Teachers Mentoring Teachers in the Billion Oyster Project and Curriculum and Community Enterprise for the Restoration of New York Harbor with New York City Public Schools (BOP-CCERS) Fellowship

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Abstract

The Billion Oyster Project and Curriculum and Community Enterprise for the Restoration of New York Harbor with New York City Public Schools (BOP-CCERS)(NSF DRL 1440869/PI Lauren Birney) program is a National Science Foundation (NSF) supported initiative through collaboration by multiple institutions and organizations led by Pace University. Partners on this initiatitve include Columbia Lamont Doherty, the New York Aquairum, the New York Harbor Foundation, the New York Academy of Sciences, the River Project, Good Shepher Services, Smartstart Evaluation and Research, the University Maryland Center for Environmental Science and Fearless Solutions. In this study, teachers from one cohort were paired with teachers from a succeeding cohort in order to facilitate a mentoring process between the two cohorts. This allows for teacher ambassadors to have a support structure throughout the program, seek integral feedback, modify teaching techniques, integrate project research and establish long term partnerships within the project team.

Keywords: mentoring, science teaching and education, environmental restoration science, citizen science, STEM education

1. Introduction

The Billion Oyster Project and Curriculum and Community Enterprise for the Restoration of New York Harbor with New York City Public Schools (BOP-CCERS) program is a National Science Foundation (NSF) supported initiative through collaboration by multiple institutions and organizations led by Pace University. BOP-CCERS is both an education and restoration initiative. The project begins with the vision that public school curricula, particularly in STEM-C content areas, can be enhanced by explicitly linking teaching and learning to a localized environmental science project that demands authentic research, data collection, and experimentation. In New York City, there are numerous local environmental problems that merit inquiry based science research by students; however, none is more fundamental than the question of human impact on our watershed.

CCERS is a model to involve a significant percentage of New York City's 1.1 million public school students in this process. The result is to create an innovative STEM-C curriculum for teachers; a meaningful, highly engaging basis of learning for students; and a unifying platform around which to engage a diverse community of STEM-C professionals, graduate and postdoctoral scientists, and out-of-school time educators in carrying out an array of complementary education and restoration activities. The process of keystone species restoration is necessarily multidisciplinary, hands-on, and scientific. In the case of oysters in New York Harbor—other regions, other species, other disciplines—the undertaking requires the expertise of biologists, ecologists, engineers, oceanographers, and computer scientists working collaboratively in classroom, laboratory, and field settings. In the formal school and afterschool-based curriculum at the foundation of the BOP/CCERS initiative these diverse disciplines are anchored in strict core competencies of science and mathematics.

In January 2017, CCERS launched the CCERS Mentoring Program (CMP), which has its purpose to provide teachers in the CCERS Program the opportunity for professional growth and development through active dialogue. CMP is designed to create a partnership between fellows who have successfully completed the program (mentors) with members of the new cohort (mentees). The mentor supports the mentee with guidance and assistance in order to better facilitate the learning goals of the CCERS program. The mentee benefits from the mentor's previously acquired knowledge, skills and understanding gained through experience in the CCERS program.

2. Literature Review

Callahan (2016) argued for the inclusion of mentoring programs in schools in order to strengthen new teacher retention. Such programs allow for new teachers to gain support and experience through collaboration, which in turn advances their professional growth and increases their effectiveness in the classroom. Callahan (2016) suggested mentors receive strong professional development and clear and concise goals to best inform new teachers. It was suggested that teacher-mentoring programs positively correlate with improved student behavior, achievement, and enthusiasm of both new teachers and students (Callahan, 2016 as cited in Kent, Green, & Feldman, 2012). Successful mentoring programs should be consistent, comprehensive, well planned, and allow for open communication between the mentor and beginning teacher. Mentors can help beginning teachers on a range of topics including, but not limited to, educational beliefs, pedagogies, classroom management, lesson guidance in planning and executing, and school procedures and policies. Callahan (2016) also suggested that a mentor provide wisdom and guidance to beginning teachers for at least two years.

In contrast, Lechuga (2014) found that mentoring might not be as successful for everyone, as he finds it to be a "dynamic process grounded in one's socialization into [his or her] discipline." Specifically, he investigated motivational practices through a self-determination perspective of 15 STEM discipline faculty members using a qualitative study. Participants were chosen through university/department websites. Semi-structured interviews allowed the author to understand the participants' views of mentoring, understand more deeply its purpose and function, and its effectiveness at cultivating success in the STEM disciplines. The author found four themes frequently discussed among participants: mentoring processes develop independence, establish professional identity, allow negotiation within fields, and allow for non-professional interactions. Furthermore, he found that mentoring processes should aim to promote autonomic environments, but also allow opportunities for faculty members to ask for and receive assistance when needed.

Oliver (2009) sought to understand the mentoring process for 38 new science and/or mathematics educators in Western Australian schools. In this innovative, pilot mentoring program, the mentees/school chose the highly experienced mentors or they volunteered themselves. Qualitative data of the participating mentees' work experiences and outlooks on teaching and mentoring programs were collected before and after the study through application forms, surveys, and interviews. It was found that the participants were eager and optimistic about the mentor program, and appreciated the knowledge, experience, and reflection practices gained from interacting with their mentors. Behavior, classroom, and time management, as well as instructional, assessment, and integration methods were common areas mentee's found they needed support. Mentors and mentees were given guidelines to follow for structured conversations and engagements. It was concluded that this mentoring experience contributed to the professional growth of the new science and/or mathematics teachers in supplementing classroom strategies, management, questioning, and assessments methods.

Santora, Mason, and Sheahan (2013) emphasized the importance of mentoring programs for beginning science teachers because mentors bring insight of technical skills and research techniques that usually are acquired through experience and practice. The authors described the traditional mentoring model as hierarchal, focusing solely on the results of transferring knowledge, increasing student learning, and an easier adjustment into the teaching profession. In contrast to this traditional method, the authors developed a progressive mentoring framework in science and engineering education that views mentoring as a collaborative process, whereas the mentor and mentee form a relationship with understanding, trust, and respect. In this model, they encouraged participants to see themselves as both the mentor and mentee as they are placed on four different levels (a) recognized expert (e.g., professor, international researcher), (b) upper-level trainee/supervisor (e.g., post-doctoral student, senior doctoral student), (c) mid-level trainee (e.g., other graduate student, K-12 teacher), and (d) lower-level trainee (e.g., undergraduate student, high school student). Interactions amongst all four levels allows for a better developmental and learning experiences for both the mentor and mentee. Results of the data indicated that progressive mentoring was effective in regard to student learning, training, and development.

Hudson and Savran-Gencer (2009) collected qualitative data on the perceptions 211 Turkish, primary science pre-service teachers had on their mentoring program within a five-factor model of (a) personal attributes, (b) system requirements, (c) pedagogical knowledge, (d) modeling, and (e) feedback. Each factor had various items for participants to rate using a five-part Likert scale, in which participants indicated whether they strongly disagree, disagree, uncertain, agree, or strongly agree with each statement. These data were analyzed using an ANOVA, which brought forwards mean scale scores and descriptive statistics.

Under personal attributes, it was found that the pre-service teachers found their mentors as supportive (90%), but not assistive in the reflection process (17%) or in listening attentively (17%). In system requirements, mentees found that their mentors did well in outlining the curriculum (92%), but not in discussing policies (26%).

Perceptions of mentors' pedagogical knowledge varied considerably. Ninety-six percent of pre-service teachers found that their mentors guided them in preparation of primary science lessons, while also assisting in planning (76%) and discussing assessment (70%). However, mentors failed to discuss science content knowledge (25%) and assisting in timetabling (6%).

Again, perceptions of modeling varied considerably with 88% if mentors modeling classroom management and 83% modeling teaching. Mentors fell short in the area of modeling with a well-designed lesson at 25%. Participants indicated that their mentors provided feedback to their science teaching, with 84% of mentors providing oral feedback and 65% providing written feedback.

Hughes, Molyneaux, and Dixon (2012) observed the mentoring relationships in a summer Research Education for Teachers (RET) program. The goal of the program is to give classroom teachers an opportunity to experience authentic scientific research performed by research scientists and use the experience to promote scientific inquiry in their classrooms. The authors discovered that the teachers' ability to promote scientific inquiry in their classrooms is related to the type of mentoring the teachers received by the research scientists in the RET program. Three different types of mentoring relationships existed in this program, and the authors focused on three case studies to highlight each mentoring relationship.

The three case studies are Julia, Anna, and Frank. Julia and four other participants had a simplified research experience in which they worked on a project that was simplified for classroom use and slightly related to the research of the mentor. Julia had daily discussions and feedback with her mentor, and the mentor let Julia form her own conclusions. Anna and four other participants' research experience is described as actual because they worked on a component of their mentor's research. Anna met with her mentor daily and attended meetings with the whole research team weekly. Anna's mentor had mentee' participation in the project progress from passive to active. Frank is the only participant who had an observed research experience. Frank observed his mentor's research, but did not have any hands-on experiences. He met with his mentor twice a week, mostly in research meetings, and Frank's mentor was not actively involved in Frank's work. Unlike Frank, Anna and Julia's mentors were actively involved in their work and provided them with hands-on experiences. As a result, Anna and Julia were able to successfully implement scientific inquiry and research into their classrooms after the program. Frank taught scientific content mostly through lectures and seldom allowed his students to participate in authentic scientific investigations.

Hartman, Renguette, and Seig (2018) examined the difficulties teachers confront when trying to implement problem-based learning (PBL), an inquiry-driven method of teaching, in their classrooms. The authors recognized that implementing PBL is difficult because teachers need to have a deep understanding of PBL and motivation to effectively use PBL. Teachers have to prepare for resistance from their students because the students might be reluctant to partake in active learning. The students have to use their own knowledge to solve problems, but this can only work if teachers have good driving questions with multiple opportunities for students to share their thinking. It is challenging for teachers to think of problems and an environment that best suit a PBL activity. The authors developed a professional development mentoring program to help teachers overcome these challenges and effectively implement PBL in their classrooms. The mentoring program also focused on teachers' literacy curricula and pedagogy in multicultural settings, specifically. The program participants attended two summer workshops and had monthly meetings during the school year. The mentors did not design a rigid framework for the program. Rather, they set parameters and let the teachers engage in peer review. As a result, the teachers had a positive experience, and they all worked at their own pace with their own lessons and benefitted from peer review. The teachers enjoyed working with other teachers, including teachers in different disciplines, since other teachers had similar challenges. The program succeeded in allowing teachers to gain trust in the PBL process and implement effective PBL lessons in their classrooms.

Kekelis, Ryoo, and McLeod (2017) through the California Tinkering Afterschool Network observed an afterschool program where mentors volunteered to help students create Making projects for presentation. It was reported that after observing the program for one year, mentors needed training that was focused more on mentoring rather than technology, and mentors needed to know how to assist and guide projects without taking over, which is a challenge for inquiry-based activities like the Making projects. The mentors made changes to the training program in the second year and believe that their reported learnings are significant to other mentoring programs, especially those that include underrepresented youth in STEM. The first learning is that the training program should set aside time upfront to give mentees constructive feedback. However, the educators reported feeling awkward giving feedback to the Making mentors because they do not want to seem unappreciative of them as volunteers in the afterschool program. The authors found that asking questions such as “What can we do more or less of to support you?” and “What did you find surprising or challenging today?” start conversations about improvement (Kekelis, et al., 2017). The authors also learned that mentors needed to be encouraged to make personal connections with the students. Mentors should practice sharing stories to each other where they avoid jargon and include information such as hobbies and failures. Lastly, educators and other program staff should show appreciation to the Making mentors. Simply acknowledging gratitude make mentors feel good about volunteering their time and recognize mentors as having an impact on the students. Thanking mentors for specific actions is even more effective in showing appreciation.

3. Methodology

Mentors and mentees were introduced to each other at the program’s orientation event in late January 2017. In total, 19 Cohort 2 teachers across four boroughs in New York City were paired with 23 Cohort 3 teachers. Working together, each mentor and mentee team developed goals and action steps to work on during the Spring 2017 semester. Each team reported their communication each month on their classroom successes, struggles and set goals for the following month. Discussion topics for mentoring sessions included:

- What does the mentee hope to accomplish throughout the program?
- What will be evidence of mentee accomplishments through the program?
- What has the mentor learned and gained during the program?
- What does the mentor know now that he/she would like to have known at the start of the program?
- What collaborations can be found between the mentor and mentee?
- What advice and feedback does the mentor have for the mentee?
- What can the mentee learn through sharing his/ her understandings with the mentee?

Mentors and mentees were expected to meet in person, phone, or through online chat for at least 30 minutes each month. They were explicitly instructed that correspondence by email alone would not be sufficient to meet program goals. Mentees had the option of visiting their mentor’s classroom for a lesson observation and debrief. Discussion questions and were reported on monthly reports that were submitted to the researchers.

4. Results

The collaborative nature of the CCERS Mentoring Program set up a support network for all program fellows. Both Cohort 2 and Cohort 3 teachers selected their learning goals based on their individual needs at the start of the program. They were not provided with a menu of possible objectives but we found that their goals generally fit into the following categories: (1) Develop curriculum planning and classroom routines; (2) Increase science content knowledge; (3) Implement field work protocols to monitor oyster reefs; and (4) To meet CCERS Fellowship requirements. A small group of participants also wanted to “learn as much as possible from each other” and “brainstorm ways to use each other’s school as resources”. They also mentioned that they wished to “have open communication [with their mentoring partner] regarding questions, experiences, challenges [and] whatever comes up.” CMP teachers also set personal goals from multiple categories as shown in Table 1.

Table 1. CMP Learning Goals of Cohort 3 Fellows

Category	Goal	# Teachers
Curriculum Planning & Classroom Routines	Curriculum development/ideas for lesson plans	17
	Strategies for engaging students	1
	Develop research questions to prepare students for inquiry based work/create opportunities for inquiry and constructivist learning practices	3
	Differentiation strategies for lessons	1
	Create a BOP research club for interested students to develop and carry out research projects/expand existing hands-on learning opportunities	2
	Continue reading Heartbeats in the Mud/recommended book list	2
	Setting up classroom tank	2
	Strategies for obtaining materials and equipment/organizing materials and Oyster Research Station (ORS) equipment	2
		TOTAL: 30
Science Content Knowledge	Knowledge of oysters, oyster restoration, and estuary ecology	5
		TOTAL: 5
Field Work to Monitor Oysters	ORS site installation	1
	ORS field work with students	6
	Use ORS equipment	2
	Develop teaching strategies for students to independently monitor ORS sites	1
	Visit other teachers classroom/ORS site	7
	Strategies for data collection	2
		TOTAL: 19
CCERS Program Goals	Meet program requirements (meetings, workshops, preparing students for BOP symposium, etc.)/run successful program at school	9
	Learn to use digital platform	4
		TOTAL: 13
Other	Have open communication re: questions, experiences, challenges...whatever comes up	1
	Learn as much as possible from each other/brainstorm ways to use each other's school as resources	2
		TOTAL: 3

Twenty of 23 Cohort 3 teachers completed all requirements of the CCERS Mentoring Program. Fellows cited difficulty in coordinating schedules as the main reason for not meeting program requirements. Feedback from teachers who completed CMP were generally positive and valued their discussions which were focused on their needs in developing lesson plans and curriculum. They reported that conversations with their mentors included: setting up a classroom tank to observe oysters and marine life, planning logistics for their Oyster Restoration Station (ORS) visit, coordinating times for visitations with each other's classrooms and additional professional development opportunities.

One teacher summarized it best in her end-of-year reflection.

In 8th grade, our students are well equipped to develop controlled experiments, generate hypotheses, represent and communicate data, as well as train others in those skills. After several visits to the restoration station, 8th grade student leaders become especially familiar with one of the protocols and its associated *equipment. They will then turnkey their knowledge to a group of 7th grade students that will continue the project. This feature of the Billion Oyster Project has allowed us to more coherently integrate reading and writing in content area standards as well as scientific communication into our curriculum without sacrificing content. The content and skills the Billion Oyster Project teaches aligns neatly to the learning objectives across 7th and 8th grade, while reinforcing underlying habits of mind that make for great scientists. There often exists a tension between the quantity of material we as teachers would like to cover in our classes with the necessity to deeply explore central concepts. The Billion Oyster Project allowed us to embed in our instruction a concrete, immediately relatable project that is ongoing and represents active scientific inquiry. This type of science engages our students and inspires in them a love of science that will carry over through high school and the rest of their lives.*

Additional conversations focused on aligning lessons with Next Generation Science Standards. Teachers discussed science content such as oyster anatomy, local flora and fauna, and water quality. They also brainstormed ways to teach scientific inquiry skills, including data collection, designing and running controlled experiments in cooperative teams. Furthermore, teachers discussed methods to differentiate lessons for students with alternate assessments to allow them to successfully participate. All lessons and activities associated with CCERS has real-world ecological consequences and supports students' development of 21st century skills.

5. Conclusion

Mentoring support is a valuable component of ongoing professional development for middle and high school science educators. Opportunities to share lesson plan ideas and hands-on activities to engage students in scientific explorations is an important part of curriculum development. The CCERS Mentoring Program supported middle and high school science teachers by providing ongoing monthly routines to discuss lessons, troubleshoot experimental set-up procedures, plan field trips logistics, and provide content support to set up oyster restoration stations.

The establishment of the mentoring component for the project would allow for teachers to have a support structure throughout the program and perhaps thereafter. This asset allows for teachers who are sometimes isolated to have a colleague to share classroom ideas, concepts, and methodologies with one another while troubleshooting any issues that have arisen in the curriculum as well as the classroom. This companionship and camaraderie seems to a unique component that will foster and strengthen the collegial bonds between the teaching fellowship ambassadors while allowing for the strengthen their practices using the given content. Allowing teachers to have a reflective practice without being overly critical, permits them to establish autonomy, enhance their classroom teaching techniques, and become veteran teachers with a given support system.

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