training activity during the 2019-2020 program year. The use of oyster tanks was the most frequently cited source of student projects, an outcome that was not surprising during COVID-19.

Career Awareness. Practices for developing student awareness of STEM careers were not explicitly addressed in professional learning activities. Participants' responses to relevant items were less positive than their responses in other categories. Fewer than half of all respondents 'agreed' or 'strongly agreed' that BOP activities modelled career development.

If career interest is a goal for BOP participation, incorporating more information or ideas on building career awareness and interest, and addressing career opportunities explicitly in every professional learning session would address that goal, as well as distributing an informational packet or lesson plans for classroom follow-up.

Teachers were most favorable about the impact of the BOP activities on students' interest in STEM. The most favorable response among all participants was to the statement: "*My students were acting as scientists and recognized that it was possible for them to become scientists*." Participants in Oyster Tank training sessions (58 percent) rated this statement higher than ORS training participants, indicating the Oyster Tank sessions were slightly more effective in achieving the goal of empowering students to see themselves as scientists. (*A detailed report of the findings from the Year-End Teacher Survey can be found in the Appendix*.)

Findings from Teacher Professional Learning Survey

Overall, data collected from a survey of teachers following their participation in a sample of BOP professional learning activities in Pillar 3 in Year 2 , provides evidence that these sessions were successful and met the project's goals to provide support and resources for teachers to increase student engagement and learning in oyster restoration research, and interest in STEM careers. Facilitating ongoing participation in professional learning gives teachers more resources for engaging their students and new ways to build STEM engagement and interest.

Again, findings showed that some sessions were more successful than others for helping teachers build student awareness and motivate interest in STEM careers.
Creating explicit content that connects students to careers, including those beyond lab scientists, is an area where BOP can expand by being more explicit in promoting student awareness of themselves as doing scientific work and linking students' research projects to the pursuit of a STEM career. Three new virtual activities emerged this semester to address this issue, a series of three career panels, which were designed specifically by and for students to address career awareness in maritime STEM fields.

Student Research Symposium Projects

A further significant result is that 72 students created, presented, and discussed with scientists their own research projects, guided by their teachers with support from BOP at the annual BOP Student Research Symposium in June 2020, during COVID-19. Supporting students in creating research projects is another opportunity for teachers to promote student engagement and interest in STEM. Fifty percent of teacher respondents to this survey reported they planned to submit student projects to the next student symposium in June 2021.

All of these outcomes in Pillar 3 suggest that BOP adapted well to the virtual learning environment for teacher activities after March, 2020. Project staff's planning in spring and summer led to the successful professional learning sessions delivered in the fall. To see how BOP project staff adapted professional learning offerings, see the last section of this report: *Changes/Problems. (More discussion of the Teacher Professional Learning findings can be found in Section III: Implementation in this report and a detailed report of findings in the Appendix.)*

PILLAR 4: ADVANCED RESEARCH METHODS FOR TEACHERS RESULTS

Little or no evaluation data was collected for this pillar in Year 2 due to the partial implementation at the participating Labs at CUNY-Brooklyn, CUNY – York College, The River Project, and the Cold Spring Laboratory, as well as the lack of teacher participation in the lab activities that were scheduled. In observations of two of the water chemistry professional learning activities delivered by The River Project and Brooklyn College Labs' scientists, the evaluator found that the quality of the activities was high. Almost all of the characteristics of effective professional development included in the evaluators' *Observation Checklist Protocol* were present. (See Appendix.) Only the organizational aspects of the sessions, such as providing agendas and reading materials for the session in advance were missing. Observations also suggested that the few participants who attended these sessions were thoroughly engaged in the activities, but they did not respond to the teacher survey. (*See the Observation Report in the Appendix for a more detailed analysis.)*

THE MARK RESEARCH RESULTS

To be able to gather data about student engagement, student learning, and student interest in STEM careers, the research staff at The Mark focused their work in Year 2 on developing a fully digital system for collecting pre-post student survey data online with a signed parental consent process. The survey was to be administered to all student participants of BOP activities in all four pillars. Continuing from Year 1, the survey design went through a long series of iterations with the result that the final version became more user friendly and accessible to students and their parents, and allowed researchers to follow up to obtain signed parent consents from students who had completed the survey so that their responses could be entered and analyzed.
The survey was not administered in its final form until Summer 2020.

IV. IMPLEMENTATION FINDINGS

In this section, the report discusses project implementation, by pillar, to answer the evaluation questions.

EVALUATION QUESTION 1: *How well was the project implemented?*

In surveys, observations and interviews of project staff, the evaluator found that overall, there were limitations in project implementation on Year 2. Of the four pillars of the project, *Pillar 1: STEM Hubs, Pillar 2: Near Peer Mentoring, Pillar 3: Professional Learning for Teachers, and Pillar 4: Advanced Research Methods for Teachers and Students*, only Pillars 1 and 3 were fully implemented. In Pillar 2,project staff encountered logistical and recruitment obstacles to implementing the model outlined in the proposal. These were exacerbated by the COVID-19 situation. In the fall, staff identified a different near-peer model that could be implemented more easily. The new model was initiated in October 2020. In Pillar 4, one of the four Labs did not have any teacher participants.

Findings are presented in more detail below, by pillar, to address the effectiveness of the implementation in achieving the project's objectives.

EVALUATION QUESTION 2*: How well did the project work in supporting students to engage in STEM, increase career awareness, and motivate them to pursue STEM interests, skills?*

PILLAR 1 STEM Hubs

Goals:

- Engaging students in real world data collection and research at STEM Hubs located at NY Harbor waterfront sites.

- Developing student awareness and interest in pursuing careers in marine sciences, environmental science, and related STEM careers

Pillar 1 was effective in achieving the objectives of Evaluation Question 2 in supporting students to motivate students to engage in STEM activities to learn about oyster restoration, and increase career awareness. Observations of two onsite STEM Hub sessions, prior to COVID-19, provided evidence of the effectiveness of the project staff's facilitation in engaging students and promoting student learning. Sessions were rated on the presence or absence of 18 characteristics of effective professional development to achieve those goals. Almost all relevant desired facilitator practices were observed as 'present.' See *Observation Protocol Checklist* attached at the end of the report.

In interviews conducted by the evaluator with the Education Grants Manager, STEM Hubs manager and the Assistant Director of Education and Outreach identified the strengths of this pillar's activities. Before COVID-19, project staff enhanced the STEM Hub activities in Year 2 by adding a new deliverable – a classroom workshop as a pre-requisite to the site field visit to prepare students for field ORS monitoring, research protocols and data collection activities. As a consequence, "students were highly engaged in the ORS monitoring and research activities when they were in the field," observed the Assistant Director of Education and Outreach. "They earned how to use the research protocols to collect water quality data, take oyster measurements, identify other marine species living in the ORS, and to test each other's work for accuracy, "said the STEM Hubs Manager, who was facilitating these sessions. Another staff member observed, "Using the field data collection protocols was a big success this year. It worked out really well. The students were excited! 'I can't believe what lives in the water,' one student said. I really enjoyed watching the kids' amazement. I could see a light going off. They understand they are involved in the environment, they grasped it and want to tell others." The evaluator's observations corroborated this student excitement and enthusiasm, as well as the learning they were acquiring in these activities." Students were knowledgeable about how to use the ORS research protocols, record and analyze data, comparing their findings related to the water quality and size of the oysters, for example, from previous visits.

"The STEM Hubs is ITEST's greatest strength," said the Education Grants Manager. "The students' execution of the research protocols and the staff's modeling of field research pedagogy for teachers were the two main deliverables of this pillar. Staff is continuing to improve that. It will be a lasting feature of the Billion Oyster Project."

Additional evidence of the strength of this pillar was the depth and breadth of student participants who presented projects at the BOP Annual Symposium in June 2020 during COVID-19. Eleven students who participated in the STEM Hubs activities in Year 2 submitted research projects. "We could see our work was impactful on students' work," said the STEM Hubs Manager.

"They demonstrated awareness of the environment, a sense of ownership of the environment, knowledge about CSOs and how harmful they are, the importance of oysters and biodiversity, and an environmental call for action that was addressed in so many of the projects. They see themselves as stewards of the harbor, as community scientists, by being involved, possibly leading to careers in environment and industry." They had some guidance from their teachers but they were mostly independent student projects, created at home in the COVID-19 environment, using their knowledge and skills in the field and a lot of their own work. "I felt like a proud mama of those students."

A total of 14 students who participated in STEM Hub activities responded to relevant student survey questions administered by The Mark. They reported they felt moderately confident about their skills in conducting a scientific investigation and their ability to collect research data. See (*Student Survey Results Report* attached)

Challenges to Implementation

Prior to COVID-19 in March 2020, live Oyster Restoration Station monitoring field sessions were conducted at three STEM Hubs - Canarsie, Bayswater, and Coney Island. One site – Bush Terminal - had construction issues that prevented the public's use of this site. Due to COVID-19, project staff could no longer hold live ORS monitoring and research sessions at the waterfront. "Not having hands-on experiences for teachers and students at STEM Hubs was the hard part for this year," said the Hubs manager.

Modifications in Implementation

When the pandemic arrived, instead of taking students out to the harbor to gather data from the ORS, project staff convened a panel of scientists on zoom, and used a video made previously of students working at the water's edge to collect data from their ORS, doing oyster measurements and data collection using the ORS protocols. Students were able to submit questions live to the scientists. Subsequently, project staff created virtual field trip videos of ORS monitoring from each of the STEM Hub sites for teachers to use on their own with students. Using pre-recorded videos, however, posed other challenges. "It's hard to know what students get from them," said the Hubs manager. "We can't figure out what teachers are doing to engage students in the videos." Project staff also designed and facilitated virtual classroom lessons for teachers and students, which before COVID-19, had been designed as the prerequisite activity for taking students out to the STEM Hubs.

An additional modification for this pillar was designing lesson plans and activities for students to do on their own. These materials included step-by-step examples of how to do BOP-related activities at home: making research tools, learning oyster anatomy, using research protocols and

data collection sheets. "We tried to keep the same spirit in a virtual way, doing hand's on and using art activities such as creating your own oysters using salt dough, your own fish, or parts of a fish; studying oyster anatomy and how oysters filter water. "Its good content and will be used now and beyond COVID-19."

Plans for the Future

The STEM Hub staff's plans for Fall 2020 and Spring 2021 include trying to develop more activities to go deeper into the content and research process in schools that were already participating in BOP, rather than expanding the number of schools participating in the virtual programming.

PILLAR 2: NEAR PEER MENTORING

Goals:

- Pairing older and younger students for oyster research mentoring to engage students in STEM learning through waterfront research activities.
- Creating student awareness and interest in pursuing careers in the marine sciences, the environment, and related STEM fields.

In interviews with project staff, the evaluator found that there were challenges right from the beginning in implementing the proposed model for this pillar. In interviewing the Assistant Director of Education and Outreach, the evaluator learned that, before COVID-19, program staff encouraged three schools (ES, MS, HS) which had already installed and were managing an ORS to collaborate with each other to identify students as mentors and mentees in facilitating oyster restoration research, and promoting student career interest. "That model was never fully operational, before or during COVID-19." Staff came up with an alternative model which was initiated, beginning in November 2020. In the new model implemented on zoom, juniors from the Harbor School, a CTLE high school on Governor's Island who were participating in the school's Harbor Corps afterschool club were to be mentors to incoming Grade 9 students at Harbor School who were learning about the school's seven maritime careers for the first time. The new model has been effective in engaging students, but the topics discussed tend to be more school-related than directed to the BOP objectives for STEM student engagement and learning. Even during COVID-19, the project coordinator was able to organize a waterfront visit for the mentors and mentees who spent several hours there to help clean up and discard trash at the waterfronts at two STEM Hub sites.

Challenges to Implementation

In interviews with the Assistant Director of Education and outreach, the evaluator found that although the pandemic interrupted the implementation of this pillar, even before COVID-19, staff reported there were challenges to operationalizing this pillar. "The primary challenge was the difficulty of bringing high school and middle school students from different schools and even different boroughs together for a mentoring activity," said the Assistant Director of Education and Outreach. "It was a hard pillar to implement from the beginning – hard to get schools to commit to it, difficult to identify and sign up mentors in the schools, and cumbersome to do cross planning between schools," said the project staff member. Only one workshop for mentors and mentees was implemented prior to COVID-19. "After COVID-19, we texted the teachers to try to continue remotely but we couldn't figure out how to do it. There was no contact with students or with the oyster restoration stations when the schools closed. Staff was searching for ways to get the mentors and mentees together virtually, but there were no remote activities for the students to do in that pillar. The mentoring pillar needed to be re-evaluated; it was not properly, fully developed."

Said the Education Grants project manager, "The near –peer mentoring pillar was weakly implemented in Year 2, but it's the area with the most potential. It would be a huge value for underrepresented students – to instill a sense of ownership in the mentors in the [harbor environment]."

Modifications in Implementation

A new model for the near-peer mentoring pillar was finally identified by project staff in September 2020 (during COVID-19) to adapt to the remote learning environment. In interviews, the Assistant Director of Education and Outreach and the pillar's coordinator described the model. "It was based on using upper grade Harbor School students who were participating in the *Harbor Corps* afterschool club as mentors to incoming Grade 9 Harbor School students." The purpose of Harbor Corps was to provide a space for students to share projects or topics they are currently working on and work together to further the mission of the Billion Oyster Project.

In the fall, Harbor School mentors and mentees met via zoom weekly to discuss topics or prompts provided by the facilitator who chose them in collaboration with the students. Students met for 30 minutes on their own, without the facilitator and then regrouped to discuss the topic as a group. In the evaluator's observations of two sessions, topics included discussion of Harbor School-related matters and issues related to remote learning, as well as career interests. This group participated in two live BOP activities in the fall: clean-ups at NY harbor sites – Brooklyn Navy yard, and Sunset Bush Terminal Park - with the long-term goal of developing a BOP community reef to engage families and younger students with the water. "The near-peer

mentoring kids got to see each other outside, with masks," said the pillar's coordinator. "They can do small-scale things as long as they are outdoors. I suspect it gives a big morale boost to the students who were glad to see each other in person."

In addition, project staff created a series of three career webinars with panels of maritime STEM professionals (a ship captain, ship crew, marine biology researchers, marine affairs policy advocates), some of whom were former graduates of the Harbor School. The panels focused on three STEM maritime careers: Ocean Engineering, Marine Biology, and Marine Policy and Environmental Advocacy. These webinars were facilitated and supported by Harbor School students. The audience for these webinars were students from other NYC high school students. "We had 200 students from schools in NYC attending the webinars," said the Assistant Director of Education and Outreach. The vast majority were students from Mott Hall Bridges school. "We sent out emails to our (newly updated) educator network and the school made it possible for all of their 7th and 8th graders to join the webinar." The career webinars were recorded and will be reprised in 2021 specifically for the *Harbor Corps* mentor-mentee group, as well as the general Harbor School student population.

EVALUATION QUESTION 3: ***How well did the project work in supporting teachers and STEM professionals/scientists/ mentors to motivate students in developing interests, skills, knowledge, and career awareness in restoration science and related fields?***

PILLAR 3: PROFESSIONAL DEVELOPMENT FOR TEACHERS

Goals:

- Provide support for teachers to take students out to the water to engage and learn hands-on in STEM discovery and exploration with Oyster Restoration Stations.
- Develop teachers' capacity to develop student awareness and interest in careers in the marine sciences, the environment, and related STEM fields.

Prior to and during COVID-19, Pillar 3 was implemented effectively with high quality onsite and virtual professional learning activities for teachers in two areas: 1) supporting teachers and students in the introduction, maintenance, and use of oyster restoration stations, 2) designing content and pedagogical strategies for teachers to engage students' in learning about and exploring marine and environmental science STEM careers. Staff noted that having to adapt BOP activities for COVID-19 "brought the education team closer together. We all had clear tasks and responsibilities and it came out really well. It was a learning moment for us to move forward virtually. We didn't want anything to fall by the wayside because of COVID-19."

Findings from observations, staff interviews, and survey data cited above provided evidence of the quality of the delivery of these activities, and effectiveness in preparing teachers to the use

their learning in these sessions to engage students, promote student learning, develop student awareness of STEM careers.

Further evidence of the effectiveness of the professional learning experiences to support teachers (mostly during COVID-19) in engaging students in oyster restoration research and raising students' awareness that they themselves were working as scientists can be found in the depth and breadth of the research projects submitted by students to the annual BOP Symposium in June 2020; 72 projects were presented, discussed, and judged via zoom over the course of a week. Observed one staff member, " It was real life scientists exploring real life issues. I saw evidence of research related to water quality and the relationship to oysters, oysters and oyster growth, the impact of combined sewer overflows…I was really happy to see what we teach in our activities shining through."

Challenges to Overall Implementation

Recruiting elementary school participants for BOP career development sessions was the biggest challenge for this pillar, before and during coved. Before COVID-19, sessions had no more than 3 or 4 participants. There were no participants for one session. Recruitment of student research projects for the June 2020 Symposium, given the low teacher participation, was also going to be a challenge.

Modifications to Overall Implementation

The project's response to the lack of teacher participation in Pillar 3 activities has been varied. It included expanding professional learning opportunities from elementary teachers to include teachers in all grades. Staff also focused on building a sustained professional learning model by creating a current contact list of past and current BOP participants in all grades to establish a viable email contact list. In addition, all professional learning activities were advertised on the BOP *Eventbrite* web page. This site facilitated teacher registration for the events and maintained an ongoing participant contact list. "[These activities] allowed us to answer the research question about how many schools and students we are working with," said the Education Grants Project Manager. "Now there is interest and the knowledge [among project staff] about how to do that. The staff now understands the value of doing that data collection."

Later in the year, project staff recognized that the descriptions of the professional learning activities on the *Eventbrite* page were ineffective in generating teachers' interest. "We needed to give more information, a fuller description of the workshop and the resources such as data collection protocols, tools, and curriculum materials that would be provided to participants during the session." Staff conceived their spring activities as a dry run of this approach – "to see what worked and didn't work."

"We have to maintain contacts with teachers in a more meaningful way," said a staff member. "We need to focus on depth, not breadth and strive for the quality of engagement that enables us to reach students in the same way. "Based on the dry run in the spring, staff came up with a strategy designed to do this. The plan was to design a menu of professional learning activities for the entire school year that was coordinated with the NYCDOE school calendar as a flow and progression of related sessions. "We know what needs to be improved. I think offering this training in progression will help teacher attendance," said the staff member. "We would organize the teachers by cohorts. Teachers would move through a progression of activities and graduate in a training cohort together. We think this will keep up and foster peer discussion and keep teachers coming to the sessions," said the field science specialist. "We're moving toward this."

To further bolster teacher recruitment in BOP professional learning activities, in Fall 2020 project staff prepared a series of courses and descriptions to submit to the NYC Department of Education's official catalogue of professional development opportunities. The NYCDOE agreed to award professional learning credits (CTLE) to teachers through Pace University as an incentive to participate in BOP activities. Accumulation of these CTLE credits enabled teachers to raise their salary level.

Recruitment of teachers and students for the June Symposium also required a change in approach. Staff used the newly updated participant email contact list for a more intensive outreach effort to teachers. "We didn't just ask teachers to submit projects, " said the Education Outreach Coordinator. "We kept in touch with teachers repeatedly by email, asking them how they were doing, and what we could do to help. " "In the months leading up to the Symposium," said the Education Field Science Specialist, "we talked to 120 students a day (virtually) in two or three schools to explain how they could do projects. Students were very excited. They continually reached out to me with questions about their projects. This was a real success."

"As BOP system grows, so does the system, "concluded the Education Outreach Coordinator. "The protocols for recruitment are getting fine-tuned so that we know what happens when a teacher enters any component of our system."

Challenges to Oyster Restoration Station (ORS)Activities

There were pre-COVID-19 and during COVID-19 challenges specific to the ORS component of this pillar: 1) Teacher participation in the full series of sessions was inconsistent and as a result, teachers did not have all the guidance they needed to work effectively with the students at their oyster restoration stations; and 2) ORS stations installed in Phase I of BOP were abandoned. "There was no accurate historical record or contact information about where the ORS stations were located and which schools and teachers managed them," said the Education Field Science

Specialist. "The program expanded quickly [in Phase 2], "but there was no follow-up. Teachers need extra hand-holding and support from BOP to be able to thrive in the program. My goal is to make sure that every participant feels supported and taken care of. We have to continually engage people who are already in the program – forming relationships in person out by the water - so that they can keep on participating and feel enriched. I would love to have a personal relationship with every teacher but I don't have the capacity and the project doesn't have the funds to support to hire additional staff to do that."

Another challenge to implementing the ORS component, before and during COVID-19, was geography. Before COVID-19, the Field Science Specialist arranged ORS site visits with teachers and students. "I connected with teachers by email to set up a time to meet at the ORS site for two hours. I did two visits in Inwood and Harlem and it worked well." However, the BOP locations at Governors Island and the Brooklyn Navy Yard made it difficult to serve neighborhoods in the Bronx, Queens and State Island. It was challenging to provide ORS support in these boroughs using only the subway to transport staff and equipment. A trip to the Bronx or Staten Island could take an entire day. "The vast majority of the ORS stations are in Manhattan and Brooklyn. If we say we are serving all NYC, we need to have the resources to set up ORS bases in the other boroughs to serve these communities."

Modifications to Oyster Restoration Station Activities

During COVID-19, project staff addressed the teacher and student recruitment challenges by building an educator network – a teacher contact list culled from over 900 past and current participants and trying to identify the teachers and schools which had installed oyster restoration stations in earlier iterations of the program. The Education Field Science Specialist and Education Outreach Director worked together to initiate and maintain contact with this cadre of teachers during COVID-19. They sent them regular emails, giving them updates on their oyster restoration cages, notifying them about upcoming events, and sending out the BOP newsletter.

Project staff converted the ORS Basic Training series to virtual sessions, using zoom technology. To recruit teachers that would attend all three sessions - two virtual and one live session outdoors at Governors Island - project staff initiated what turned out to be an effective outreach effort. A 45-minute webinar – open to any interested teachers - was designed to provide an overview of the workshops and requirements for participation in Oyster Restoration Station Basic Training to interested teachers, so they could get a sense of what was involved and know the extent of the commitment required before they signed up for the training. "This was a good innovation," said the Outreach Director. "The webinar gave teachers the opportunity to ask questions, and to clarify whether the activities were appropriate for their students and the classroom or curriculum." It also added accountability.

An "oyster blitz" was another idea to promote interest in oyster restoration, post COVID-19. On the same day, all the teachers, students, and everyone who had an ORS would go out to monitor and collect data from their oyster cages (many of which are installed at the same waterfront sites). "All the school groups would be at the waterfront together, mingling and getting guidance."

Plans for Future ORS Activities

With these modifications in place, project staff said they were "looking forward to tightening up the ORS component, adding more tracking systems to document teacher training and support; monitoring the schools' ORS field activities, and use of the digital platform for students to enter, record, and analyze quality oyster data. "When we don't have that kind of data, we can't see where the program is going," said a staff member.

To engage the wider community in oyster restoration after COVID-19, and bolster the participation of the education community, the specialist described initiating informal *Meet and Greet* events at the ORS sites to build a community of ORS stewards. "I believe people are more interested if they are part of a community."

PILLAR 4: ADVANCED RESEARCH METHODS

Goals:

- Introduce advanced level research methods for teachers to engage high school students in oyster restoration-related research.
- Encourage and motivate students to pursue a career in the marine sciences, the environment, and related STEM fields.

In Year 2*,* Pillar 4 was not fully implemented. Before COVID-19, three of the four participating research labs - CUNY Brooklyn, CUNY- York College, and The River Project developed their own two-day series of professional learning activities for teachers in water chemistry and e-DNA. A very small number of teachers participated in the series created by CUNY - Brooklyn College (1-2 students) and The River Project (2-3 students) related to New York Harbor water chemistry and bacterial monitoring. In observations of two sessions and interviews with the Lab scientists, the evaluator found that the strengths of the activities that were delivered were the opportunities for teachers to engage in authentic research procedures themselves - collecting water samples from the NY harbor, recording data, learning how to use research protocols, enacting simple water sample analysis, and using a variety of data sets to analyze data, comparing bacteria in different parts of the harbor – all skills and practices which they could teach to their students. No teacher or student survey data was generated for this pillar due to low participation.

The third participating laboratory, CUNY York College, designed a series of e-DNA sessions but no one attended. The fourth Lab, Cold Spring Laboratory, did not produce any DNA barcoding professional learning activities in Year 2.

EVALUATION QUESTION 4*: To what extent was the research plan effective in identifying the impacts of the program?*

RESEARCH ACTIVITIES

In interviews and 21 biweekly meetings with Senior and Associate Researchers, the evaluator found that implementation of research activities was lagging behind and continued to be delayed into Fall 2020. Continuing in Year 2, the research staff worked on the development of a fully digital student survey with parental consent forms. In addition to research questions, the survey included 4 to 5 evaluation questions for each pillar. The surveys were to be administered online to all BOP student participants. There was a series of challenges that delayed the student survey administration until Fall 2020.

Challenges

Recruiting teachers participants for the advanced research methods lab professional learning activities was a challenge. Three of the four labs participating in this pillar implemented professional learning activities. Only two people attended the two two-day water chemistry courses offered by Brooklyn College and The River Project, one environmental educator and one teacher. Only the teacher attended both sessions; no one attended the eDNA series offered at CUNY -York College. "There was insufficient publicizing, recruitment outreach, and contact building to attract teachers to the labs' professional learning activities," said a staff member. "The challenge was how to connect the Labs' activities to BOP's other professional learning recruitment. "

The Cold Spring Laboratory DNA barcoding activities were not implemented at all by early fall 2020.

Modifications

To adapt to COVID-19, lack of implementation by two participating Labs, and lack of teacher participation, project staff initiated a meeting of the scientists from the participating labs' in the summer 2020 to explore the development of materials for virtual lessons – classroom guides and digital versions of the lab protocols - for teachers to use in the virtual zoom classroom. Scientists from each lab were preparing their own materials. The scientist from Cold Spring Laboratory's DNA Learning Center which did not deliver any activities in Year 2 reported, "We will

be packaging our resources as a tool kit for teachers with instructions about how to use it, create training videos to get teachers up to speed on DNA and species identification by cross pollinating our college program with the BOP project."

Project staff saw the potential for generating or modifying their own project materials in a similar way to attract advance level high school teachers and students. "The labs' materials can be customized as part of a professional learning package for more advanced teachers, " said the Director of Education. "We need to get teachers to use the materials and figure out how to measure the effects of the activities," said the grants manager.

Another suggested modification was to prepare advanced research lab activities for students to do on their own, at home or outside their homes, but with such limited teacher participation, and no follow-up, there was no way to identify students who might be interested in doing these activities.

In Fall 2020, to bolster teacher recruitment to the Advanced Research Lab activities along with the BOP professional learning sessions in other pillars, the NYC Department of Education agreed to award education credits teachers to teachers participating in BOP professional learning activities (CTLE) through Pace University. These credits enhanced opportunities for teachers to increase their salary level. Taking a cue from the experience of Pillar 3 staff, who enhanced their course descriptions for the *Eventbrite* web page, the Education Grants Manager created a full description of each of the Lab courses to attract teachers and submitted it to the NYCDOE's catalogue of professional learning courses and workshops.

The final iteration of the survey was completed in Summer 2020. In Year 2, student evaluation data was generated for Pillar 1 only. The results from the student survey in Year 2 have not yet been presented to project staff.

IV. CONCLUSION

Reviewing the data collected in the BOP evaluation activities to answer the evaluation questions related to project implementation, the evaluator found that the project's implementation in Year 2 contributed to promoting the project's goals to increase STEM student engagement, student learning, and student interest in STEM careers. Pillars 1 and 3 designed and delivered onsite and virtual interventions that were effective in preparing teachers to engage students in learning science content related to oyster restoration research in the New York Harbor. Prior to and during COVID-19, project staff who were facilitating Pillar 1 and Pillar 3 modelled and explored 'best' pedagogical practices and activities that were designed for teachers to engage students in STEM learning. Aspects of these sessions provided opportunities for raising students' awareness about careers in STEM marine sciences, such as encouraging students to see themselves as

scientists while they are collecting data at ORS sites and promoting students' awareness of the possibility that they themselves could become scientists in the future conducting similar kinds of research. However, the references to career opportunities must be more explicit and consistent throughout the project's activities.

The evaluation findings indicate that if all four pillars could be implemented with the same quality, consistency, and creativity as *Pillar 1: STEM Hubs* and *Pillar 3: Teacher Professional Development*, the BOP project could be effective overall in achieving the program goals of promoting student engagement with STEM, instilling student learning, and motivating students to pursue careers in marine and environmental sciences, even as remote learning continues. In the creation of a new model more adapted to the remote learning environment, *Pillar 2: Near Peer Mentoring* appears to be on the way toward effective implementation if the activities in Year 3 are focused more directly on achieving the project's goals for students. They should be more directed more explicitly to career development For the future of *Pillar 4: Advanced Research Methods*, a model of effective remote program implementation has been established in two of the four pillars and at two of the four participating Labs. This model could be utilized to fully implement this pillar. Near the end of Year 2, implementation of the research activities is not yet fully realized, but appears to be on the way to presenting its results by the end of Year 2.

APPENDIX

Evaluation Reports

Table of Contents

Gaylen Moore Program Evaluation Services

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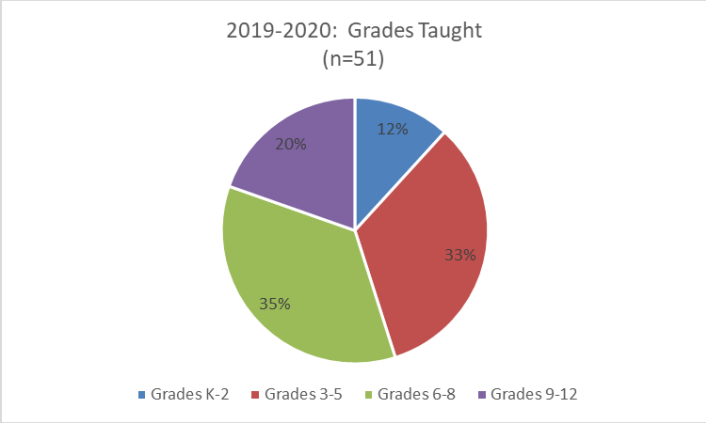
STEM+C
Year-End Teacher Survey Findings
June 2020

FINDINGS

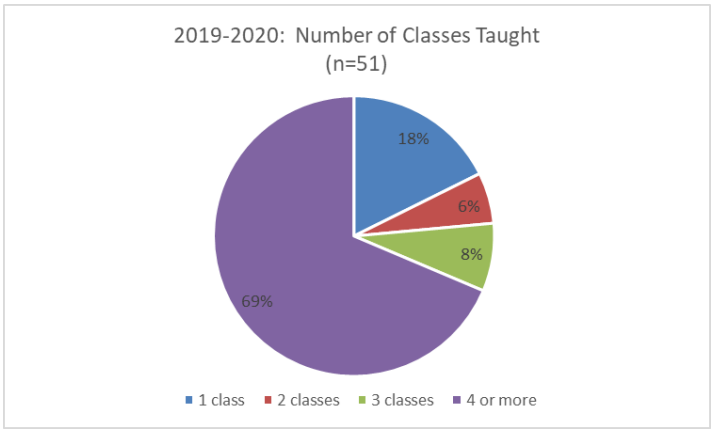
Teachers who participated in Billion Oyster Project (BOP) activities completed a survey about their experiences in 2019-20 at the end of the school year in June 2020. Below are findings* from 51 teachers who responded. They attended either an Oyster Research Station (ORS) training or Oyster Tank training session during the 2019-2020 program year. Participants responded to survey questions following these activities: how BOP participation had an impact on their teaching practice, their students' research project activities, and developing student awareness of STEM careers. Teachers also shared feedback about the challenges, both before and after the covid-19 outbreak and closure of schools on March 16, 2020 in implementing BOP activities online with their students.

*Note: A second round of this survey was administered in late July to capture the responses of teachers who participated in the June 2020 Symposium of Student Research Projects. Only one additional response was collected, and is not included in this report.

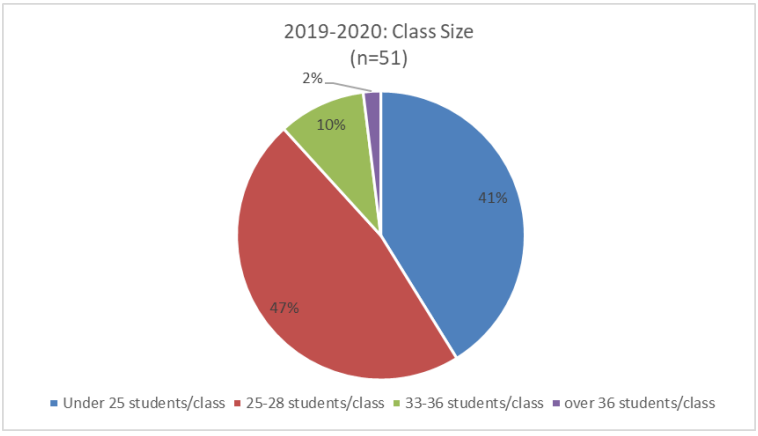
Demographics



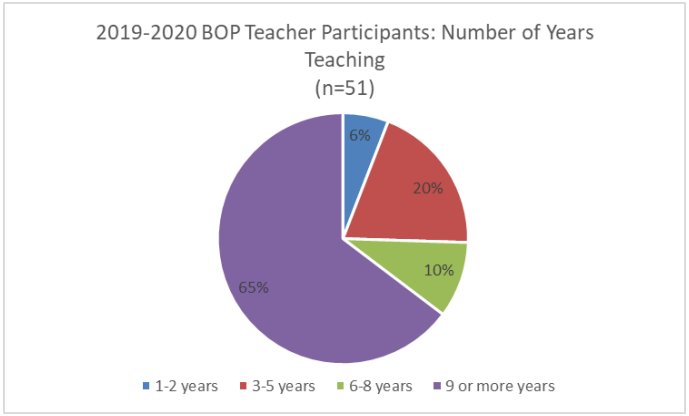
- Respondents represented teachers across all grades.
- Upper elementary school teachers (grades 3-5) and middle school teachers (grades 6-8) were most frequent, with 33 and 35 percent of respondents respectively.



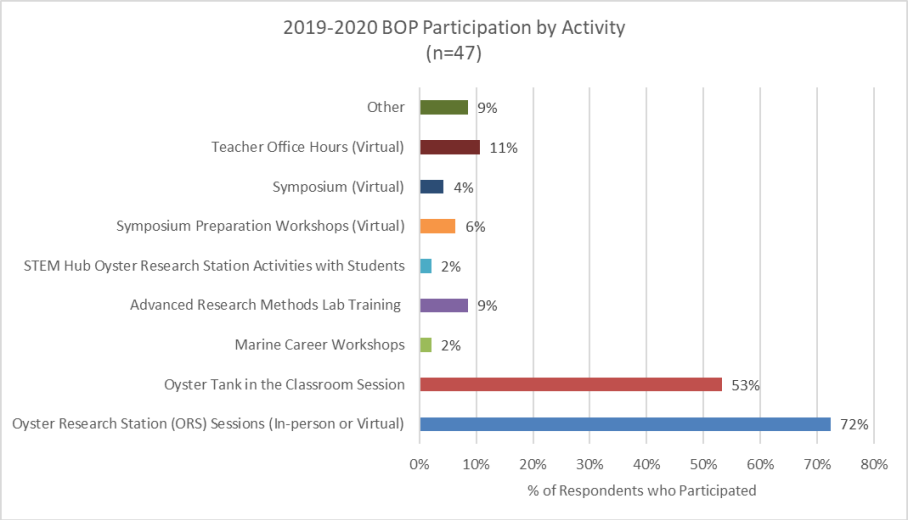
- The most frequent number of classes taught was four or more. This potentially means teachers were able to use BOP activities with multiple classes.



- Eighty-eight percent of respondents teach classes of 28 or fewer students.



- Most teachers participating in BOP activities are experienced. Seventy-five percent of respondents have been teachers for at least six years.
- Sixty-five percent of respondents reported having taught for nine years or more.

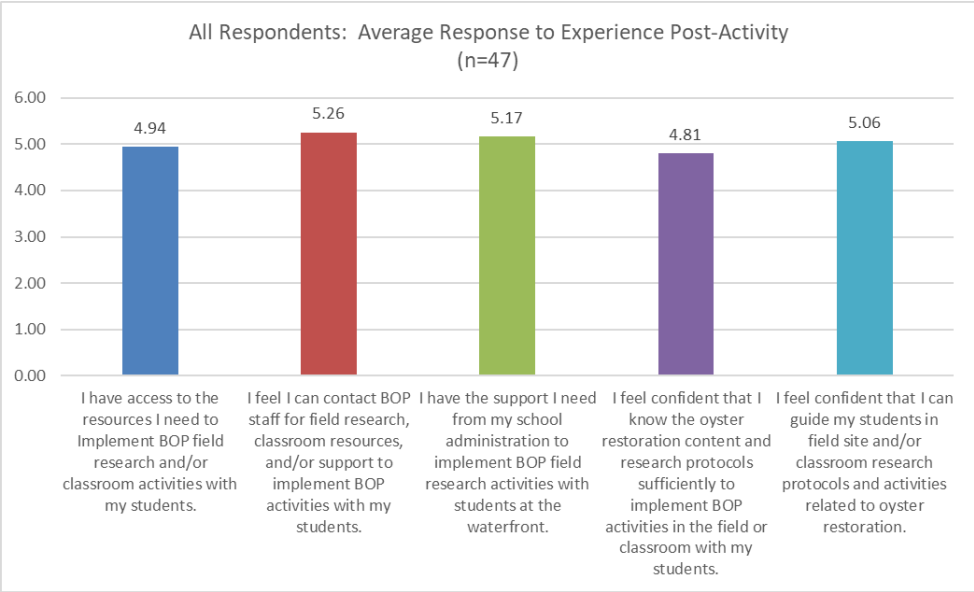


- Eighty-six percent of survey respondents reported that 2019-2020 was their first year participating in BOP activities. This is reflected in which activities were most commonly attended by these respondents.
    - Seventy-two percent attended an Oyster Research Station training, either in-person or virtually.
    - Fifty-three percent attended Oyster Tank training.
    - More specialized sessions such as the Marine Careers workshop series and the Advanced Research Methods training had fewer respondents, as well as participants overall.
- Based on these results, researchers decided to administer a second round of the End-of-Year survey, revising the recipient list to target teachers who attended events with low responses in order to get a more accurate representation of these events. The second round yielded only one additional response which is not included in this analysis.

EFFECTIVENESS AND IMPACT OF BOP ACTIVITIES

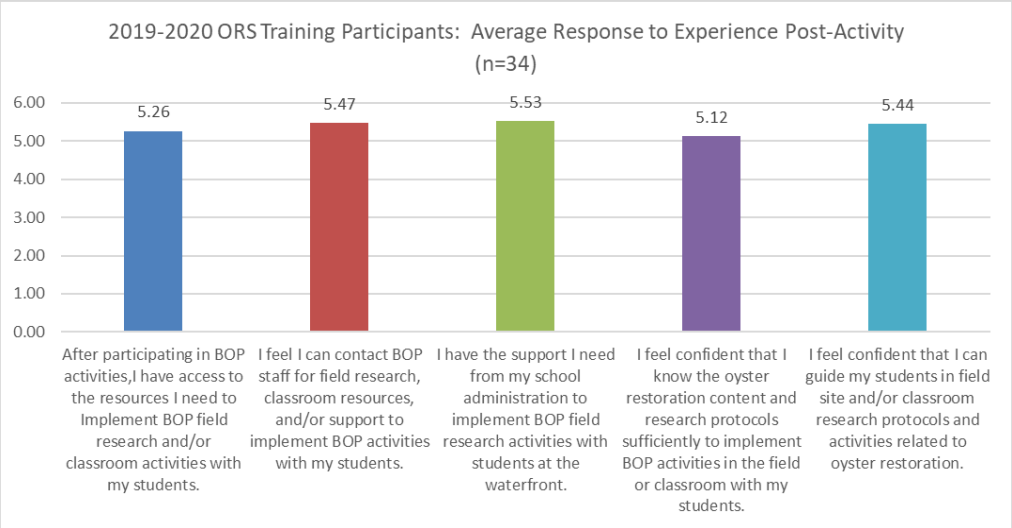
Teachers responded to statements about their experience in the oyster research station (ORS) and oyster tank (OT) training sessions and how they had utilized their related knowledge and skills with their students. They responded to the statements on a scale of 1 (Strongly Disagree) to 6 (Strongly Agree).

All Respondents



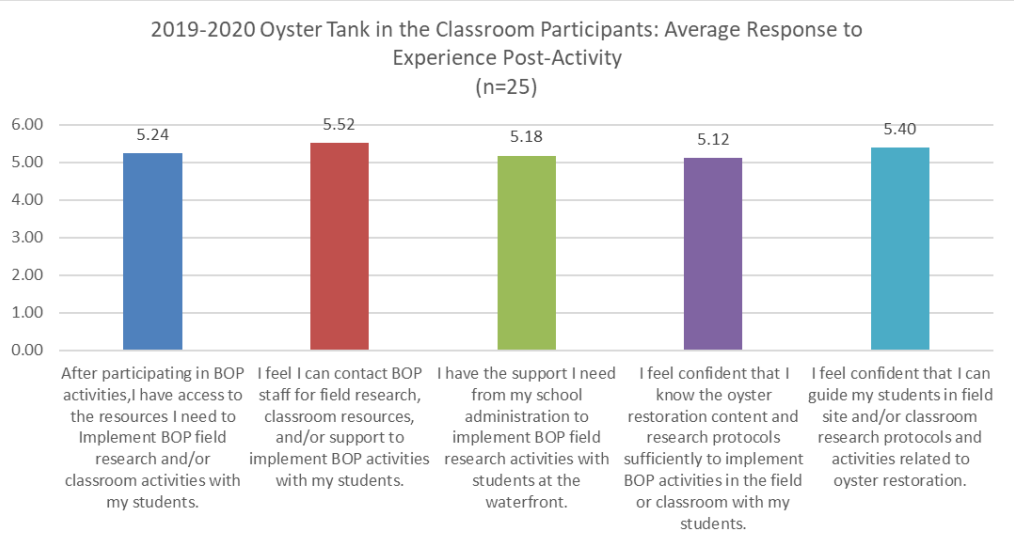
- Average responses to all statements were positive, with teachers agreeing to some degree with all statements.
- The statement with the highest average response across all respondents was *I feel I can contact BOP staff for field research, classroom resources, and/or support to implement BOP activities with my students*, with an average response of 5.26 (standard deviation=1.17), suggesting that participants see BOP facilitators as an ongoing resource in implementing the activities with students.
- The statement with the lowest average was *I feel confident that I know the oyster restoration content and research protocols sufficiently to implement BOP activities in the field or classroom with my students*, with an average response of 4.81 (standard deviation=1.21).

Participants in Oyster Restoration Station Training



- Responses for 2019-2020 ORS training participants were more positive than among the overall respondent group. All average responses fell between 5 (Agree) and 6 (Strongly Agree) and reflect a high level of confidence in implementing BOP activities with students.

Participants in Oyster Tank Training

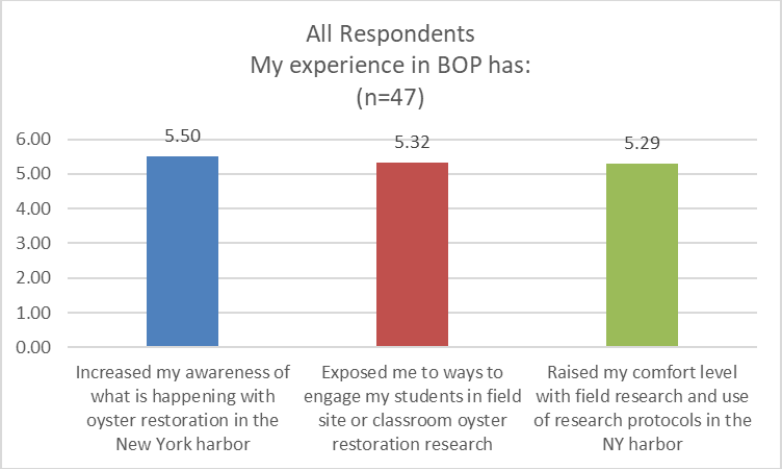


- Similarly, average responses from 2019-2020 Oyster Tank training participants were higher than those from the all respondent group and fell between 5 (Agree) and 6 (Strongly Agree).

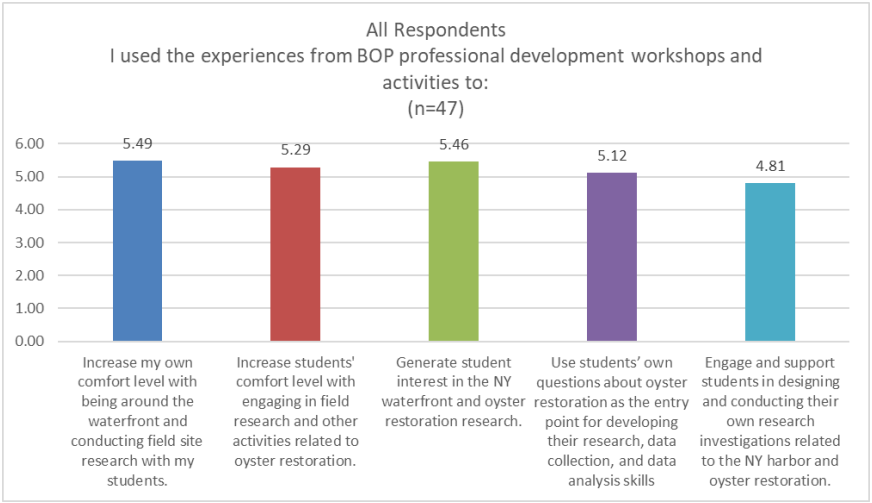
IMPACT ON TEACHING PRACTICE

Teachers responded to series of statements reflecting on how their BOP experience changed their practice related to engaging students in field science and student-driven research. These statements were evaluated on a scale of 1 (Strongly Disagree) to 6 (Strongly Agree).

All Respondents



- Average responses to statements about impact on teachers were positive with all averages falling between 5 (Agree) and 6 (Strongly Agree).
- The highest average response was to the statement *My experience in BOP has increased my awareness of what is happening with oyster restoration in the New York Harbor*, with an average of 5.50 (standard deviation=1.10).

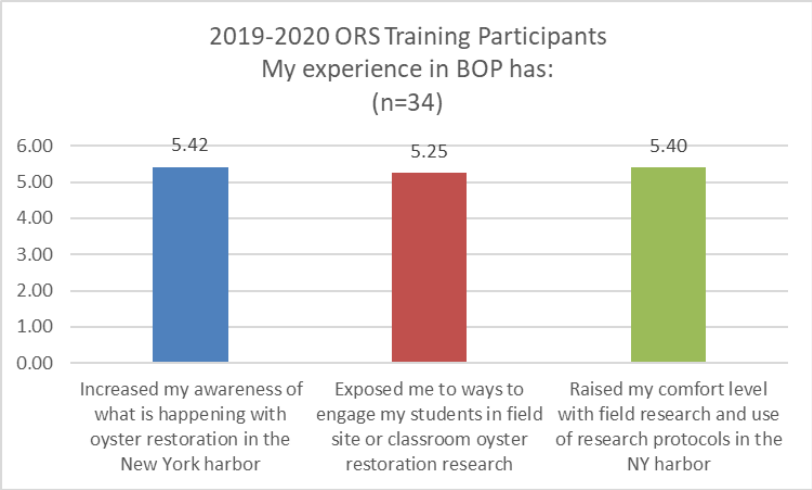


- A second set of statements centered on teachers use of their BOP experience with students also had positive results. Average responses were all above 4 (Somewhat Agree).
- The highest response was to *Increase my own comfort level with being around the waterfront and conducting field site research with my students* with an average response of 5.49 (standard deviation=0.93).

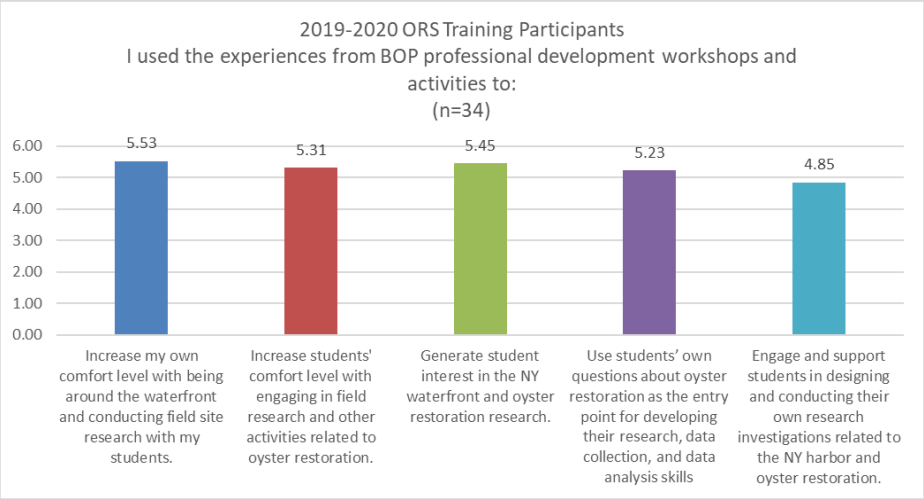
- The lowest response was to *Engage and support students in designing and conducting their own research investigations related to the NY Harbor and oyster restoration*, with an average of 4.81 (standard deviation=1.24).

While this is still a positive outcome, this lower response to confidence in their ability to support student research is reflected in the lower number of teachers who reported engaging students in BOP related research projects generally and BOP Symposium projects specifically (see below). This year's school closures also led to specific challenges in this area, which will be discussed at the end of this report.

Participants in Oyster Restoration Station Training

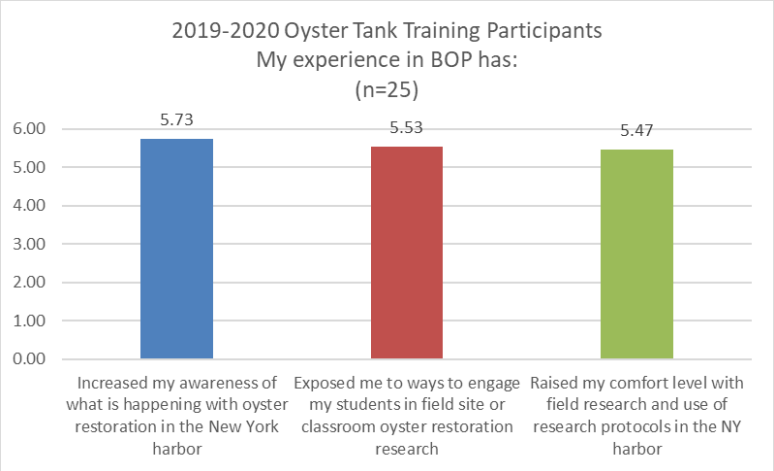


- Among 2019-2020 ORS training participants, average responses to statements about impact on teachers were positive with all averages falling between 5 (Agree) and 6 (Strongly Agree).
- Average responses to two statements were slightly lower for this group than the overall respondent group.
- Average responses to one statement, *My BOP experience has raised my comfort level with field research and use of research protocols in the NY Harbor* was higher. ORS training intensively focuses on this aspect of BOP's work.

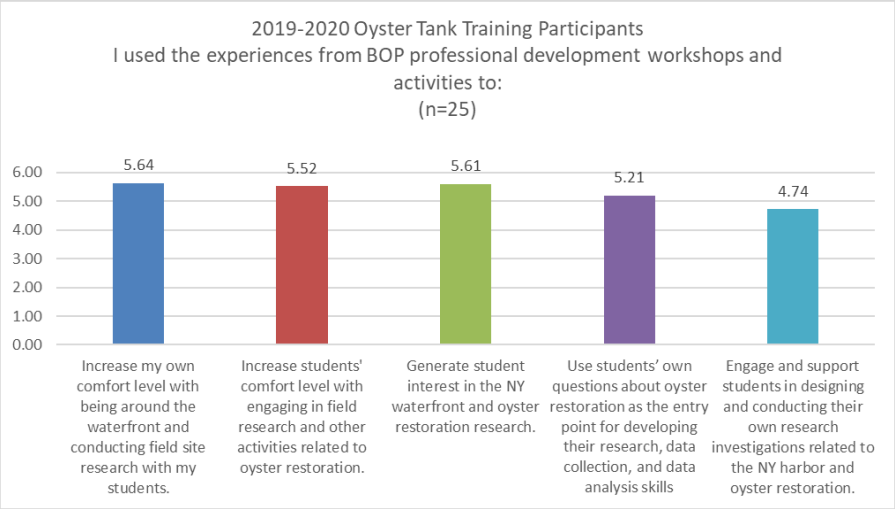


- Similarly, ORS training participants' responses were slightly higher on statements about using their BOP experience with students and reflect positive responses overall, with all responses above 4 (Somewhat Agree). These average responses suggest that teachers feel more confident engaging with students in field science and research than they did prior to participation.

Participants in Oyster Tank Training



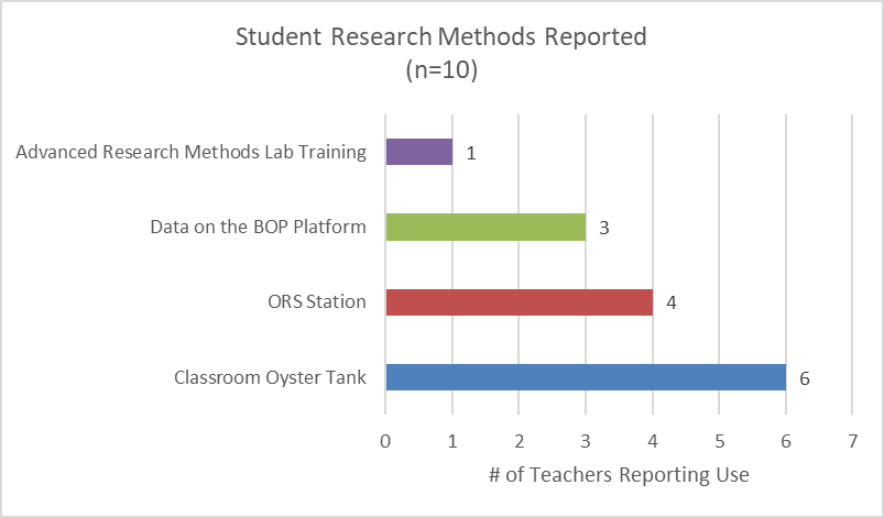
- Oyster tank training participants had the most positive responses with average responses approaching or above 5.50 on all statements.



- On three out of five statements about using their BOP experience with students, oyster tank training participants responded more positively than ORS participants or the all respondent group.
- This group had the lowest overall response to *Engage and support students in designing their own research investigations related to the NY Harbor and oyster restoration*, with an average response of 4.74 (standard deviation=1.28).
    - This lower response is somewhat surprising as using an oyster tank provides students with opportunities to do research without leaving the classroom.
    - Among those who reported that their students did participate in BOP related research, oyster tanks were the most frequently sited source of this research (see below).

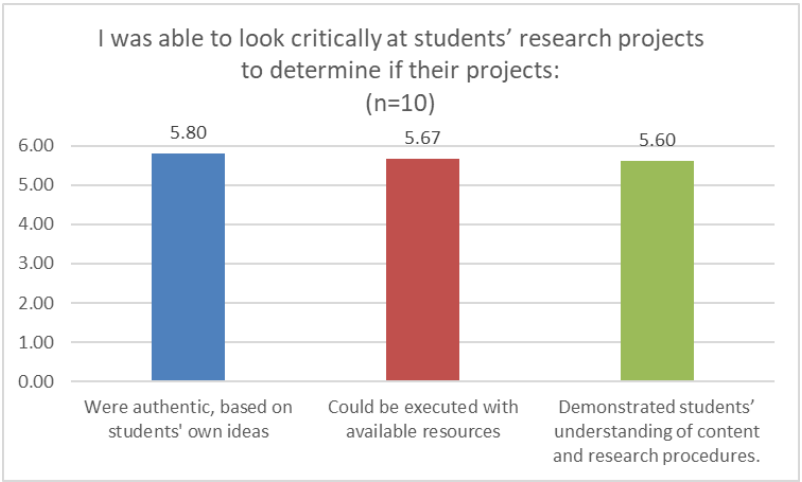
STUDENT RESEARCH PROJECTS

Twenty-four percent of participants reported that their students were developing research projects related to oyster restoration. All of the teachers who reported students doing this research had attended either an ORS training or an oyster tank training during the 2019-2020 program year.



- When asked what methods of research students used, teachers reported that students used:
    - *Classroom oyster tanks*
    - *ORS stations*
    - *Data on the BOP platform*
    - *Advanced Methods Lab training*

  Note: teachers could select more than one research method
- The most common source of research was the classroom oyster tank, which was reported by six teachers.
- The least common response was Advanced Methods training. This training was more specialized and reflects a lower number of participants, as well as survey respondents, overall.



- Among those whose students did research projects, teachers were able to assess their students' work in three areas: authenticity, feasibility, and content knowledge. Teachers

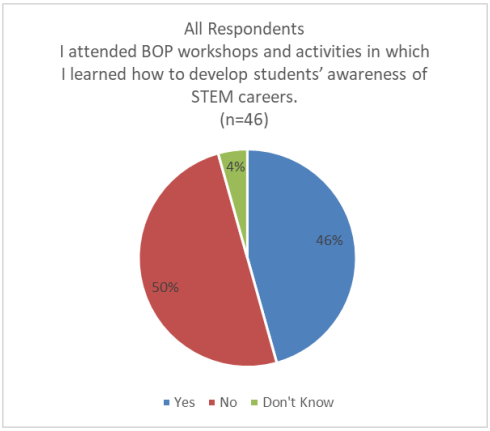
responded positively to their abilities to make such assessments with average responses to all statements between 5 (Agree) and 6 (Strongly Agree).

- Teachers reported that school closures led to challenges for students' research, as will be discussed below

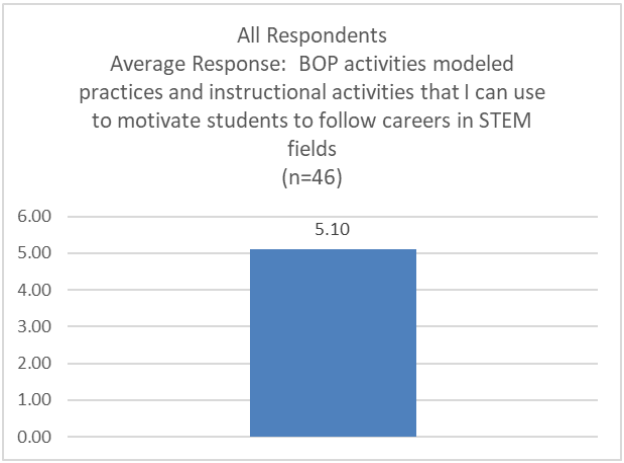
STUDENT STEM CAREER AWARENESS

Participants responded to statements about how their participation with BOP helped them develop students' interest in STEM careers, especially those careers related to marine science and technology.

All Respondents

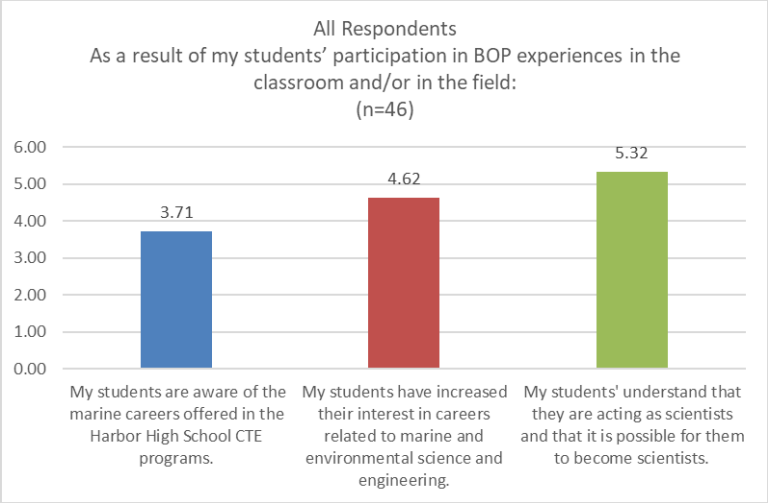


- Forty-six percent of all respondents responded that they attended a session in which they learned how to develop student awareness of STEM careers.
- Fifty-four percent either responded that they did not attend a session where they learned this or they did not know if they did.



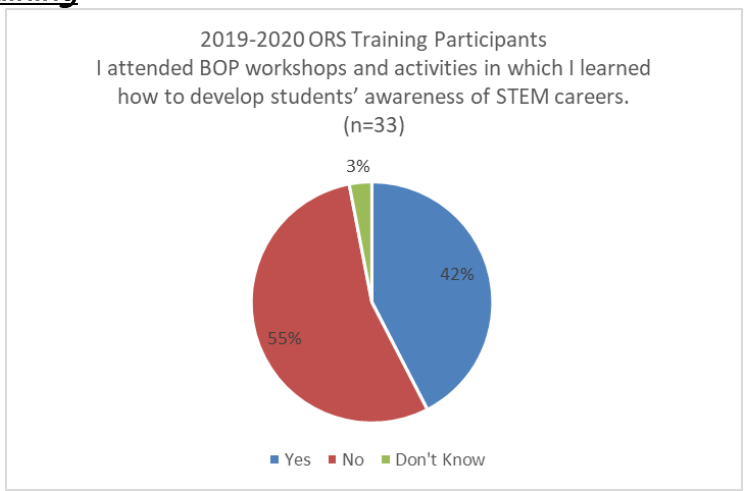
- When asked on a scale of 1 (Strongly Disagree) to 6 (Strongly Agree) if BOP modeled practices to motivate student interest in STEM careers, the average response from all

participants was between 5 (Agree) and 6 (Strongly Agree), with an average of 5.10 (standard deviation=0.99).



- Additionally, participants responded to more specific questions about student STEM career interest. Average responses to these statements were mixed.
- The highest response was to the statement *My students understand that they are acting as scientists and that it is possible for them to become scientists* with an average response of 5.32 (standard deviation=0.93).
- The lowest response was to the statement *My students are aware of the marine careers offered in the Harbor High School CTE programs* with an average response of 3.71 (standard deviation=1.68). The Harbor School's CTE programs were less of a focus in some of the activities than others.

Participants in ORS Training

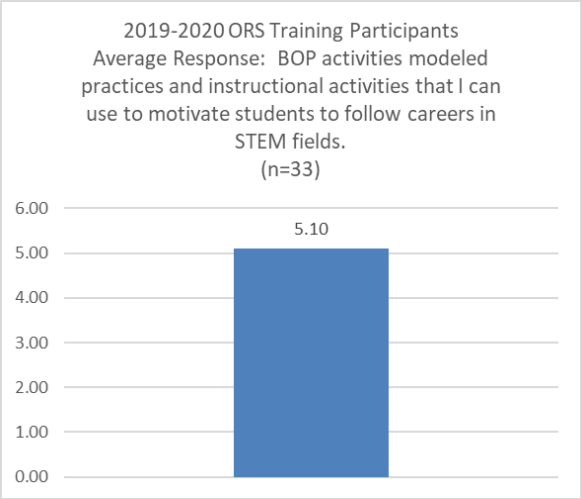


- Among teachers who attended ORS training in 2019-2020, 58 percent reported that they did not attend an activity in which they learned how to develop students' interest in STEM

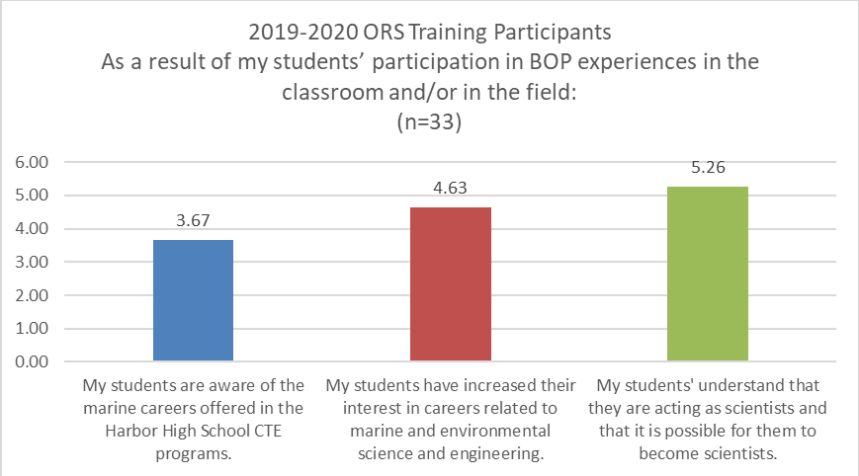
careers or that they did not know if they did attend such a session. This is slightly higher than the all respondent group response.

- Forty-five percent of ORS training participants reported that this was the only BOP activity they attended during the 2019-2020 program year.

If career interest is a goal for BOP participation, incorporating more information or ideas on building career awareness and interest, and addressing career opportunities explicitly in the session may be worthwhile, as well as distributing a post-training packet or lesson plans for classroom follow-up.



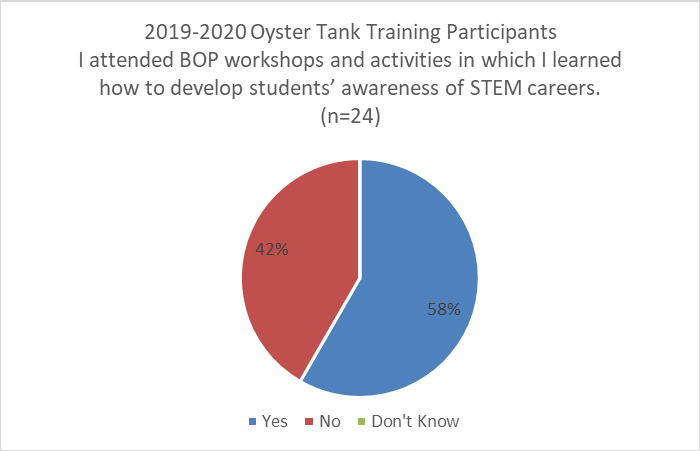
- The average response from ORS training participants to a question about BOP activities modeling practices to motivate students' interest in STEM careers was the same as for the all respondent group, 5.10 (standard deviation=1.01).



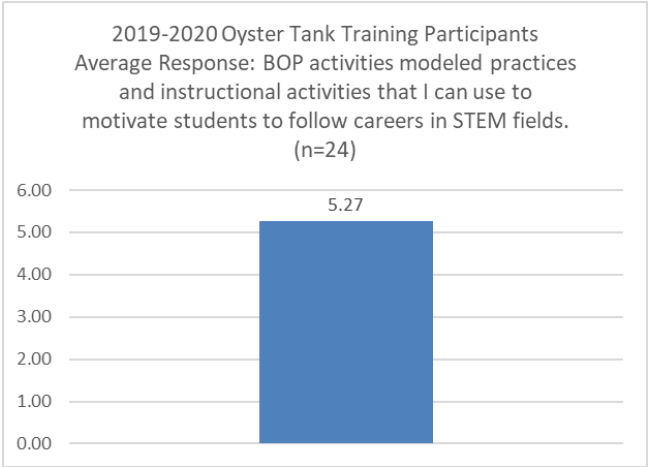
- ORS training participants' responses to more specific statements were either similar to or lower than the responses of the all respondent group.

- Similarly, the highest average response was to the statement *My students understand that they are acting as scientists and that it is possible for them to become scientists* (average response of 5.26, standard deviation=1.03), and the lowest average response was to *My students are aware of the marine careers offered in the Harbor High School CTE programs* (average response of 3.67, standard deviation=1.66).

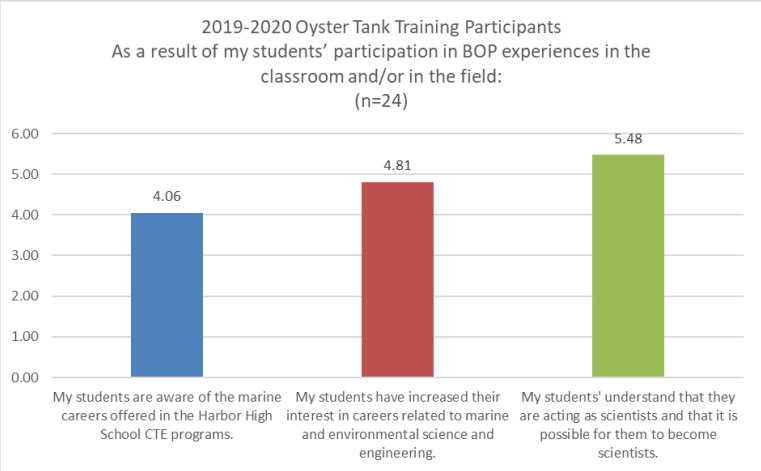
Participants in Oyster Tank Training



- Fifty-eight percent of 2019-2020 oyster tank training participants responded that they did attend a BOP activity in which they learned about developing student awareness of STEM careers. This is higher than for the ORS participants or the all respondent group.



- Oyster tank training participants also had a higher average response to BOP activities which '*modeled practices and instructional activities that I can use to motivate students to follow careers in STEM fields*,' with an average of 5.27 (standard deviation=0.77).



- Responses to more specific statements were also higher Oyster tank training sessions. Participants agreed to some extent with all three statements on average.
- Responses to this category were lower than responses to other categories. There is room for BOP facilitators to focus more on developing strategies for teachers to build STEM career awareness with their students.

CHALLENGES TO PROGRAM IMPLEMENTATION IN 2019-20

Challenges Pre-COVID-19 Outbreak

Challenges reported by teachers who participated in both ORS and Oyster tank training sessions before the COVID-19 outbreak and subsequent school closures fell into the following categories: organizing students; fitting field visits into schedules; weather; missing oyster cages or oysters; teacher confidence; site safety; funding; group management and school rules; permitting; and other. Specific comments include:

- *Scheduling time out of the class to visit the ORS station. Accessing ORS is not hard, but the activity takes at least 90 mins to do effectively… and we had an hour….*
- *Some challenges included finding our cage empty when going into the field. BOP educators were always willing to bring replacements, but I am never sure what I will find, because some stations get harvested by people within the community.*
- *Since this was my first year with BOP, I had a lot of training and workshops to do before I could take my students. [Because of COVID-19] I didn't have as much time to get all 6 of my classes to the ORS as I would have liked. I was looking forward to the spring ORS data collection. I'm looking forward to next year!*
- *Planning trips to the research station is cumbersome. Hopefully it will get smoother over time as I get more comfortable with the process.*

- *In order to do the water quality monitoring, I would have to order expensive equipment to do fieldwork with my students. I tried to do a Donors Choose but that wasn't successful. BOP wasn't providing me with the water quality kits.*
- *The distance to ORS was a challenge and we're moving to a new school so it will be a longer commute.*
- *We had no feedback [from BOP] about our permits for our ORS. Only when I, monthly or so, contacted your people did I get any feedback. You changed the contact person and did not let us know. The only thing I get from you guys is fund raising emails and surveys. Still have no permits, so how can we start? My co-teacher and I said last evening how the fun is gone from this. You got my fee for the class and then were no help at all. We got permission from yacht clubs and co-ops to hang the ORS. [….] I think you want publicity and money.*

Challenges Related to COVID-19 Outbreak

Teachers were also asked about the specific challenges of virtual implementation following school closures in Spring 2020 due to Covid-19. Teacher identified challenges in the following categories: need for hands-on experience; access to students; need for site access to successfully engage in research; demands on student time; and student trauma.
Some specific comments include:

- *One student in my class conducted research on oysters within the classroom as her bio research project. Because of the demands being placed on my student in terms of finishing up school work for all of her courses, she was not able to participate in the virtual symposium.*
- *Kindergarteners really need hands on experiences— all virtual learning is a disaster for them*
- *The ELA teacher took the lead for this with my students as an ELA project and she said a challenge was getting them to complete the work remotely with limited resources.*
- *We were planning on taking part in the symposium but all of the projects got locked in at school.*
- *It was difficult for me to adapt the Billion Oyster Project curriculum remotely as an elementary school teacher.*

Additional Suggestions from Teachers

Below are some additional comments from teachers about improving BOP programming:

- *I would like to add Ipas to sessions and record the activities for reinforcement.*
- *It would help to receive an offer of dates/times that are reserved instead of first come, first serve registrations that fill up.*

- *A newsletter with updates about BOP which also highlights school projects and resources*
- *Increased diversity of your staff members / workshop leads.*
- *Offer more flexible times, public school time off, etc.*
- *More K-2 activities please*
- *My only suggestion is to have more curriculum support/info for younger grades. I did BOP with 2nd graders and needed to modify a fair amount of the info...*
- *More readily available resources for implementing the BOP curriculum in an elementary classroom.*
- *I would love to have a classroom visit of BOP professionals to explain this to the students that aren't involved in the field group.*
- *Easier access for students to connect with other BOP student participants to engage in a "social/ citizen scientist student share". Create an interactive platform for student- led engagement and interactions*
- *There should be grants that teachers can apply for to have assistance in obtaining basic equipment to perform fieldwork.*

SUMMARY OF FINDINGS

Participants were positive about the amount of support and resources, as well as the oyster-related knowledge and practices they learned to be able to guide students in oyster field research. Respondents were most positive about the extent to which the BOP activities increased awareness of what is happening with oyster restoration in the New York Harbor.

ORS Training Activities

Participants in the Oyster Research Station training activities were most positive about the extent to which the training had increased their own comfort level with being around the waterfront and conducting field site research with students. They felt more confident engaging with students in field science and research after participating in ORS activities than they did prior to participation.

Oyster Tank Training Activities

Oyster Tank training participants had more positive responses to statements about the impact of BOP in increasing their awareness of oyster restoration in New York Harbor, increasing their comfort level with field research, and guiding students in field research.

Symposium Student Research Projects

Twenty-four percent of participants reported that their students engaged in research projects in Spring 2020 that they presented at the BOP Symposium in June. All of the teachers who reported their students prepared and presented projects at the Symposium attended either an ORS training or an Oyster Tank Training activity during the 2019-2020 program year. The use of

oyster tanks were the most frequently sited source of student projects, an outcome that was not surprising in the covid-19 phase of virtual learning.

Career Awareness

When asked about the extent to which the Oyster Tank training and ORS Training sessions addressed practices for developing student awareness of STEM careers, participants' responses were lower than their responses to other categories. Fewer than half of all respondents 'agreed' or 'strongly agreed' that BOP activities modelled career development.

Teachers were most favorable about the impact of the BOP activities on students. The most favorable response among all participants was to the statement: "*My students were acting as scientists and that it was possible for them to become scientists*." Participants in Oyster Tank training sessions (58 percent) rated this statement higher than ORS training participants, indicating the Oyster Tank sessions were slightly more effective in achieving the goal of empowering students to see themselves as scientists.

If career interest is a goal for BOP participation, incorporating more information or ideas on building career awareness and interest, and addressing career opportunities explicitly in every session (ORS and Oyster Tank training) may be worthwhile, as well as distributing a post-training packet or lesson plans for classroom follow-up.

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Billion Oyster Project
ITEST Professional Learning for Teachers
Fall 2020 Teacher Survey Results

The Billion Oyster Project (BOP) offered professional learning activities for teachers and community scientists throughout 2020, but with the onset of COVID-19 and closure of schools in March, the delivery of Spring 2020 activities was limited. Project staff worked effectively over the summer months to modify and adapt their menu of professional learning activities to the virtual learning environment. From October to December 2020, BOP facilitated 12 remote and 1 onsite professional learning sessions. Participants responded to a survey following each session. In total, evaluators received 98 responses. Out of these responses, 70 came from teachers or educators, and 28 were from community scientists.

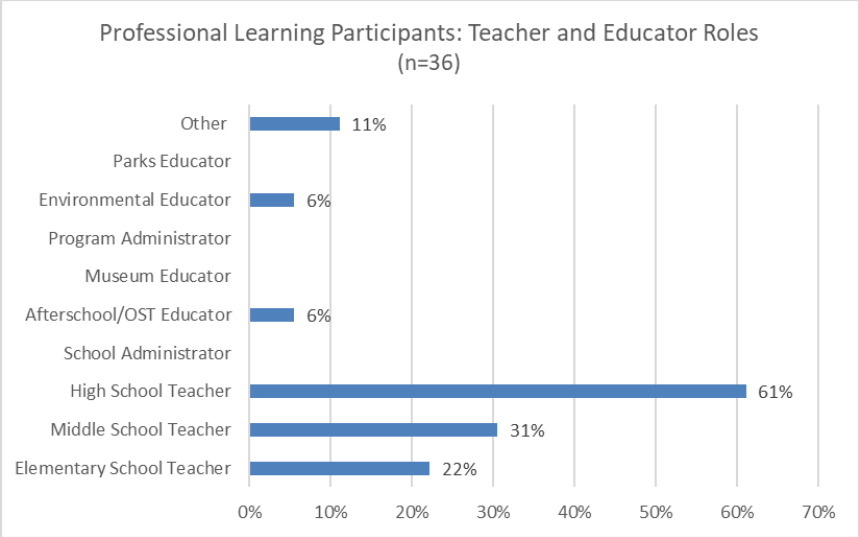
The survey solicited teachers' evaluation of BOP professional learning experiences in two areas: their own content learning and practice, and perceptions of the use and impact of their learning on students' interest and engagement with STEM and student awareness and interest in pursuing a STEM career.

TEACHER AND EDUCATOR PROFESSIONAL LEARNING SURVEY RESULTS

Below are the responses from the 70 program participants who identified themselves as teachers or educators. Many of these participants attended multiple sessions indicating that project staff's efforts to develop a cohort of teachers to encourage ongoing teacher participation and build a community of BOP educators was succeeding. The sessions were organized in the following four categories: *Oyster Research Station (ORS) Basic Training*, *Oyster Tank Training*, the *Inquiry from Anywhere* professional learning series, and others, including *Living Breakwaters* activities. Evaluators reviewed results from these sessions in the following categories of teacher and student engagement: teacher engagement and learning, continuing teacher participation, teacher feedback, student engagement and learning, and student interest in STEM careers.

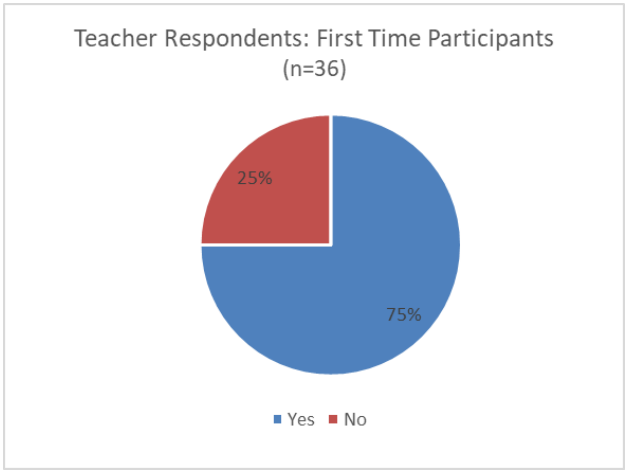
Overview of Respondents

Thirty-six individual teachers responded to the survey. For teachers who completed the survey following multiple workshops, results in the following tables reporting the nature of teacher participation are based on respondents' first survey only. From these 36 teachers, at least 1500 students may engage in BOP activities in their classes based on these workshops.

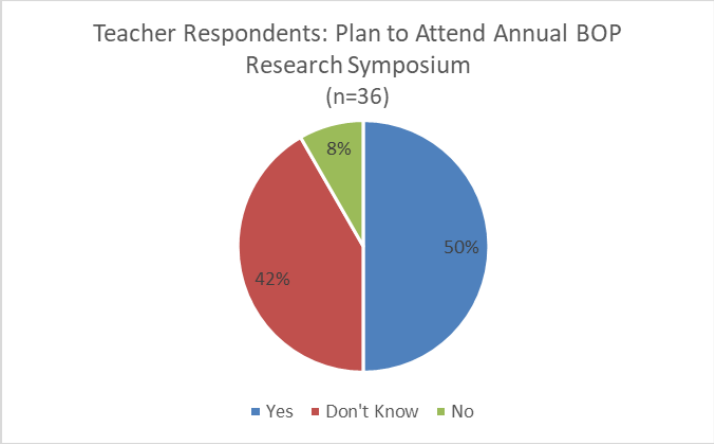


Note: respondents could select more than one response.

- The majority of respondents teach in a school setting. Sixty-one percent of respondents teach high school. Thirty-one percent teach middle school, and twenty-two percent teach elementary school.
- Eleven percent reported that they have 'Other' roles. Those roles include:
    - Science Department Chair
    - Afterschool Program Manager
    - Universal Literacy Coach

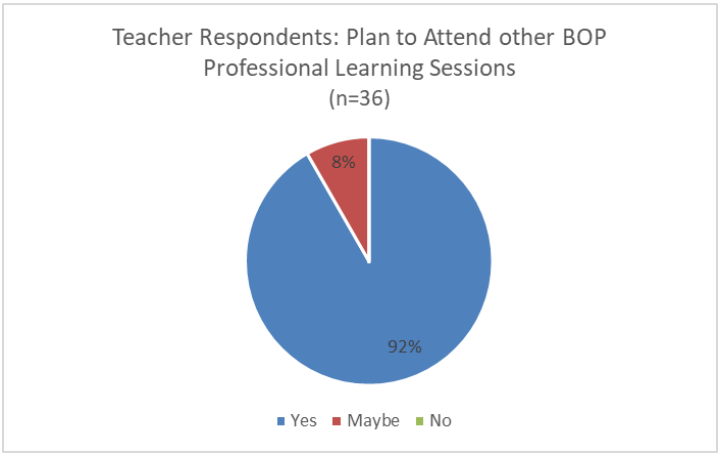


- Seventy-five percent of respondents said they were new to BOP. This fall (during COVID-19) was the first time they participated in Billion Oyster Project professional learning opportunities.
- Twenty-five percent of respondents had participated in BOP programming prior to this year.



- Half of survey respondents plan to attend the annual BOP Student Research Symposium with their students.
- Forty-two percent do not know if they will attend with their students.

The Symposium provides a connection from teacher professional learning sessions to student learning and potential STEM career interest. While teachers are attending the professional learning sessions, they can utilize the activities and lessons from these sessions to engage students in their own research projects. At the Symposium, students present their projects and have the opportunity to discuss them with the scientists and other STEM professionals on the judging panel and to learn from them directly about STEM careers.



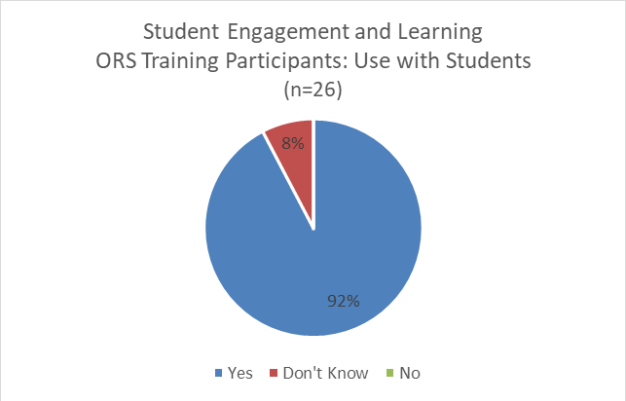
- Ninety-two percent of respondents plan to attend future BOP professional learning workshops. As seen from the repeated survey takers from various events, some respondents already attended several more workshops since their initial BOP activity.

OYSTER RESEARCH STATION (ORS) BASIC TRAINING

Evaluators received twenty-six surveys from four sessions of Oyster Research Station (ORS) basic training workshops. ORS basic training is an entry-level training to familiarize participants with BOP, harbor restoration, and collecting data through monitoring an ORS unit. ORS basic training consisted of three sessions held virtually and in-person. Some participants completed surveys after both of their virtual sessions; these surveys are included in the responses below. ORS training dates included in these results are: Oct. 1, 2020, Oct. 6, 2020, Nov. 6, 2020, and Nov. 11, 2020. For 46 percent of respondents, the first session of their ORS training was their first time participating in BOP programming.

Student Engagement and Learning

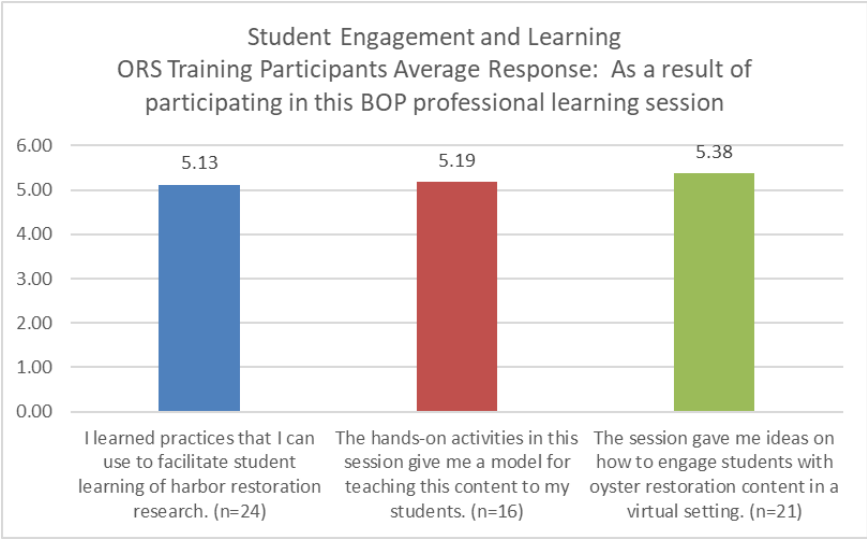
Student engagement and learning was evaluated through teacher participants' intention to use activities from their BOP professional learning session(s) with their students, the ways they intend to use the activities, and what they learned from their session that can inform how they engage students with BOP activities and lessons.



- Ninety-two percent of respondents plan to use activities from ORS training with their students.
- Teachers plan to use the training with students for research projects, data collection, curriculum about oyster restoration, in extracurricular groups, and other ways. Specific thoughts about how or why they will use ORS activities include:
    - *Teach students how to record the data*
    - *Many of my research students are interested in the environment and this is a great way to get them involved in their community.*

- *Great opportunity for students to appreciate local ecology and practice science skills*
- *I think this would be a great ongoing project for the Science Dept at the high school. We are starting with Honor Society but could grow from there.*
- *I hope to enter data with some students in Urban Barcode*
- *We are hoping to adopt an ORS and get a new one installed so that students can participate in measurements*
- *Many of my research students have an interest in the environment and this would be a perfect way to get them involved in it.*
- *We have a marine biology club. This will definitely help them to take care of the oysters*
- *Our students are very excited to monitor oysters in our tanks and at field stations.*
- *A student actually reached out to me who had worked with UBP. This could be a great continuation to use with Science Honor Society students.*
- *I will use the video of the oyster anatomy and the ORS before taking the students out in the field.*
- *I plan to co-mentor one team that I believe will be doing a BOP related project.*
- *Oyster anatomy will be key to introduce to my kids and then learning how to survey the ORS.*
- *I believe that this activity will not only fascinate my students but will also build community relations.*

Teachers also responded to a series of statements about what they learned from the professional learning session they attended. These statements were rated on a scale of 1 (Strongly Disagree) to 6 (Strongly Agree). Note: for these statements, respondents also had the option "Not addressed in this session." Differences in n-values reflect those who selected "Not addressed."

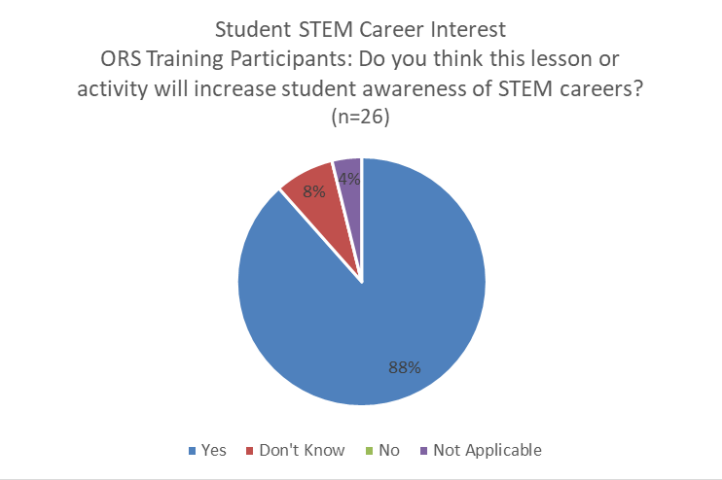


- Average responses from teachers to three statements pertaining to student engagement and learning all ranged from 5 (Agree) and 6 (Strongly Agree).
- The statement with the highest average response was *The session gave me ideas on how to engage students with oyster restoration content in a virtual setting*, with an average of 5.38 (standard deviation=1.16). Five respondents selected 'not addressed in this session.'

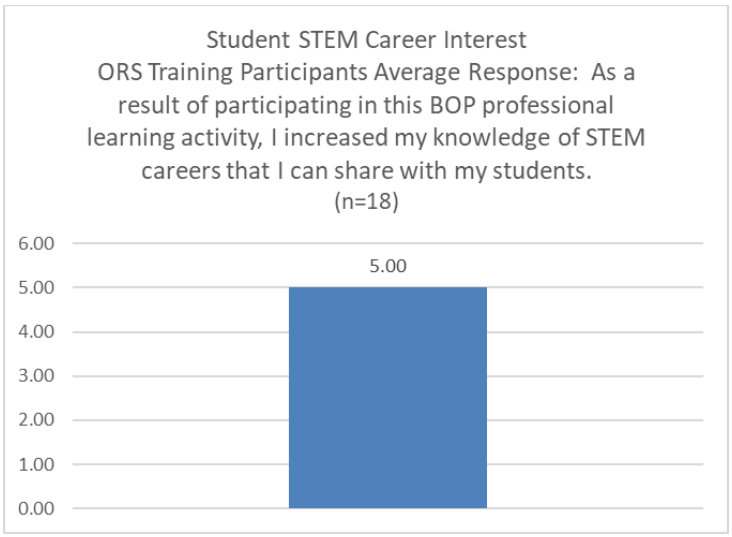
High average responses to these statements suggest that teachers feel prepared to engage students in learning about harbor restoration content and research following ORS basic training activities.

Student Interest in STEM Careers

Student interest in STEM careers was evaluated through teacher participants' perceptions of BOP activities and the extent to which they could contribute to increasing student awareness of STEM careers, as well as their own learning about STEM careers.

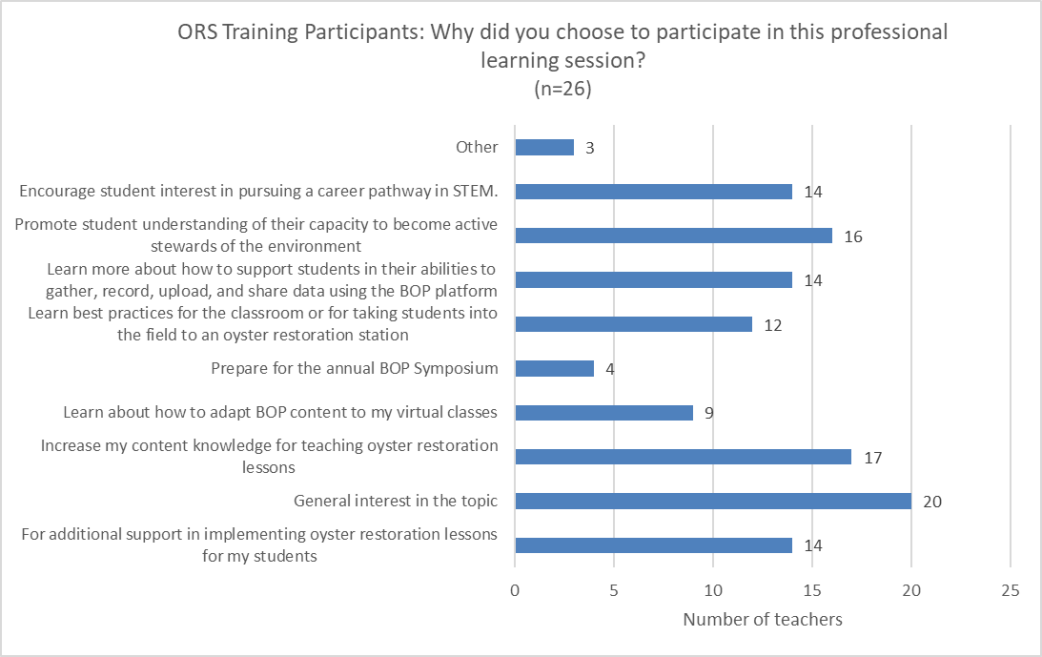


- Eighty-eight percent of respondents thought that using the ORS training lessons and activities would increase their students' awareness of STEM careers.



- On average, teachers 'agreed' they increased their knowledge of STEM careers through their participation that they can share with students. Eight participants responded that this was 'not addressed in this session.'

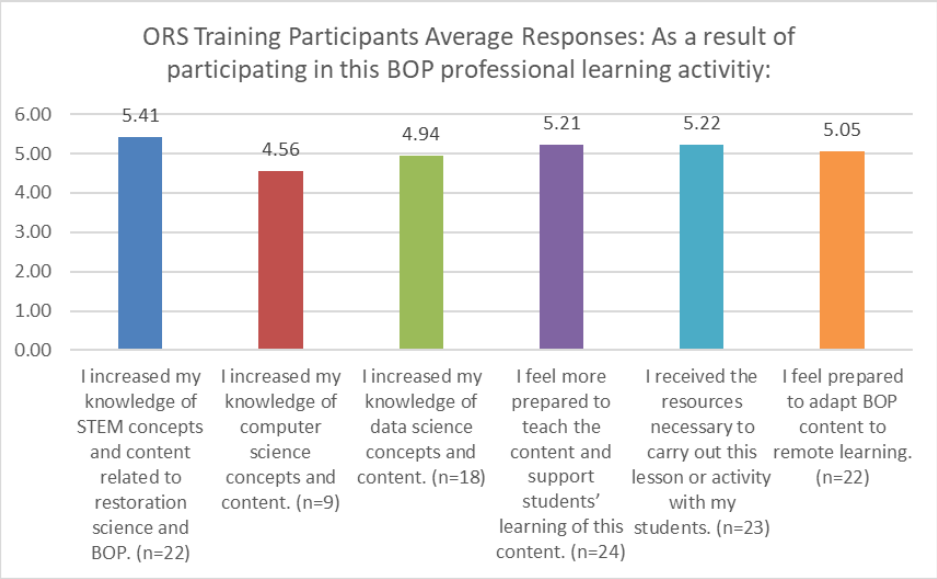
Teacher Engagement and Learning



- More than 50 percent of respondents chose to participate in ORS training for the following reasons:
    - General interest in the topic (77% of respondents)
    - Increase content knowledge for teaching oyster restoration lessons (65%)
    - Promote student understanding of their capacity to become active stewards of the environment (62%)

- Encourage student interest in pursuing a career pathway in STEM (54%)
- Learn more about how to support students in their abilities to gather, record, upload, and share data using the BOP platform (54%)
- For additional support in implementing oyster restoration lessons for my students (54%)

- The reasons highlighted in yellow connect to student engagement and student interest in STEM careers. As teachers seek out professional learning to meet these goals, they bring this information back to their students and can actively promote career awareness and engagement as environmental stewards. Teachers responded to a series of statements about what they learned from the professional learning session they attended. These statements were rated on a scale of 1 (Strongly Disagree) to 6 (Strongly Agree). Note: or these statements, respondents also had the option "Not addressed in this session." Differences in n-values reflect those who selected "Not addressed."

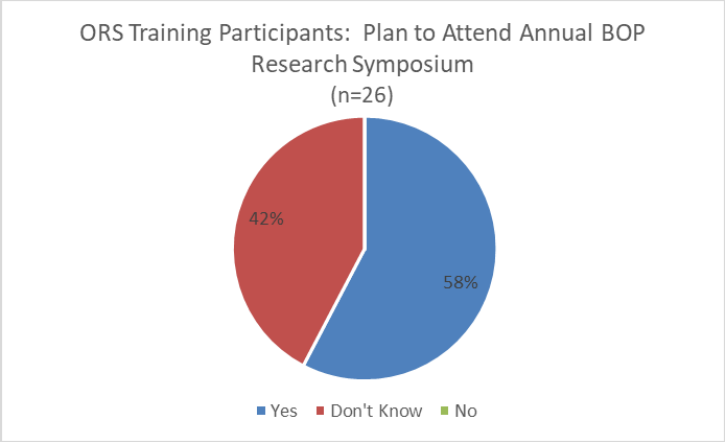


- Average responses to all statements were above 4 (Somewhat Agree), representing an overall positive experience with the ORS training.
- The highest average response was to the statement *I increased my knowledge of STEM concepts and content related to restoration science and BOP* with an average of 5.41 (standard deviation=1.18). These training sessions focused on the oyster research station and harbor restoration; this high rating suggest that teachers think BOP is meeting their primary goal in these trainings.
- The lowest average response was to the *statement I increased my knowledge of computer science concepts and content* with an average of 4.56 (standard deviation=1.59). Seventeen respondents said that this was 'not addressed in this session.' Computer science is not a focus of these training sessions and lower ratings are not surprising.

- Teachers were asked what could be changed about the training to better prepare teachers to use this material with their students. Answers are from after the first and the last session of the multi-session ORS training and included the following:
    - *More info on how to start oyster project.*
    - *Access to the model data sheet*
    - *I think this session served its purpose well.*
    - *I think that this session could have been a little longer, so that we had time to share teaching ideas, ask questions, and sort out any tech problems. I am very interested in accessing BOP data and online teaching resources.*
    - *It was great. Maybe add extension lessons for the classroom but we may be getting that.*
    - *How to implement resources for this topic for virtual learning.*
    - *Resources to share with the students.*
    - *It was repetitive from the last session*
    - *Nothing was missed. I am prepared for tomorrow when we do the hands-on portion.*
    - *More info about data sharing across ORS sites.*
    - *This session was pretty teacher-focused so it doesn't translate directly to students, I learned a lot. I would have liked a little more information about how BOP/ORS has been integrated into classrooms around the city, modifications for online learning, etc.*
    - *Nothing was missing in this session. The presenter did an exceptional job informing the audience.*
    - *Insight on how to use this in a virtual setting.*

Continuing Teacher Participation

Teachers' interest in continuing participation in BOP activities was evaluated by their plans to attend the annual BOP research symposium and to attend future BOP professional learning sessions, as well as whether they completed another survey from a different type of professional learning session.

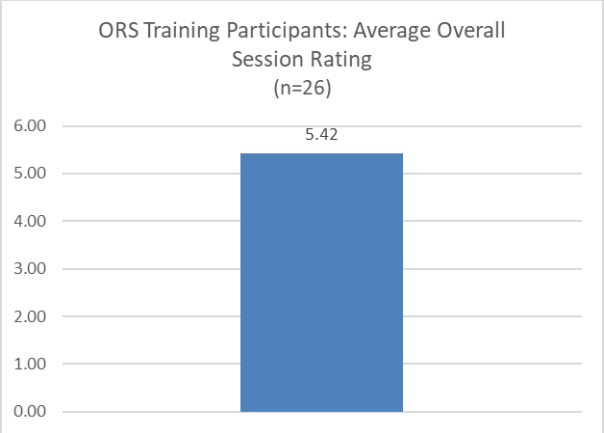


- Fifty-eight percent of participants plan to attend the annual student research project symposium with their students in June 2021. As mentioned above, the symposium is an opportunity for students to engage with scientists and others' research as well as to present their own research. Sessions such as the ORS basic training provide an entry point for teachers to motivate and support their students to engage in their own research and attend events such as the symposium.

- Seventy-three percent of respondents plan to attend other BOP professional learning sessions.
- Among those who said they would 'maybe' attend, scheduling and availability were cited as factors for attending.
- Two teachers who cited ORS basic training as their first BOP participation completed surveys for additional professional learning sessions during fall 2020.

Teacher Comments and Feedback

Participants rated the session overall on a scale of 1 (Poor) to 6 (Excellent).

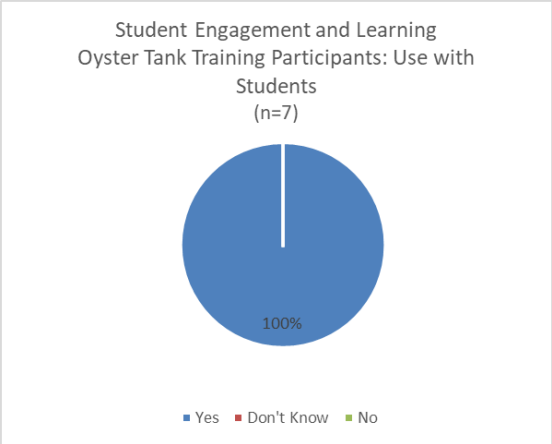


- The overall average rating for this session was highly positive at 5.42 (Standard deviation=0.81).
- Teachers provided additional feedback on how the sessions could be improved:
    - *It was perfect and a lot of fun.*
    - *Would like more info about sharing data and collaborating with other groups*
    - *Love the field research. More ideas for activities.*
    - *More hands-on activities.*
    - *It would be great if an activity involved watching BOP staff measuring and counting oysters through Zoom so that students can see firsthand what they will be expected to do when they collect data and if it is on Zoom, they can ask questions right there.*
    - *Have a classroom teacher present to share their experience with the program along with the BOP educator.*
    - *These learning opportunities have been a wonderful experience. There is nothing to improve on.*

OYSTER TANK TRAINING

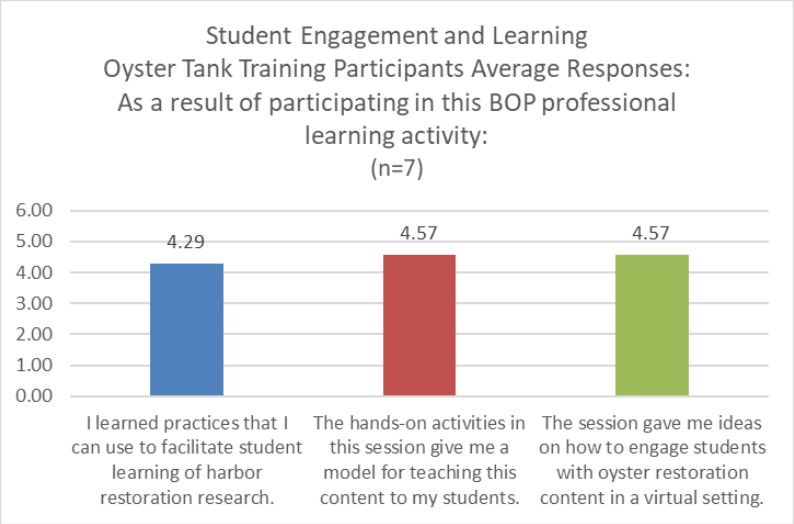
Evaluators received seven responses from two dates of oyster tank training workshops. Oyster tank training is a one-time session that walks participants through setting up and caring for their own oyster tank. Dates included in these results are: Oct. 23, 2020, and Oct. 24, 2020. For 57 percent of survey respondents, oyster tank training was their first time participating in BOP programming.

Student Engagement and Learning



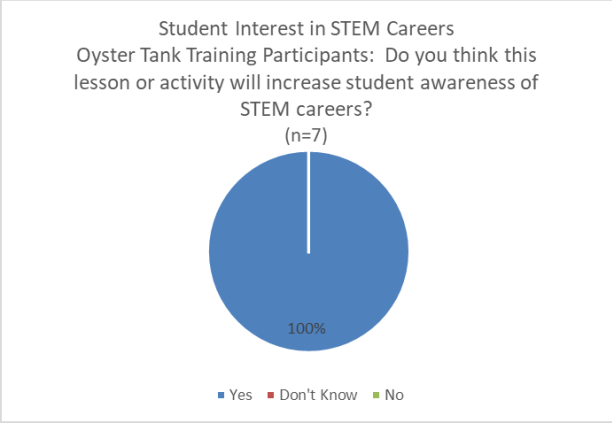
- One hundred percent of oyster tank training participants plan to use activities and lessons from their training with their students.
- Teachers plan to use oyster tank activities to engage students in research projects, math extensions, extracurricular clubs. Other thoughts about how to use the activities include:
    - *Just because we are remote, I don't want the kids to feel that we cannot get involved with the environment and do research.*
    - *My students will be in charge of my tanks and I will just be there to facilitate*
    - *We have a Marine Biology Society consisting of 57 students who are very interested in partaking in oyster research and presenting at the Symposium in June.*
    - *Especially during times of COVID, it is essential to provide students with experiences outside of their textbooks and bring the world into the classroom.*
    - *I want to expose my students in carrying out an authentic science experiment, as well as collecting and analyzing data.*

Teachers also responded to a series of statements about the extent to which the workshop modeled practices that they could use to engage students in oyster restoration research. These statements were rated on a scale of 1 (Strongly Disagree) to 6 (Strongly Agree). Note: for these statements, respondents also had the option "Not addressed in this session." Differences in n-values reflect those who selected "Not addressed."



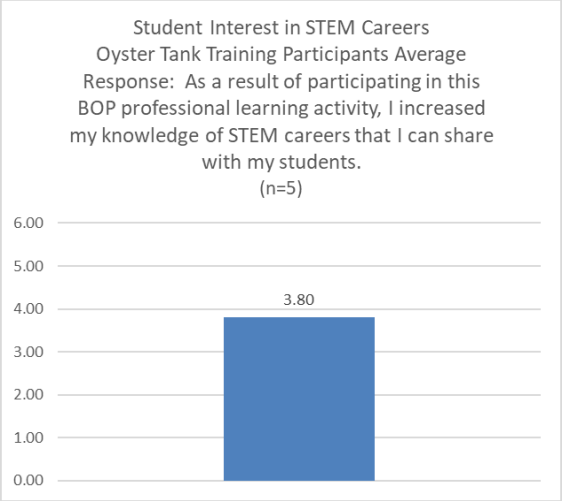
- Average responses to all three statements about student engagement and learning were between 4 (Somewhat Agree) and 5 (Agree), indicating that the oyster tank training was effective in providing the practices that would help teachers engage students in oyster restoration.[1]

Student Interest in STEM Careers



- All respondents thought that engaging students in the oyster tank activities could be utilized to increase their awareness of STEM careers.
-

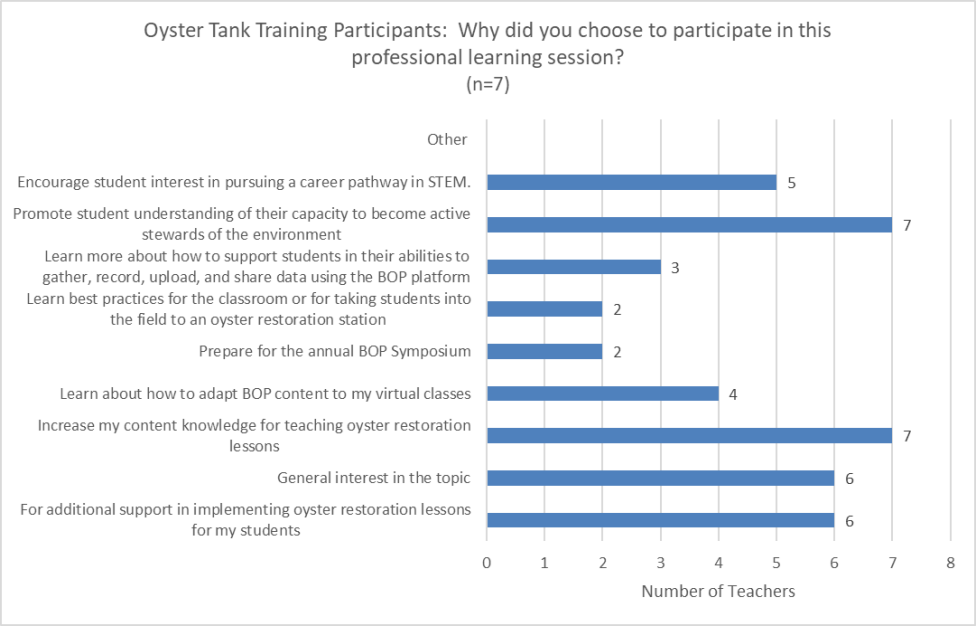
[1] Positive comments combined with a positive overall rating of this session in sections below as well as high variance in responses suggests that one or more respondents may have misread the survey and checked boxes for 'highly disagree' instead of 'highly agree.' This may account for some of the lower averages across all statements.



- Despite thinking that these activities would raise student awareness of STEM careers, the average response to *I increased my knowledge of STEM careers that I can share with my students* was between 3 (Somewhat Disagree) and 4 (Somewhat Agree) at 3.80 (standard deviation=2.59). Two respondents replied that this was 'not addressed in this session.'

Career awareness is one area where the training could be improved. The oyster tank training activities may be a less direct way to raise students' awareness of STEM careers, but still offer opportunities to do that. The majority of the training focuses on setting up the tank and how to use the tank with students to collect data. Facilitators of these sessions could make explicit references to career opportunities in this type of research activity and model the practice of raising teachers' awareness of these careers, so that teachers can share that with their students when they use the tanks to gather data. In previous years, students have utilized oyster tanks in their research projects presented at the annual BOP symposium.

Teacher Engagement and Learning

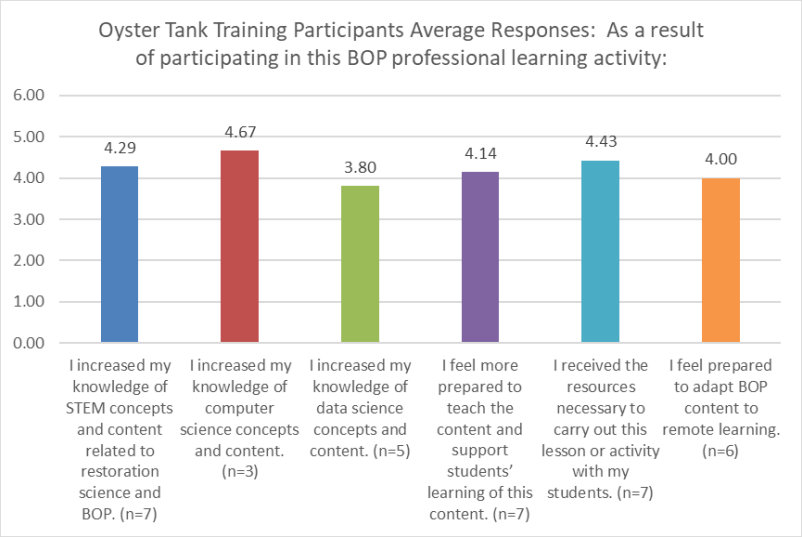


- More than 50 percent of respondents chose to participate in oyster tank training for the following reasons:
  - Encourage student interest in pursuing a career pathway in STEM (71%)
  - Promote student understanding of their capacity to become active stewards of the environment (100%)
  - Learn about how to adapt BOP content to my virtual classes (57%)
  - Increase my content knowledge for teaching oyster restoration lessons (100%)
  - General interest in the topic (86%)
  - For additional support in implementing oyster restoration lessons for my students (86%)
- The reasons highlighted in yellow connect to student engagement and student interest in STEM careers. Teachers in this training were highly interested in STEM career pathways and students as environmental stewards.

Teachers are actively seeking ways to incorporate information around these topics into their classroom. BOP activities can build on this interest and expand teachers' knowledge through the connections to various STEM careers that BOP already has. As activities change for virtual settings, providing videos or other media from people in various careers that connect to tank activities is one way that student knowledge of STEM careers could be expanded, particularly beyond ideas of being a scientist in a lab.

Teachers also responded to a series of statements about what they learned from the professional learning session they attended. These statements were rated on a scale of 1 (Strongly Disagree)

to 6 (Strongly Agree). Note: for these statements, respondents also had the option "Not addressed in this session." Differences in n-values reflect those who selected "Not addressed."



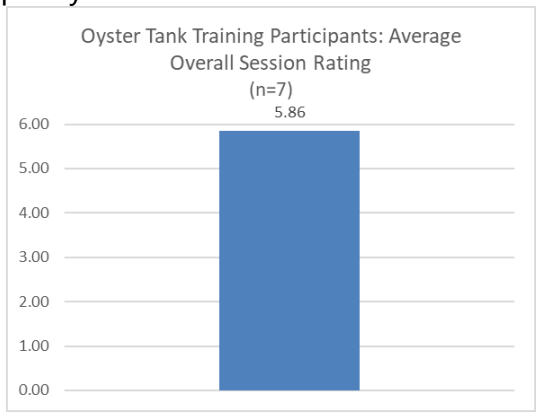
- The statement with the lowest average response was *I increased my knowledge of data science concepts and content* with an average of 3.80 (standard deviation=2.59). Two teachers responded that this was 'not addressed in this session.' As this training is a one-day introductory training, it is difficult to fit all potential topics and applications into one training. An advanced training could be added to address more of the ways an oyster tank can be utilized.
- Teachers responded most positively to the statement *I received the resources necessary to carry out this lesson or activity with my students* with an average response of 4.43 (standard deviation=2.37).[2]
- Teachers were asked what could be changed about the training to better prepare them to use this material with their students. Answers included the following:
    - *This session was informative and covered interesting topics.*
    - *Nothing - everything was extremely helpful in allowing us to utilize the Oyster Research Tanks in the classroom!*
    - *Being new to the oyster setup I think this was the best introductory lesson between the background of the program, oyster awareness and setting up the tank. I think I would like another training based on all the other testing supplies like the dissolved oxygen.*
    - *More time*

Continuing Teacher Participation

[2] See footnote on page 12.

- Eighty-six percent of participants plan to attend the annual BOP research symposium with students. As noted above, at previous symposia, many students presented research connected to oyster tanks. This training provides an entry point to getting students involved in research, particularly in the virtual learning environment, in which teachers maintain the tanks in their homes or classrooms in a blended learning environment.

- All respondents plan to attend another BOP professional learning session. Three teachers who reported that the oyster tank training was their first time participating in BOP attended other professional learning sessions later in the semester. *Teacher Comments and Feedback*
- Participants rated the quality of the session overall on a scale of 1 (Poor) to 6 (Excellent).

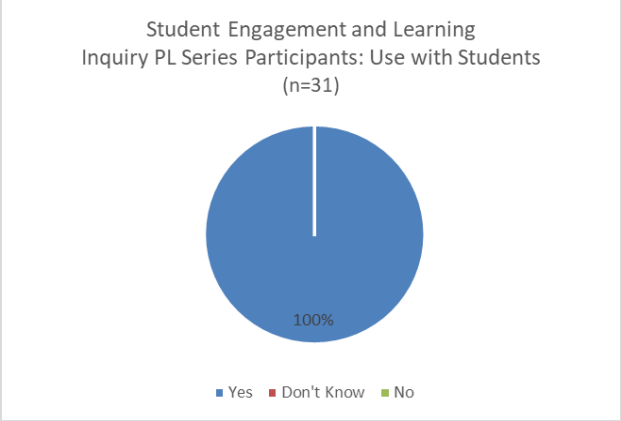


- Participants rated this training highly positively with an average response of 5.86 (standard deviation=0.38).
- Teachers provided additional feedback on how the sessions could be improved:
    - *Perfect as is!*
    - *Maybe make workshops geared to specific grade levels (elementary and secondary)? I really liked this professional development and I personally know I would love more!!!*
    - *Have more learning activities*

INQUIRY FROM ANYWHERE PROFESSIONAL LEARNING SERIES

The *Inquiry from Anywhere* series was designed specifically for the remote learning environment to enable teachers and students to conduct scientific research at home or outside the home. There were four sessions in the series. The second session was a repeat of the first session delivered because of popular demand. Sessions one and two focused on data collection and observations from the natural world, session three focused on animal behavior, and session four focused on biodiversity. Evaluators received 31 responses from these sessions. Some participants attended one session and others attended more. These workshops were held on the following dates: Oct. 27, 2020, Nov. 12, 2020, Nov. 17, 2020, and Dec. 8, 2020. For 29 percent of survey respondents, a session in the *Inquiry from Anywhere* series was their first time participating in BOP programming. Some participants completed surveys for multiple sessions.

Student Engagement and Learning

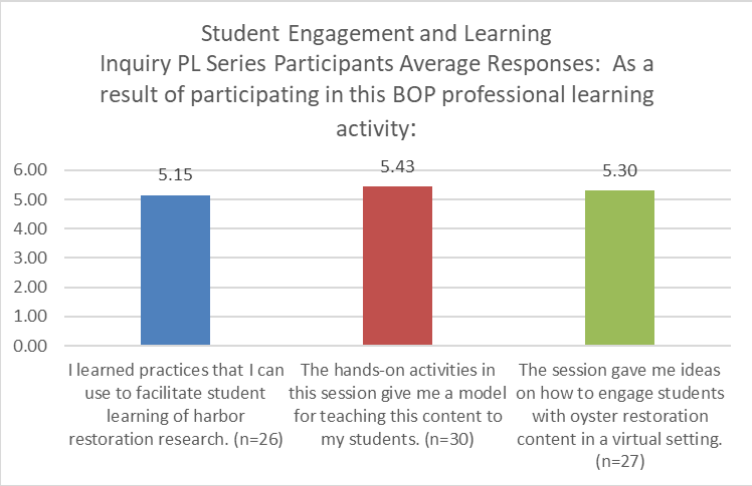


- All respondents plan to use activities and lessons from the inquiry professional learning series with their students.
- Teachers plan to use activities and lessons from the inquiry series in a variety of ways including as research activities in larger curricular units, to generate questions for research and experimental design, for data collection and entry, with extracurricular clubs, as part of the Living Environment curriculum, and other ways. Specific ideas for use included:

- *We have a field study class for the freshmen, and I am looking to expand the class for upper class men.*
- *It is a way for students to learn how to manipulate data with Google Sheets that they or their peers might have collected themselves.*
- *I will use this is an example of how students can begin to think about how to analyze data.*
- *The data set is really good and will be a great way to introduce students to data collection and analysis using something that will be interesting to them.*
- *I like that the data provided is for a local ecosystem and can be used for different levels of instruction.*
- *It can help get them engaged in a virtual setting and is something they can do from home with technology.*
- *Using videos to make observations is a very promising strategy during remote learning.*
- *I think this is an excellent way to introduce students to creating authentic questions, making observations, and coming up with ways of collecting data in a remote setting.*
- *While animal behavior is not a part of my curricula, it would be a good activity to help students develop their question-asking and data collection skills.*
- *I'd like to use it as an exercise to get students to think about what types of data can be collected from the spaces around us that we might not normally consider for data collection/study.*
- *This session helped me see how easy it can be to engage students in data collection and analysis in an unconventional setting.*
- *My club has been itching to "get outside" and these activities are a good reminder of what we'll need to be doing in the field!*
- *I would like my students to engage in science in their community, even if they are remote. My students need to interact in with their environment*
- *I see this as a good opportunity for students to experience hands-on science.*
- *I would like to promote my students' understanding of their capacity to become active stewards of the environment*
- *I will facilitate the use of this lesson because it is a new virtual lesson that will keep my students engaged and interested in learning science.*
- *I think it is a great way to engage students in inquiry based learning while open enough to help them pursue this work within their own personal interests.*
- *Even if I do not do the oysters, this PD gave me great ideas to implement life science into the second grade curriculum and promote interest, inquiry, and discussion.*

- *We're working on making and recording observations as a basis for inquiry, so this is very relevant for my class right now.*

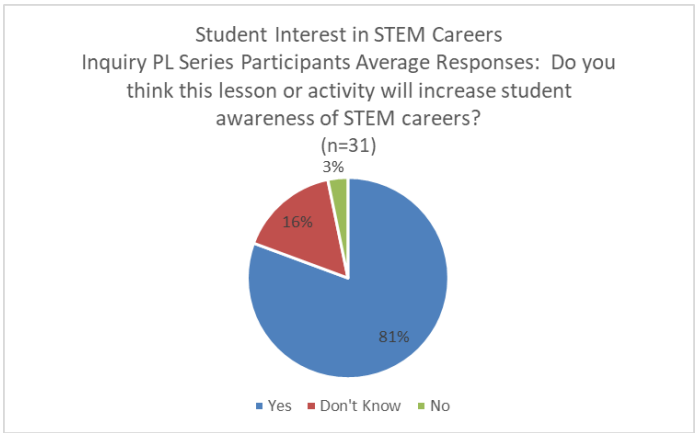
Teachers also responded to a series of statements about what they learned from the professional learning session they attended. These statements were rated on a scale of 1 (Strongly Disagree) to 6 (Strongly Agree). Note: for these statements, respondents also had the option "Not addressed in this session." Differences in n-values reflect those who selected "Not addressed."



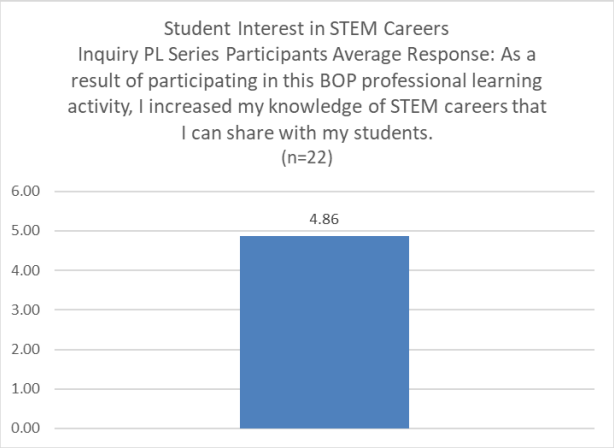
- On average, teachers rated all three statements positively with average responses between 5 (Agree) and 6 (Strongly Agree).
- The highest average response was to the statement *The hands-on activities in this session give me a model for teaching this content to my students* with an average of 5.43 (standard deviation=1.01).

As teachers highlighted in their comments above, they thought that the activities in these sessions would be useful for introducing a range of topics and also had application beyond oyster restoration.

Student Interest in STEM Careers



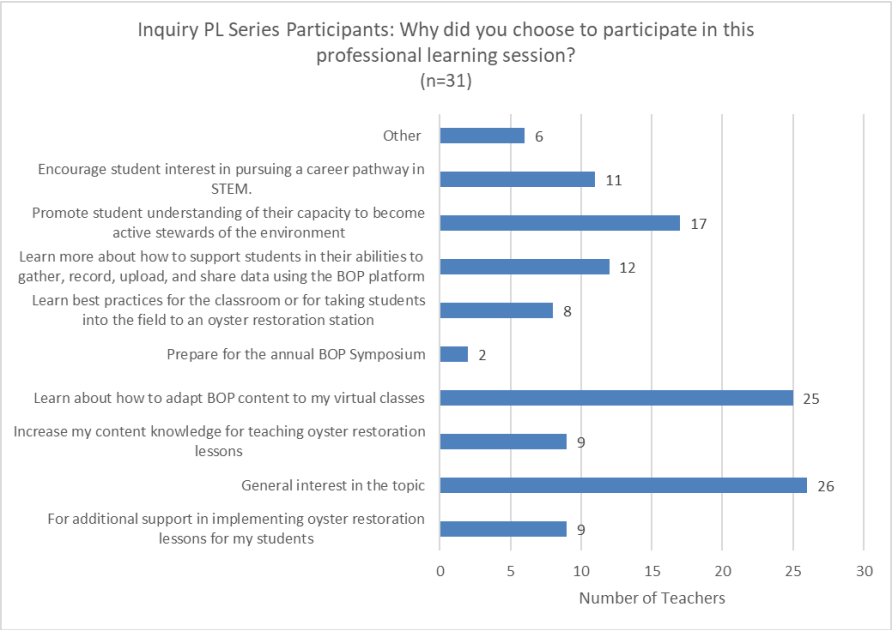
- Eighty-one percent of respondents thought that activities and lessons from the inquiry series would increase student awareness of STEM careers.



- The average response for *I increased my knowledge of STEM careers that I can share with my students* was 4.86 (standard deviation=1.01), with nine responding 'not addressed in this session.'

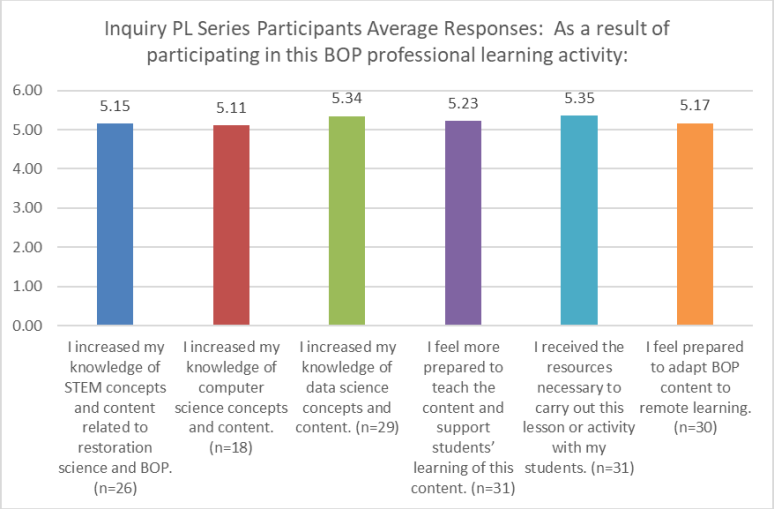
Teachers can use this *Inquiry* series to lay a foundation for many scientific ideas and ways of engaging students in the research process. To promote career awareness, facilitators could model strategies and be explicit in these sessions to introduce STEM careers to students in the context of these inquiry sessions.

Teacher Engagement and Learning



- A majority of respondents chose to participate in the *Inquiry from Anywhere* series for the following reasons:
    - *General interest in the topic* (84%)
    - *Learn about how to adapt BOP content to my virtual classes* (81%)
    - *Promote student understanding of their capacity to become active stewards of the environment* (55%)
- The reasons highlighted in yellow connect to teachers' interest in motivating student engagement in the content and student interest in STEM careers.

Teachers also responded to a series of statements about the nature and extent of their learning from the professional learning session they attended. These statements were rated on a scale of 1 (Strongly Disagree) to 6 (Strongly Agree). Note: for these statements, respondents also had the option "Not addressed in this session." Differences in n-values reflect those who selected "Not addressed."



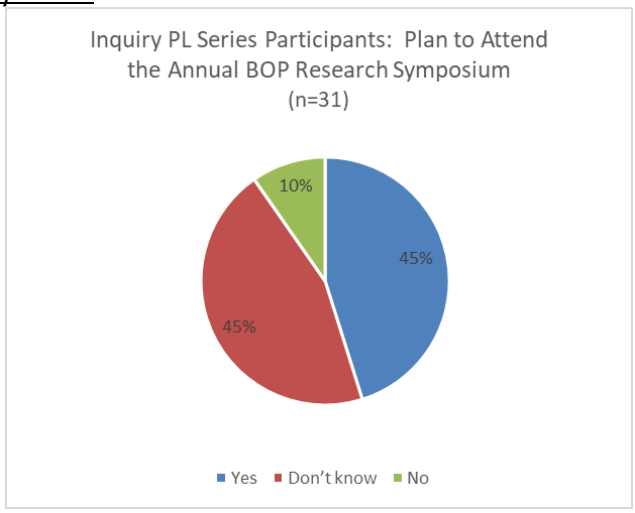
- Average responses to all statements were positive and between 5 (Agree) and 6 (Strongly Agree).
- The highest average response was to the statement *I received the resources necessary to carry out this lesson or activity with my students* with an average of 5.35 (standard deviation=1.05).
- The lowest average response was to the *statement I increased my knowledge of computer science concepts and content* with an average of 5.11 (standard deviation=0.58). Thirteen respondents said that this was 'not addressed in this session.' Computer science was not a focus of these sessions and lower ratings are not surprising.

High rating on teacher engagement and learning suggests that teachers felt confident following the sessions to engage their students in these activities.
Teachers were asked what could be changed about the sessions to better prepare them to use this material with their students. Answers included the following:

- *Nothing. It was great!*
- *It might have been interesting to hear about specific lesson plans or activities using the BOP biodiversity data and species guide to help brainstorm ideas about writing our own lessons.*
- *Nothing was missing from the session, but I think it would be helpful to have additional data such as size of the areas where the abundance was measured for statistics purposes.*
- *I liked the discussion between teachers about ideas for using the resources.*
- *maybe an introduction in how to create charts and graphs (like on google sheets)*
- *More time to discuss animal behavior videos students could use to make observations.*

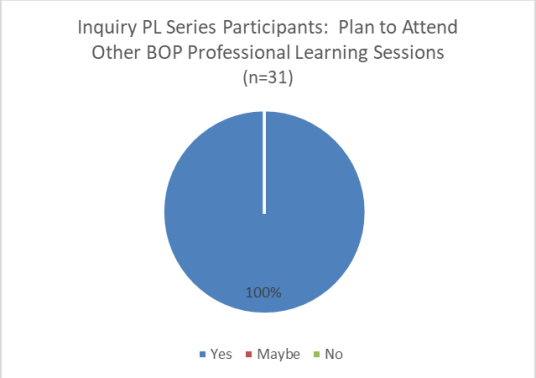
- *Differentiation for lower grade levels.*
- *Everything was amazing*
- *I would like to listen to teachers who have done it.*
- *A scope and sequence on how to teach this unit/series of lessons on inquiry-based learning*
- *I would have appreciated a bit more time focused on how to integrate these activities within larger themes and how to assess some of these activities.*

Continuing Teacher Participation



- Forty-five percent of participants in this series of plan to attend the annual BOP research symposium with their students.
- Forty-five percent do not know if they will attend.
- Ten percent do not plan to attend.

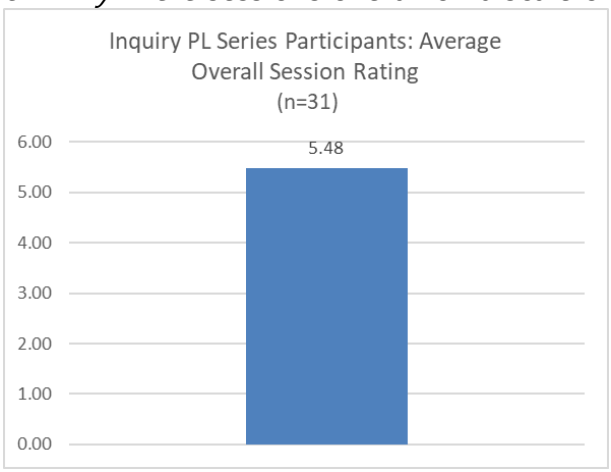
These findings suggest that the evaluator's observations of modelling of inquiry practices and discussions with participants about how to use them in the classroom gave teachers confidence to implement the same practices with their students in creating their own research projects, a key feature of the annual BOP Symposium. Session facilitators could include time in the workshops to discuss the symposium and how to use these sessions as resources for symposium projects, in particular because symposium participation is an opportunity for students to more directly engage with harbor restoration science, and to perceive themselves as someone who might be motivated to pursue a career in STEM.



- All participants from the inquiry professional learning series plan to attend more BOP PL sessions. These sessions were the last of the Fall 2020 school semester.

Teacher Comments and Feedback

Participants rated *Inquiry from Anywhere* sessions overall on a scale of 1 (Poor) to 6 (Excellent).



- Teachers rated this session positively with an average rating of 5.48 (standard deviation=0.81).
- Teachers provided additional feedback on how the sessions could be improved:
    - *Thanks for the resources*
    - *This has been a great series. Not sure how I would improve them.*
    - *Data that includes abiotic and biotic factors*
    - *Incorporate culturally responsive curriculum workshops/ antiracist curriculum workshops.*
    - *Incorporate next gen science standards*
    - *Keep on incorporating practical applications and incorporate considerations for equity.*
    - *I am interested to hear about experiences from teachers who have done it.*
    - *anchoring in NGSS would be helpful for educators*

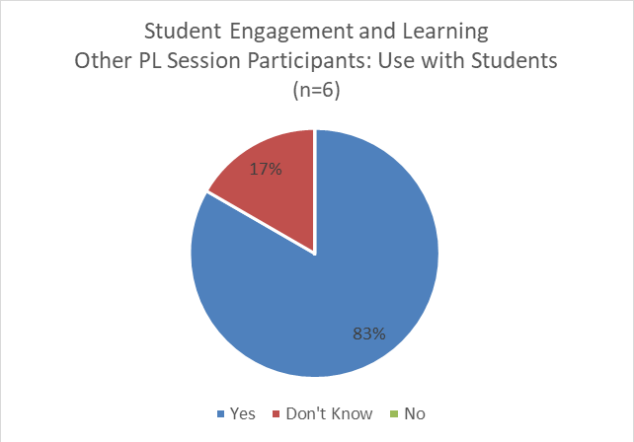
OTHER PROFESSIONAL LEARNING WORKSHOPS

Evaluators received six responses from two other stand-alone professional learning sessions. These sessions are the *Life Cycles of New York Harbor Critters* workshop on Nov. 10, 2020 and the *Living Breakwaters as a Habitat* workshop on Dec. 1, 2020. While these sessions were not a series, they both connected to BOP's Living Breakwater curriculum and highlighted specific activities for teachers to use with students. For 50 percent of survey respondents, one of these sessions was their first time participating in BOP programming.

As in discussions above about these survey findings, the impact of BOP professional learning sessions on student engagement and learning was evaluated through teacher participants' intention to use activities from their session(s) with their students, the ways they intend to use the activities, and what they learned from their session that can inform how to engage students with BOP activities and lessons.

Student Engagement and Learning

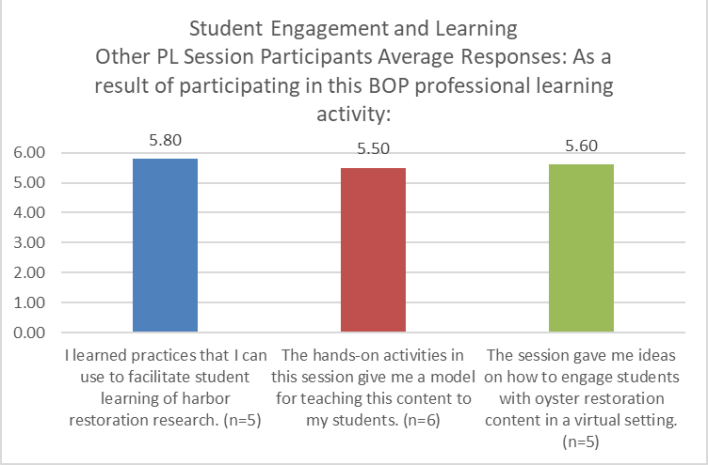
As in discussions above about these survey findings, the impact of BOP professional learning sessions on student engagement and learning was evaluated through teacher participants' intention to use activities from their session(s) with their students, the ways they intend to use the activities, and what they learned from their session that can inform how to engage students with BOP activities and lessons.



- Eighty-three percent of participants plan to use the activities and lessons from these two sessions with their students.
- Teachers plan to use the activities within the Living Environment or life cycles curricular units. Specific thoughts about how to do that include:
    - *I'm not sure yet where this would fit in. I'm considering how I can introduce oysters in the first place. However, there are elements of the structural build that I think I can employ.*

- *The hands-on experience is greatly needed during remote learning.*
- *The google slide has a depth of knowledge of marine animals on the east coast. and it is ready to use in my classroom*
- *Possibly an activity in which students construct a breakwater in an ecosystem so they can form hypotheses about how it would affect the ecosystem and its species.*
- *I will ask the students to create their own models of the living breakwaters using materials from around their house. I even think using food or different shape/size pasta could be applicable. I would have them cut out the organisms from the slide deck and stick them in locations they believe the organisms would be found.*
- *Adapt using engineering standards for students to construct their own breakwater models*
- *I will share some of Google slide deck in Google classroom - having students do activities- such as sort the creatures and organize the development stages*

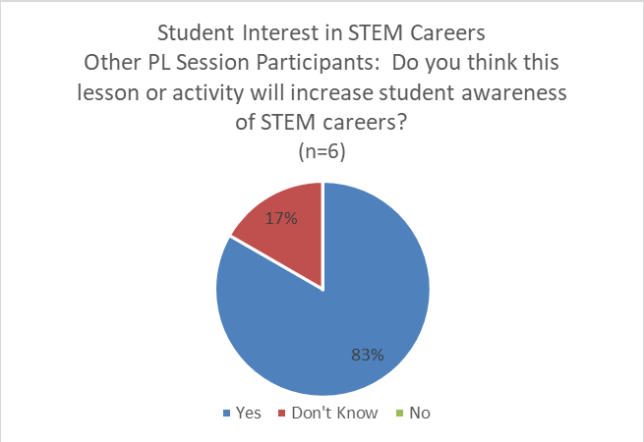
Teachers also responded to a series of statements about how the practices they learned from the professional learning session would facilitate student learning. These statements were rated on a scale of 1 (Strongly Disagree) to 6 (Strongly Agree). Note: for these statements, respondents also had the option "Not addressed in this session." Differences in n-values reflect those who selected "Not addressed."



- On average, teachers responded positively to statements about student engagement and learning, with all three statements receiving ratings between 5 (Agree) and 6 (Strongly Agree).

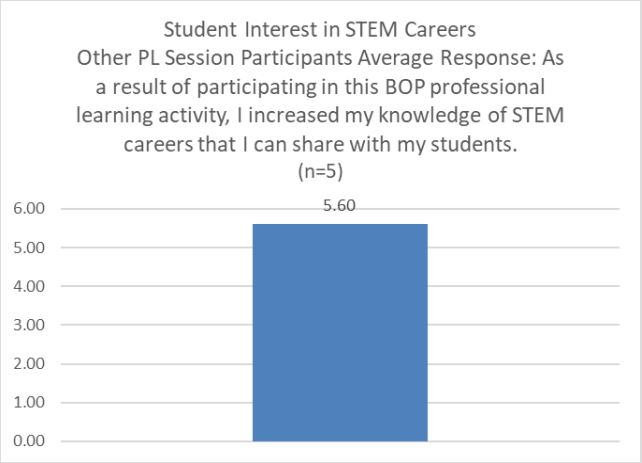
This finding suggests that one strength of these sessions was modeling ways to facilitate student learning and engage students virtually in oyster restoration content.

Student Interest in STEM Careers



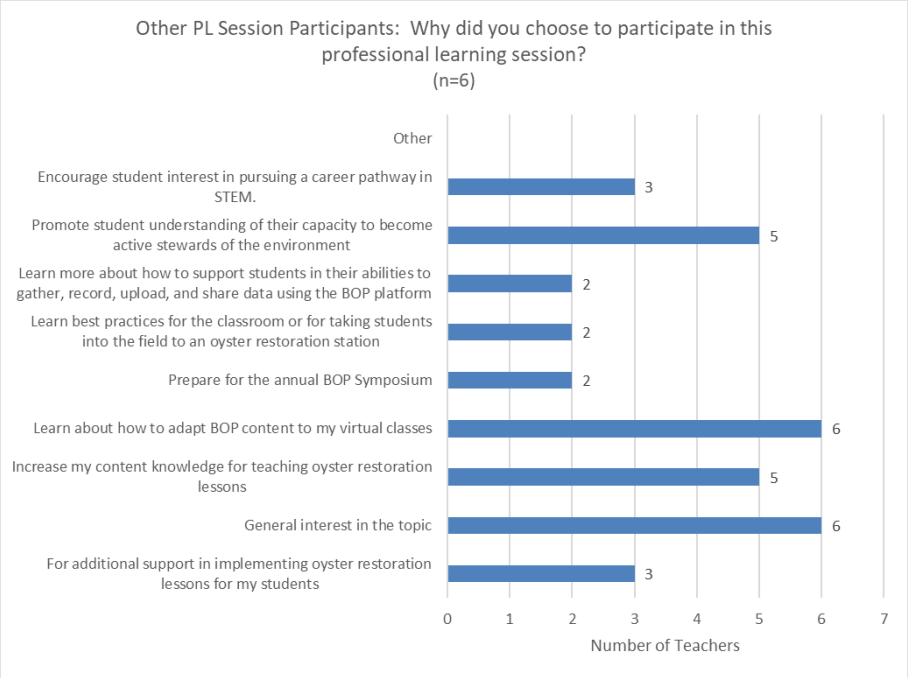
- Eighty-three percent of participants thought that these lessons and activities would increase student awareness of STEM careers.

Because these sessions introduced BOP's Living Breakwater curriculum, the curriculum could provide lessons and extension activities that connect more specifically to developing student STEM career interests. As presented in the graph below, teachers sought out these sessions for ideas about how to teach BOP material in the virtual setting. The virtual setting provides a unique opportunity to give teachers more resources about careers through activities such as "virtual fieldtrips" than they otherwise might be able to do, and could enable students see how STEM professionals use concepts from the curriculum.



- Teachers responded positively to increasing their own knowledge of STEM careers through this session, with an average response of 5.60 (standard deviation=0.55). One participant responded 'not addressed in this session.

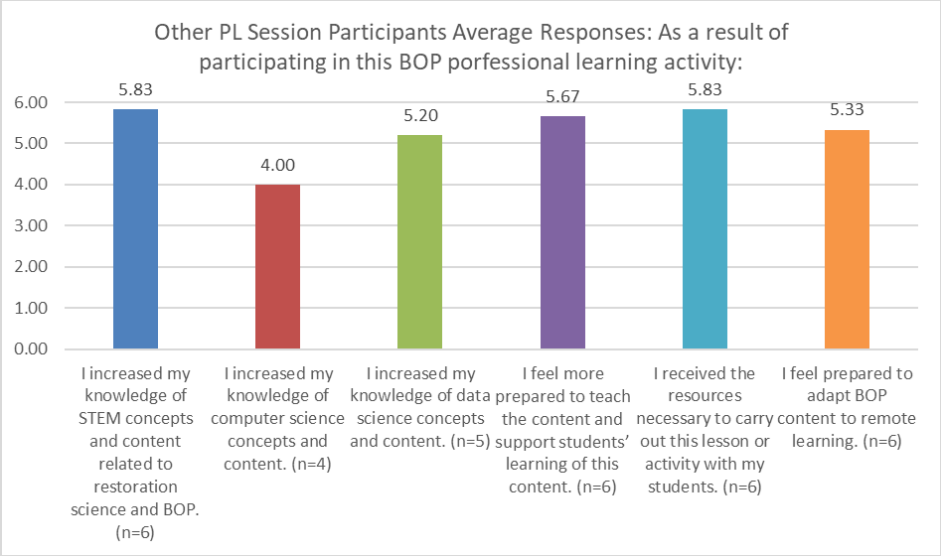
Teacher Engagement and Learning



- Fifty percent or more of respondents chose to participate in these other professional learning sessions for the following reasons:
    - Learn about how to adapt BOP content to my virtual classes (100%)
    - General interest in the topic (100%)
    - Promote student understanding of their capacity to become active stewards of the environment (83%)
    - Increase my content knowledge for teaching oyster restoration lessons (83%)
    - Encourage student interest in pursuing a career pathway in STEM (50%)
    - For additional support in implementing oyster restoration lessons for my students (50%)

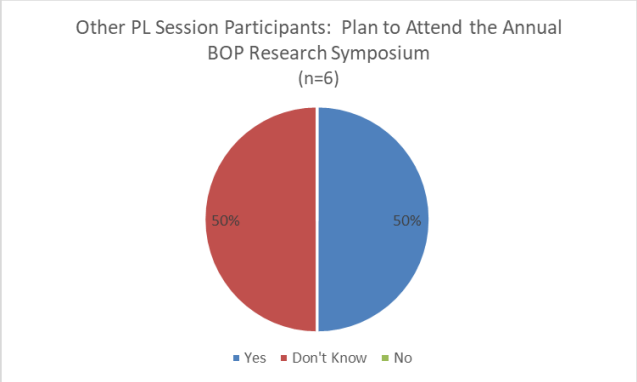
The reasons highlighted in yellow connect to teachers' interest in motivating student engagement in the content and student interest in STEM careers.

Teachers also responded to a series of statements about what they learned from the professional learning session they attended. These statements were rated on a scale of 1 (Strongly Disagree) to 6 (Strongly Agree). Note: for these statements, respondents also had the option "Not addressed in this session." Differences in n-values reflect those who selected "Not addressed."

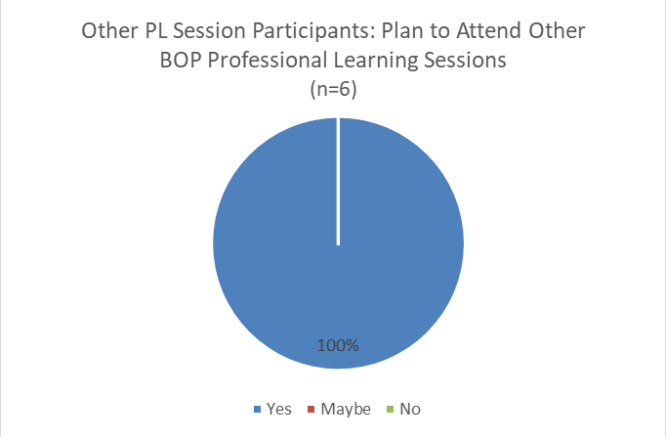


- The highest average response was on the following statements with an average of 5.83 (standard deviation=0.41):
    - *I increased my knowledge of STEM concepts and content related to restoration science and BOP.*
    - *I received the resources necessary to carry out this lesson or activity with my students.*
- The lowest average response was to the statement *I increased my knowledge of computer science concepts and content* with an average of 4.00 (standard deviation=1.41). Two participants responded that this was 'not addressed in this session.' Computer science was not a focus of these session, and this lower rating is not surprising.
- Teachers were asked what could be changed about the sessions to better prepare them to use this material with their students. Answers included the following:
    - *Perhaps a video showing an actual breakwater and how it effects ecosystems. Perhaps material connecting macroprocesses like global warming more directly to breakwaters.*
    - *Nothing was missing. I think instead of just using recyclable materials, items such as paperclips, erasers, cotton balls, or even different sized food items could also be applied (pasta, pretzels, jellybeans, gummy bears, tic tacs etc.).*
    - *I'm used to checklists or worksheets that can be used to guide students that are younger.*
    - *My students generally come from Central America and the Caribbean; it might be useful to know where to find information about organisms native to those areas.*

Continuing Teacher Participation



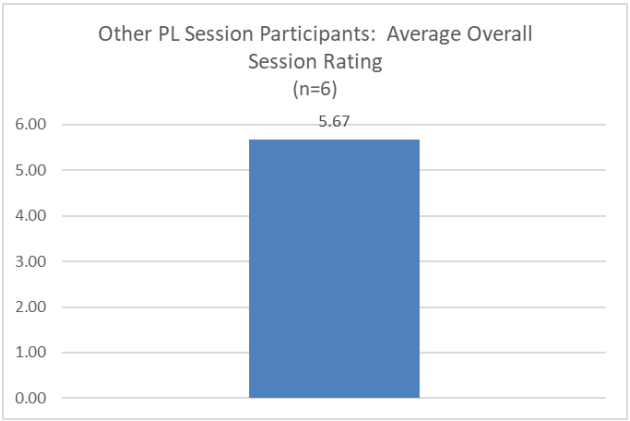
- Fifty percent of participants plan to attend the annual BOP symposium with their students.



- All participants plan to attend other BOP professional learning opportunities. These were the some of the last sessions of this semester.

These findings suggest that promoting ongoing participation in professional learning gives teachers more resources for engaging their students and new ways to build STEM career interest.

Teacher Comments and Feedback

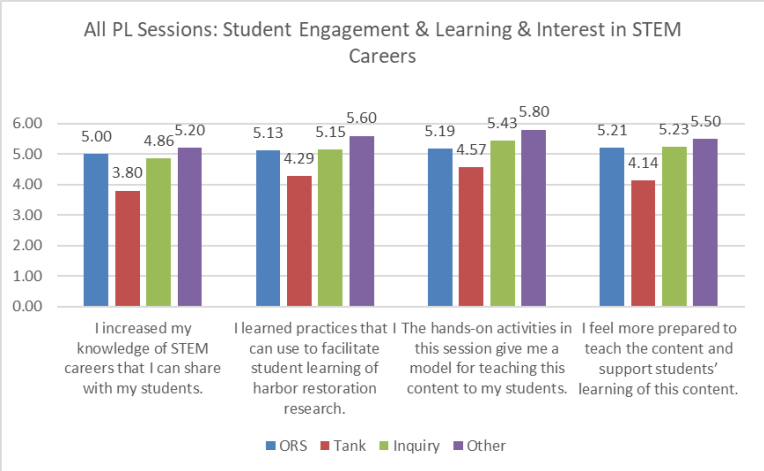


- On average, teachers rated these sessions highly positively with an average of 5.67 (0.82).

- Teachers provided additional feedback for ways to improve sessions:
    - *I think all of the learning activities I have attended so far have been great and hope there are more to come!*
    - *I just keep thinking about AR or virtual simulations that probably exist…however, having an active build is great too.*

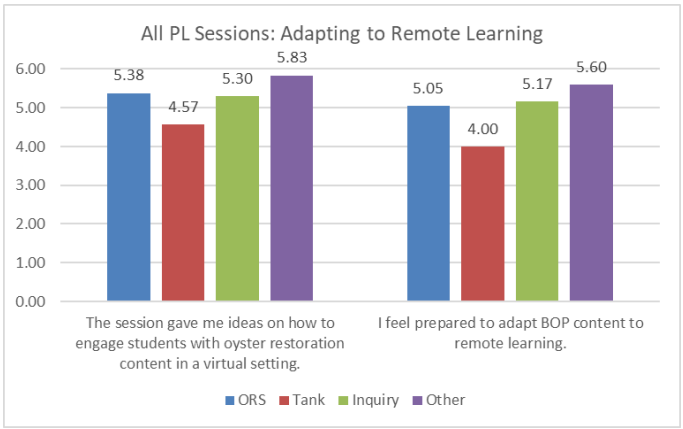
COMPARISON OF RESULTS ACROSS PROFESSIONAL LEARNING SESSIONS

Student Engagement and Learning and Interest in STEM Careers



- Connections to student engagement, learning, and interest in STEM careers were positive across all session categories.
- Teachers average responses were most positive to all statements in the single session other professional learning sessions connected to the Living Breakwater curriculum.

Adapting to Remote Learning



- Overall, teachers felt prepared following their professional learning sessions to utilize BOP lessons and activities in a virtual setting as remote learning is ongoing due to COVID-19.

- Two sets of sessions, the Inquiry from Anywhere and Other, were developed after the pandemic started and reflected a need for teachers to have access to more lessons for this environment. Applying some of the successful aspects of these sessions to some of the other sessions, in particular the oyster tank training, could lead to further teacher confidence in using BOP in remote learning.

SUMMARY OF EVALUATION SURVEY FINDINGS

Overall, data collected from a survey of teachers following their participation in BOP professional learning activities, provides evidence that these sessions were successful and met the project's goals to provide support and resources for teachers to engage students in oyster restoration research and learn to think of themselves as environmental stewards. Some sessions were more successful than others for helping teachers build student awareness and motivate interest in STEM careers.
Creating explicit content that connects students to careers, including those beyond lab scientists, is an area where BOP can expand by being more explicit in using the workshop activities to teach teachers how to raise student awareness of themselves as doing scientific work and to link students' research to the pursuit of a STEM career. The findings suggest that promoting ongoing participation in professional learning gives teachers more resources for engaging their students and new ways to build STEM career interest. Three new virtual sessions emerged this semester to address this issue, a series of career panels, which were designed specifically by and for students to address career awareness in maritime STEM fields. Student responses to those panels are addressed by The Mark project research staff.

Additionally, the annual BOP Student Research Symposium is a place where teachers can provide students with more direct engagement in BOP. Fifty percent of teacher respondents planned to bring students to the symposium following professional learning workshop participation. Having time to discuss next steps with teachers to continue or build on teachers' current engagement may encourage more teachers to plan to engage students in creating research projects for the symposium.

These findings suggest that BOP adapted well to the virtual learning environment that was dictated by the onset of COVID-19 in March. Project staff planning in spring and summer led to the successful professional learning sessions delivered in the fall. To see how BOP project staff adapted professional learning offerings, see the staff and scientists interview data in *Interview Report.*

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Billion Oyster Project
ITEST Teacher Professional Learning Session Observation Results
2020

Background

From January through December 2020, the evaluator observed 12 professional learning sessions facilitated by the Billion Oyster Project. These sessions were evaluated using the *Observation Checklist for High-Quality Professional Development Training* developed by Noonan et al. (2016 (updated 2017)) and adapted by evaluators for use in BOP professional learning sessions. According to Gaumer Erickson et al. (2016), "this checklist was designed specifically to: 1) evaluate training on the inclusion of research-based adult learning components that have been shown to increase the knowledge and skills to implement practices; and 2) provide guidance for training providers to help them improve their practices."

Each of the 18 items on the instrument represents a high-quality professional development practice. The instrument uses a 'yes' or 'no' rating system, indicating the presence or lack of presence of each of the desired practices measured by the protocol. For this report, results are presented in three categories: organizational practices, facilitator actions in the session, and participant actions in the session.

The 12 observed sessions were:

- *Ocean Engineering - Introduce Your Students to Marine Careers!* on January 9, 2020
- *Billion Oyster: Virtual Symposium Prep - Projects to do with Your Students* on March 26, 2020
- *ORS Basic Training (Session 1 of 3)* on October 1, 2020
- *Inquiry from Anywhere PL Series for Teachers—Data Collection* on October 27, 2020
- *Billion Oyster 101 Reef Structure* on November 5, 2020
- *ORS Basic Training (Session 1 of 3)* on November 6, 2020
- *Life Cycles of New York Harbor Critters: Professional Learning Opportunity* on November 10, 2020
- *ORS Basic Training (Session 3 of 3)* on November 11, 2020
- *Inquiry from Anywhere PL Series for Teachers—Data Collection* on November 12,2020
- *Inquiry from Anywhere PL Series for Teachers—Animal Behavior* on November 17, 2020

- *Living Breakwaters as a Habitat: Professional Learning Opportunity* on December 1, 2020
- *Inquiry from Anywhere PL Series for Teachers—Biodiversity* on December 8, 2020

Organization

Evaluators looked for four items as indicators of organization during each professional learning session. Organization items link to preparation for the session and managing time within the session. These items are listed below.

Item	Percent of Sessions Item Observed
Provides a description of the training with learning objectives prior to training	100%
Provides readings, activities, and/or questions in accessible formats to think about prior to the training	17%
Provides an agenda before or at the beginning of the training	42%
Adheres to agenda and time constraints	100%

Two items in this category were observed at all sessions. BOP provided a description on their Eventbrite of each training when teachers signed up, and during the sessions, facilitators stayed on time. Facilitators provided readings or other activities prior to the session only 17 percent of the time. Facilitators provided an agenda before or at the beginning of the training during 42 percent of observed trainings.

Facilitator Actions

Evaluators looked for nine items from the facilitator. These items are actions that connect participants to the topic of the professional learning session, emphasize the importance of the content and practices in the session, provide resources during and following the session. These items are listed below.

Item	Percent of Sessions Item Observed
Establishes rapport with participants from beginning of the session	100%
Connects topic to participants' context	100%
Content builds on or relates to participants' previous professional development (not applicable to all sessions)	13%

Aligns with organizational standards or goals	100%
Emphasizes impact of content (e.g., student achievement, family engagement, client outcomes)	100%
Builds and reiterates shared vocabulary required to implement and sustain the practice	100%
Provides examples of the content/practice in use (e.g., case study, vignette)	100%
Illustrates the benefits of the material, knowledge, or practice to the participants' context.	100%
Offers opportunities for continued learning through technical assistance and/or resources	100%

BOP facilitators were highly successful in this category. All items except for one were observed in 100% of the sessions. Facilitators connected to or built on prior training in 13 percent of applicable sessions; this item was not applicable to all professional learning sessions as some are stand-alone or entry level sessions. While not all participants may have attended a previous session in a series, relating to what was already presented creations connections for the participants who have been in prior sessions.
Some examples of practices observed in this category are:

Participant Actions

Evaluators looked for four items connecting to opportunities for participants to be actively involved in the training. These items connect to using the skills and content in the session, giving perspectives and working with other session participants, and time for reflection on the session and learning. These items are listed below:

Item	Percent of Sessions Item Observed
Includes opportunities for participants to apply content and/or practice skills during training	100%
Includes opportunities for participants to express personal perspectives	100%
Facilitates opportunities for participants to interact with each other related to training content	91%
Includes opportunities for participants to reflect on learning	100%

BOP professional learning facilitators exceled in this category with all items observed in over 90 percent of sessions, and three items observed in all of the sessions. Providing opportunities for participants to have an active role is important for high-quality professional learning sessions as these practices can carry over to the classroom. Teachers report in their participant survey that these qualities are what makes BOP sessions successful for them.

Summary

Billion Oyster Project provided high-quality professional learning opportunities for teachers in 2020. The majority of items noted as features of high-quality sessions were observed in BOP's professional learning sessions. BOP successfully and quickly shifted their sessions from in-person to virtual in March 2020 when it was necessary due to the COVID-19 pandemic. Based on these observations, the quality of professional learning opportunities did not decrease with that change. Responses from teacher surveys also reflect that teachers view these sessions as high-quality and teachers plan to attend more BOP professional learning sessions in the future. Organization was the weakest area of the sessions. This is easily changed by providing readings or other materials for consideration before sessions and by providing an agenda of the session either prior to the session or at the beginning.

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ITEST

Summary Report of Evaluation Interviews with Project Staff, Scientists, and Researchers July-December 2020

From July to September, 2020, the evaluator conducted 12 interviews with BOP ITEST project staff, project scientists, and researchers with updates provided by at ITEST quarterly meetings through December 2020 to gather information about the implementation of the ITEST project in 2020.

Project Staff Interviewed:

Education Grants Project Manager
Assistant Director of Education & Outreach
Education Field Science Specialist
Education Outreach Coordinator
Community Reefs Regional Manager

NOTE: The Director of Education was not interviewed due to scheduling problems.

Scientists interviewed:

CUNY-York College, Director of Alter DNA Lab, DNA
Professor, CUNY-Brooklyn College, water chemistry
The River Project, Director of Education, water pathogen monitoring and IDEXX collection
Cold Spring Laboratory, DNA bar coding, Director DNA Learning Center
Assistant Professor, Department of Natural Sciences, CUNY-Baruch College

Researchers interviewed:

Senior Evaluator, The Mark
Evaluation Associate, The Mark

Interview questions were designed to gather data related to the Evaluation Questions. They included:

- What were the most effective aspects or activities of your work? (strengths)
- What were the challenges to implementation?
- What changes or modifications did you make to address the challenges?

Responses to the interviews are organized by ITEST pillar:

Pillar 1. Community Based Restoration STEM Hubs

Pillar 2. Near-Peer Mentoring Program

Pillar 3. Restoration Science Professional Development for Teachers

Pillar 4. Advanced Methods in Restoration Science for High School

PILLAR 1 STEM Hubs

Goals:

- Engaging students in real world data collection and research at STEM Hubs NY Harbor waterfront sites.
- Developing student awareness and interest in pursuing careers in marine sciences, environmental science, and related STEM careers

Pre-COVID-19, project staff enhanced the STEM Hub activities in Year 2 by adding a new deliverable – a classroom workshop as a pre-requisite to the site field visit to prepare students for field ORS monitoring, research protocols and data collection activities. As a consequence, students were highly engaged in the ORS monitoring and research activities when they were in the field, observed the Assistant Director of Education and Outreach. "They earned how to use the research protocols to collect water quality data, take oyster measurements, identify other marine species living in the ORS, and to test each other's work for accuracy, "said the Community Reefs Manager, facilitating these sessions. Another staff member observed, "Using the field data collection protocols was a big success this year. It worked out really well. The students were excited! 'I can't believe what lives in the water,' one student said. I really enjoyed watching the kids' amazement. I could see a light going off. They understand they are involved in the environment, they grasped it and want to tell others." The evaluator's observations corroborated this student excitement and enthusiasm.

"The STEM Hubs is ITEST's greatest strength" said the Education Grants Manager. "The students' execution of the research protocols and the staff's modeling of field research pedagogy for teachers were the two main deliverables of this pillar. Staff is continuing to improve that. It will be a lasting feature of the Billion Oyster Project."

Evidence of the strength of this pillar was the depth and breadth of student participants who presented projects at the BOP Annual Symposium in June 2020 during COVID-19. Eleven students who participated in the STEM Hubs activities in Year 2 submitted research projects. "We could see our work was impactful on students' work," said the STEM Hubs Manager. "They demonstrated awareness of the environment, a sense of ownership of the environment, knowledge about CSOs and how harmful they are, the importance of oysters and biodiversity, and an environmental call for action that was addressed in so many of the projects. They see themselves as stewards of the harbor, as community scientists, by being involved, possibly leading to careers in environment and industry." They had some guidance from their teachers but

they were mostly independent student projects, created at home in the COVID-19 environment, using their knowledge and skills in the field and a lot of their own work. "I felt like a proud mama of those students."

PILLAR 2: NEAR PEER MENTORING

Goals:

- Pairing older and younger students for oyster research mentoring to engage students in BOP waterfront research activities.
- Creating student awareness and interest in pursuing careers in the marine sciences, the environment, and related STEM fields.

Strengths

Before COVID-19, program staff encouraged three schools (ES, MS, HS) which had already installed and were managing an ORS to collaborate with each other to identify students as mentors and mentees in facilitating oyster restoration research, and promoting student career interest. When that model was never fully operational, before or during COVID-19, until Fall 2020, staff came up with an alternative model which was implemented effectively in Fall 2020. Harbor School juniors participating in the school's Harbor Corps afterschool club were to be mentors to incoming Grade 9 students at Harbor School which has turned out to be an effective model in engaging students in exploring the seven maritime careers taught as CTLE courses at the Harbor School. Even during COVID-19, the project coordinator was able to get the mentors and mentees outside to clean up the waterfronts at two STEM Hub sites.

PILLAR 3: PROFESSIONAL DEVELOPMENT FOR TEACHERS

Goals:

- Get teachers and students out to the water to work hands-on with Oyster Restoration Stations
- Develop teachers' capacity to develop student awareness and interest in careers in the marine sciences, the environment, and related STEM fields.

Strengths

Prior to and during COVID-19, this pillar effectively provided high quality onsite and virtual professional learning activities for teachers in two areas: 1) supporting teachers and students in the introduction, maintenance, and use of oyster restoration stations, 2) designing content and pedagogical strategies for teachers professional learning activities to engage students' in exploration of maritime STEM careers.

Evidence of the effectiveness of the professional learning experiences and myriad efforts to support teachers (pre-COVID-19, but mostly during COVID-19) in engaging students in oyster

restoration and working as scientists themselves was in the depth and breadth of research projects submitted by students to the annual BOP Symposium in June 2020; 72 projects were presented, discussed, and judged via zoom over the course of a week. Observed one staff member, " It was real life scientists exploring real life issues. I saw evidence of research related to water quality and the relationship to oysters, oysters and oyster growth, the impact of combined sewer overflows…I was really happy to see what we teach in our activities shining through."

Staff noted that having to adapt BOP activities for COVID-19 "brought the education team closer together. We all had clear tasks and responsibilities and it came out really well. It was a learning moment for us to move forward virtually. We didn't want anything to fall by the wayside because of COVID-19."

PILLAR 4: ADVANCED RESEARCH METHODS

Goals:

- Introduce advanced level research methods to engage high school students in oyster restoration-related research projects.
- Motivate students to pursue a career in the marine sciences, the environment, and related STEM fields.

Strengths

Pillar 4 was not fully implemented. Before COVID-19, two of the four participating research labs developed their own two-day series of professional learning activities for teachers. Teachers participated in the series created by CUNY - Brooklyn College and The River Project related to New York Harbor water chemistry and bacterial monitoring. The strengths of these activities observed by the evaluator were the opportunities for teachers to engage in authentic research procedures themselves - collecting water samples from the NY harbor, recording data, learning how to use research protocols, enacting simple water sample analysis, and using a variety of data sets to compare bacteria in different parts of the harbor – all skills and practices which they could teach to their students. No teacher or student data was generated for this pillar due to low participation.

Challenges

Pillar 4 was not fully implemented. One of the Lab participants did not deliver program activities. Two Labs implemented sessions that were poorly attended, and one Lab reported no attendance at all.

RESEARCHER INTERVIEWS

Goals:

- Develop an online, fully digitalized student data collection system to gather data to assess the impact of the program on student engagement in STEM, STEM learning, and interest in STEM careers.

Strengths

To be able to gather data about student engagement, student learning, and student interest in STEM careers, the research staff at The Mark focused their work in Year 2 on developing a fully digital system for collecting pre-post student survey data online with a signed parental consent process. The survey was administered to all student participants of BOP activities in all four pillars. In Year 2, the survey design went through a series of iterations with the result that the final version became more user friendly and accessible to students and their parents and allowed researchers to follow up to obtain signed parent consents.

Challenges

The major challenge for researchers was gathering the data. Researchers wanted to create both a digital and manual version of the survey with parental consents that would not be cumbersome and create a bottleneck in identifying student respondents and getting student responses. "Said the senior researcher, "I wanted to protect the user data so the project could go forward in recruiting respondents while being confident that respondents would have a good experience with the survey and we wouldn't burn our bridges with the study population."

Researchers originally planned for a solely digital survey, but issues of equal access to a digital survey required them to develop a manual paper version. It became apparent, however, that there was no mechanism for distributing a manual survey. The IRB prevented contact between researchers or project staff and research subjects.

A complication that significantly delayed the administration of the survey was preparing and getting final approval for the IRB and subsequent IRB amendments from the New York City Department of Education. No student surveys could be administered until the IRB was approved which meant that many opportunities to collect student data in Year 2 were lost. The process proceeded for almost a year. In addition to a first version which did not follow the NYCDOE IRB guidelines, approval became stalled in the NYCDOE IRG review process bureaucracy which demanded many revisions. A new research team at NYCDOE was in the process of revising the IRB approval process which also contributed to confusion and many delays at their end. The time between submission of subsequent amendments and requested revisions was lengthy. In the interim, researchers used the already approved PACE IRB to initiate some aspects of the student

data collection. By the end of the approval process, the NYCDOE adopted the BOP IRB submission as a model for their future research submissions.

The Mark's relationship with project staff was also a challenge. "Staff had no idea of what the grant involved," said the Senior Researcher. "It took a year to get up to speed. There was a big shift in what we were hired to do and what we were doing. It took time for the research staff to reorient in Year 2. Another obstacle was coming to agreement with project staff on a final version of the survey. There was insufficient communication to move the work forward. "When project staff had an issue with our version of the survey they didn't let us know what the problems were," said the Senior Researcher. "We had to draw it out of them when we saw that nothing was happening."

Another challenge was getting project staff to identify practices to collect the electronic and paper survey data. "We were thinking we had agreed upon the project staff's role in reaching out to students to get them to take the survey, then it wouldn't happen, and then staff didn't communicate that it didn't happen. My desire was to have everything proven before we could go forward. By the time we realized it wasn't happening, there were no more activities left in the year to survey students. Judging by the number of survey responses, the outreach to encourage survey participation was ineffective." In addition, Pillars 2 and 4 were only partially implemented which eliminated two prime sources of student survey data.

Said the Senior Researcher, "We need to get more data and integrate the research with the interventions more effectively. Adding project activities can deliver more student data.

The most difficult challenge since the beginning of the grant was developing a system for identifying control group of students to compare to the students receiving the project's interventions.

Modifications

The transition was made to operationalizing the student data collection as fully digital. The strengths of the final survey were achieved by shortening the survey, adding mixed media photos and images, and simplifying the language for younger students. "Equity in the digital administration was restored during COVID-19 because all students had access to the online version," said the Senior Researcher. The final version of the survey also created more direct communication with parents by collecting contact information that enabled researchers to follow up in getting the signed parental consents.

"I finally got to the point where I was proud of some of it. We made the transition from a manual to exclusively electronic student data collection system. The digital survey is shorter, multi-media, is respectful of participants by not being overwhelming, and is accessible for students, just a click

away. In Fall 2020, a student comparison group was identified and data is being collected from this group."

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ITEST Pillar 1: STEM Hubs
Report of
2020 Student Survey Evaluation Results

Middle school and high school students who participated in BOP ITEST Pillar 1 through STEM Hubs, classroom sessions or other events hosted by BOP had the option of taking an evaluation survey about their perceptions of their scientific skills as well as their interest in STEM careers after their participation. Fourteen students took the survey who said they had been to a Billion Oyster Project oyster activity in the past twelve months.

Respondents

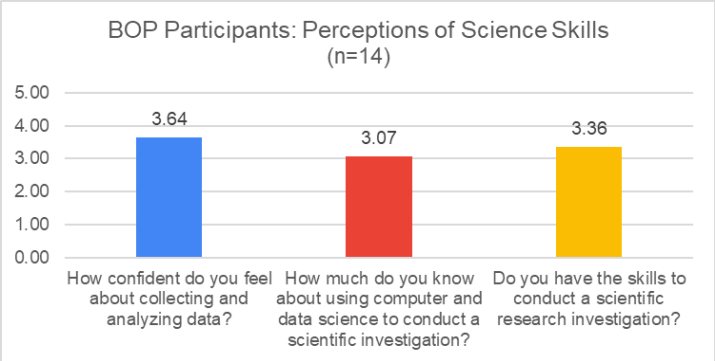
Among the 14 respondents who took the survey through Pillar 1 activities, half reported that they had also participated in other STEM activities over the past year. Activities included:

- STEM camp
- Math class
- Bio lab and marine biology society
- Marine biology
- robotics
- Oyster club at my school
- Science Olympiad, science museum visits, etc.

Students participating in marine biology society or oyster club may have exposure to further harbor restoration content and BOP activities.

Student Perceptions of Science Skills

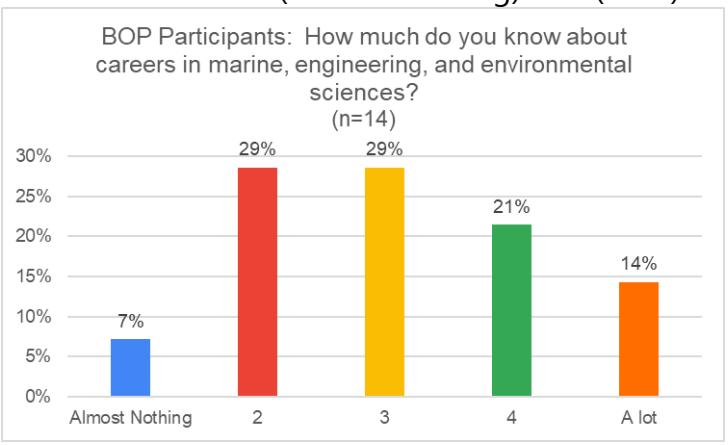
Students responded to three questions about their perceptions of their skills in carrying out science investigations. Statements were rated on a scale of 1 (Almost Nothing) to 5 (A lot).



- Students responded most positively to the question *How confident do you feel about collecting and analyzing data?* with an average response of 3.64 (standard deviation=0.84). Many Pillar 1 activities focus on collecting data about oysters and their environment.
- The question with the lowest average response was *How much do you know about using computer and data science to conduct a scientific investigation?* with an average of 3.07 (standard deviation=1.07).

Student Knowledge of STEM Careers

Students also responded to a question about how much they know about STEM careers connected to BOP topics in marine, engineering, and environmental sciences. Students responded to this question on a scale of 1 (Almost Nothing) to 5 (A lot).



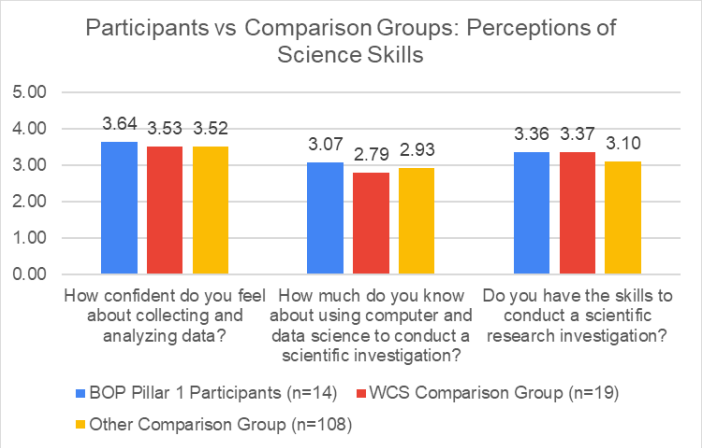
- Students' average response was 3.07 (standard deviation=1.21).
- The most common answers were 2 and 3, with 3 representing an average amount and 2 less than average, at 29 percent of respondents each.
- Thirty-five percent of students thought they knew a more than average amount about these STEM careers.

Comparison Group Results

There are two comparison groups for this survey. One group is comprised of students who visited the New York Aquarium and participate in WCS programming for students. For the second group,

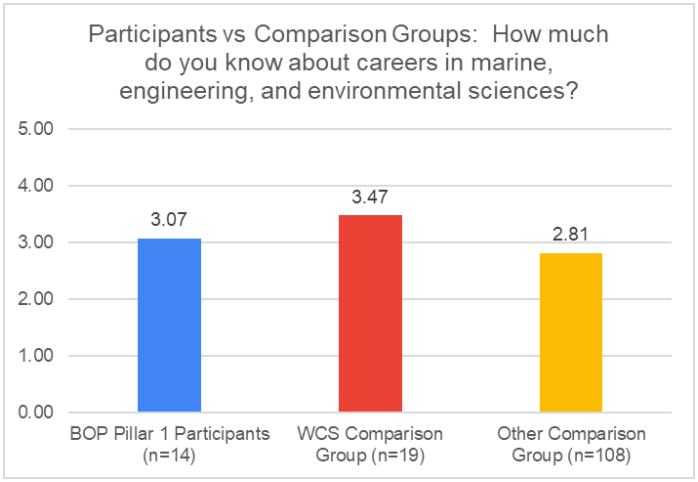
the link was distributed publicly to students who did not take the survey with one of these groups.

Perceptions of Scientific Skills



- BOP participants rated their perceptions of their own scientific skills higher than both comparison groups on two questions:
  - *How confident do you feel about collecting and analyzing data?*
  - *How much do you know about using computer and data science to conduct a scientific investigation?*
- BOP participants felt comparable to WCS participants and more positively that the general comparison group about skills to conduct a scientific research investigation.

Knowledge of STEM Careers



- BOP participants thought they knew more about STEM careers connected to harbor restoration science than the general comparison group students did.
- BOP participants rated themselves lower than the WCS comparison group students.

These findings suggest that participating in BOP does increase student knowledge about STEM careers and improves their perceptions of their scientific skills compared to those with less

involvement in science programming. Many BOP student activities were interrupted due to the COVID-19 pandemic, particularly around student participation at field sites. As BOP offers new student programs, such as the Near-Peer Career Panels introduced in late-fall 2020, these results may improve.

Observation Checklist for High-Quality Professional Development Training (Modified for BOP Training Sessions)

The *Observation Checklist for High-Quality Professional Development*[1] was designed to be completed by an observer to determine the level of quality of professional development training. It can also be used to provide ongoing feedback and coaching to individuals who provide professional development training. Furthermore, it can be used as a guidance document when designing or revising professional development. The tool represents a compilation of research-identified indicators that should be present in high quality professional development. Professional development training with a maximum of one item missed per domain on the checklist can be considered high quality.

Date:	Location:
Topic:	Presenter(s):
Number of Participants:	Observer:
GRANT NAME: ITEST STEM+C OTHER	

1. Provides a description of the training with learning objectives prior to training ● *EXAMPLE 1: Training description and objectives e-mailed to participants in advance* ● *EXAMPLE 2: Training description and goals provided on registration website* ● *EXAMPLE 3: Agenda including learning targets provided with materials via online file sharing before training*	
Evidence or example:	
2. Provides readings, activities, and/or questions in accessible formats to think about prior to the training ● *EXAMPLE 1: Articles for pre-reading e-mailed to participants in advance* ● *EXAMPLE 2: Book for pre-reading distributed to schools before training* ● *EXAMPLE 3: Materials made available via online file sharing*	

Evidence or example:	
3. Provides an agenda (i.e., schedule of topics to be presented and times) before or at the beginning of the training ● *EXAMPLE 1: Paper copy of agenda included in training packet for participants* ● *EXAMPLE 2: Agenda included in pre-training e-mail*	
Evidence or example:	
4. Establishes rapport with participants from the beginning of the session ● *EXAMPLE 1: Trainer gives own background, using humor to create warm atmosphere* ● *EXAMPLE 2: Trainer praises group's existing skills and expertise to create trust* ● *EXAMPLE 3: Trainer uses topical videos to break the ice with the audience* ● *EXAMPLE 4: Trainer refers to experiences from a previous session*	
Evidence or example:	
5. Connects topic to participants' context ● *EXAMPLE 1: Trainer connects content to participants' curriculum and classrooms* ● *EXAMPLE 2: Trainer shares participating district data profiles and asks participants to consider how the intervention might affect students* ● *Example 3: Trainer shows examples from classrooms, then asks participants to compare the examples to what happens in their school*	
Evidence or example:	

6. Content builds on or relates to participants' previous professional development ● *EXAMPLE 1: Trainer refers to or builds on content provided in previous trainings within the sequence* ● *EXAMPLE 2: Trainer uses participants' knowledge of other interventions or experiences to inform training*	
Evidence or example:	
7. Aligns with organizational standards or goals ● *EXAMPLE 2: Trainer refers to STEM+C data or computer science goals* ● *EXAMPLE 3: Trainer refers to program goals of student motivation toward STEM careers* ● *EXAMPLE 4: Trainer aligns content with grade level standards or Scope and Sequence* ● *EXAMPLE 1: Trainer refers to the program as part of a federally-funded grant*	
Evidence or example:	
8. Emphasizes impact of content (e.g., student achievement, family engagement, client outcomes) ● *EXAMPLE 1: Participants brainstorm the ways the intervention will impact students and student interest in STEM careers* ● *EXAMPLE 2: Trainer uses data to show that the intervention is shown to positively impact post-school outcomes or positively impacts future STEM engagement.* ● *EXAMPLE 3: Trainer shares research that shows that the use of the instructional strategies improved academic achievement for students*	
Evidence or example:	
9. Builds and reiterates shared vocabulary required to implement and sustain the practice *EXAMPLE 1: Trainer has participants work together to formulate definitions of the intervention components and then goes overs the definitions as a group* *EXAMPLE 2: Trainer defines instructional practices according to program goals.* *EXAMPLE 3: Trainer ensures everyone has the same understanding of what's being addressed.*	

Evidence or example:	
10. Provides examples of the content/practice in use (e.g., case study, vignette) ● *EXAMPLE 1: Trainer provides video examples of the intervention in place within classrooms at different grade levels* ● *EXAMPLE 2: Trainer provides hands-on demonstrations of how to use new technology tools* ● *EXAMPLE 3: Trainer uses a case study to demonstrate how to implement the intervention* ● *EXAMPLE 4: Trainers use role play or model practices for participants*	
Evidence or example:	
11. Illustrates the benefits of the material, knowledge, or practice to the participants' context. ● *EXAMPLE 1: Trainer describes how the intervention will benefit schools/classrooms* ● *EXAMPLE 2: Trainer elicits participants' ideas about how they feel their students could benefit* ● *EXAMPLE 3: Trainer presents a case study of a teacher who has successfully implemented the intervention*	
Evidence or example:	
12. Includes opportunities for participants to apply content and/or practice skills during training. ● *EXAMPLE 1: Trainer has participants perform a mock lesson using the new instructional strategy* ● *EXAMPLE 2: After receiving training on how to complete an activity, participants practice completing the activity with a sample case* ● *EXAMPLE 3: Participants practice identifying various instructional strategies from sample videos*	
Evidence or example:	
13. Includes opportunities for participants to express personal perspectives (e.g., experiences, thoughts on concept) ● *EXAMPLE 1: Participants use their experiences and prior knowledge to fill in a worksheet on the advantages and disadvantages of various instructional approaches* ● *EXAMPLE 2: Participants work together to strategize ways to overcome barriers to implementation in their school* ● *EXAMPLE 3: In groups, participants share personal and professional experiences related to the topic.*	

Evidence or example:	
14. Facilitates opportunities for participants to interact with each other related to training content ● *EXAMPLE 1: Participants independently answer questions, then discuss those answers as a large group* ● *EXAMPLE 2: Participants work in groups to assess implementation progress in their building* ● *EXAMPLE 3: Participants think/pair/share about questions within the training*	
Evidence or example:	
15. Adheres to agenda and time constraints ● *EXAMPLE 1: Breaks, lunch, and dismissal occur on schedule according to written or verbal agenda* ● *EXAMPLE 2: Trainer adjusts training content to accommodate adjustments to agenda (e.g. participants arriving late due to inclement weather)*	
Evidence or example:	
16. Includes opportunities for participants to reflect on learning ● *EXAMPLE 1: Participants strategize how to apply the knowledge from the training in their own schools* ● *EXAMPLE 2: Participants record 3 main points, 2 lingering questions, and one action they will take* ● *EXAMPLE 3: Green, yellow, and red solo cups at tables used to visually check for understanding at key points throughout training*	
Evidence or example:	
17. Engages participants in assessment of their acquisition of knowledge and skills ● *EXAMPLE 1: Post-test to assess trainees' grasp of learning objectives* ● *EXAMPLE 2: After guided practice on how to complete an observation form, participants use the form to individually rate a video example and compare their responses to the trainer* ● *EXAMPLE 3: Participants complete performance based assessment, illustrating that they have mastered the learning targets.*	
Evidence or example:	

18. Offers opportunities for continued learning through technical assistance and/or resources ● *EXAMPLE 1: Trainer describes future trainings and explains how training fits into the series* ● *EXAMPLE 2: Trainer provides contact information for technical assistance including e-mail address and phone number* ● *EXAMPLE 3: Trainer shows participants where to find additional materials and readings on the project website*	
Evidence or example:	

[1] Noonan, P., Gaumer Erickson, A., Brussow, J., & Langham, A. (2015). *Observation checklist for high-quality professional development in education* [Updated version]. Lawrence, KS: University of Kansas, Center for Research on Learning

Authors' Note:

This checklist is not designed to evaluate all components of professional development, because as Guskey (2000) points out, professional development is an intentional, ongoing, and systemic process. However, training (e.g. workshops, seminars, conferences, webinars) is the most common form of professional development because it is "the most efficient and cost-effective professional development model for sharing ideas and information with large groups" (p. 23). Therefore, this checklist is designed to improve and evaluate the quality of training.

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