AEESP Foundation Grant

Final Report

Connecting middle and high school students to their estuary: Pairing smart devices to estuary parameters

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1. Overview

The objectives of this work was to foster collaborative learning for middle school students by enabling them to gather, view, share, and synthesize evidence-based observations of the Hudson River Estuary, and to encourage and promote their interest in environmental engineering. The broad impacts of this project are: 1) the education and training of future environmental engineers through hands-on experience of field data collecting and analyzing estuary water parameters; 2) the interaction of children from low-income communities to use technology to further interest in environmental education; 3) increased ecological literacy for students in middle and high school.

2. Background

The primary objective of this project is to foster collaborative learning by combining hands on activities with field trips to increase student learning about the Hudson River Estuary, and to encourage and promote student interest in environmental engineering. The overall goal of this project was to provide a means whereby youth living in communities adjacent to the Hudson River Estuary can connect with physical and biological components of their local wetland to foster appreciation, stewardship and scientific curiosity of this critical ecosystem. The desired outcome was to bring between 50-100 middle and high school students to their local wetland to capture a synoptic view of the water quality and water movement.

In 2016, the PIs were awarded a Hudson River Estuary Grant for River Access and River Education from the New York State Department of Environmental Conservation. As part of this grant, professors and graduate students visited two school districts and conducted hands-on activities to introduce the students to environmental engineering and to water quality issues in their local estuary. Before the classroom lesson, students completed a survey to gage their existing knowledge of their environment, engineering, and their estuary. After the classroom visit, students traveled to the estuary where they used hand held probes and smart tablets to measure water quality parameters and then compared their results to existing water quality data that was being continuously recorded by blue-tooth enabled gages in the estuary. Additionally, students conducted kick-net sampling for macroinvertebrates and used a smartphone app (developed by a Manhattan College graduate student) to calculate the water quality index in their estuary. After the site visit, student learning was evaluated by having them complete a post-site visit survey. Finally, a “lessons learned” workshop was held where students from both schools were brought together to share their results and findings.

This program was run from 2016 to 2019 and has reached over 150 students. The program has been largely successful, with a significant increase in student learning as a result of the combined classroom activity plus site visit. Results of this project have been presented at the ASCE EWRI Annual Conferences in 2018 and 2019.

The objective of this work was to continue this estuary education program and to use the expertise of the faculty to continue to improve environmental education for middle and high school students, to interest them in environmental engineering, and promote their first steps towards preparing them to be environmental engineers. The PIs have developed relationships with Hendrick Hudson School District and Peekskill School District, which is located in an Environmental Justice

Community. Both school districts have expressed an interest in continuing the program for their students.

3. Accomplished Tasks

3.1 Hands-on activities to promote student learning

In February 2020, the PIs and two graduate students visited two school districts: Hendrick Hudson and Peekskill to conduct classroom activities to educate students about the Hudson River Estuary. First, students were given a brief lecture where they learned about the Hudson River Estuary and water quality. Students participated in a class discussion of how different water quality parameters including temperature, dissolved oxygen, turbidity, conductivity, and pH might affect the estuary and the ecosystem. Students also learned how different stream barrier such as culverts and dams might affect water quality. Next, students were given worksheets and worked in groups to use the hand-held wireless probes (Dissolved oxygen probe shown in Figure 1; Figures 2 and 3 show students using the probes and tablets) and smart tablets to measure the water quality parameters in a sample.

Figure 1. Dissolved oxygen hand held wireless probe (PASCO).

Figure 2. Students learning to use the hand-held probes and smart tablets.

Figure 3. Students learning to use the hand-held probes and smart devices.

Students recorded the data and then filtered their sample through a column containing different media such as sand, gravel, and carbon. Filtering the sample simulated how estuary water might be filtered in a wetland. Students then repeated the water quality measurements after filtering their sample. Finally, the class reconvened and the graduate students led a discussion on how the water quality parameters changed before and after filtration. Students also were given the opportunity to talk with the graduate students about environmental engineering and college engineering classes. Between the two school districts, 155 students participated in these classroom activities.

3.2 Virtual estuary field trip

After the classroom visits, the next task was to have students build upon their water knowledge of water quality and environmental engineering by visiting their estuary and collecting water samples

and using the same hand held probes to measure the different environmental parameters. This field trip unfortunately had to be cancelled due to Covid-19. The PIs instead visited the estuary and filmed the field trip activities that the students would have conducted. The PIs recorded the water sample collection, parameter analysis using the hand held probes, and discussion of culverts and dams in the estuary. The video was uploaded to YouTube and the school teachers shared the video with their students so they could watch the video and participate in "collecting" the water quality data. Figure 4 show stills from the virtual field trip video. This video is available to the public at: https://youtu.be/_kivoq-1CQ8.

Figure 4. Field trip video showing water quality parameter measurement and sample collection.

The PIs still plan to reschedule the field trip in Fall or Spring, whenever permissible. The PIs plan to reuse this video is for future estuary outreach and education.

3.3 Virtual lessons learned workshop

After the students watched the field video, the PIs worked with the classroom teachers to recruit students to participate in a virtual lessons learned workshop via Google Meet where students would share what they had learned from the classroom visits and the field trip video. This workshop was moderated by a Manhattan College graduate student, the PIs, and one of the school teachers. Unfortunately, due to challenges with distance learning, only 3 students were able to attend the workshop. The students were instructed to review a slide show before the workshop (Appendix A). During the workshop, the graduate student asked questions and recorded student answers during the Google Meet (student answers in blue text on the slides in Appendix A). Figure 5 shows screenshots from the workshop (full workshop video available at: https://drive.google.com/file/d/1lhqHqOwJ5J-YFPFu0zJbl8NtdCmfW7hr/view?usp=sharing). Despite the low turnout, the discussion was lively and all 3 students participated in answering questions about the water quality data and providing explanations for the discussion questions.

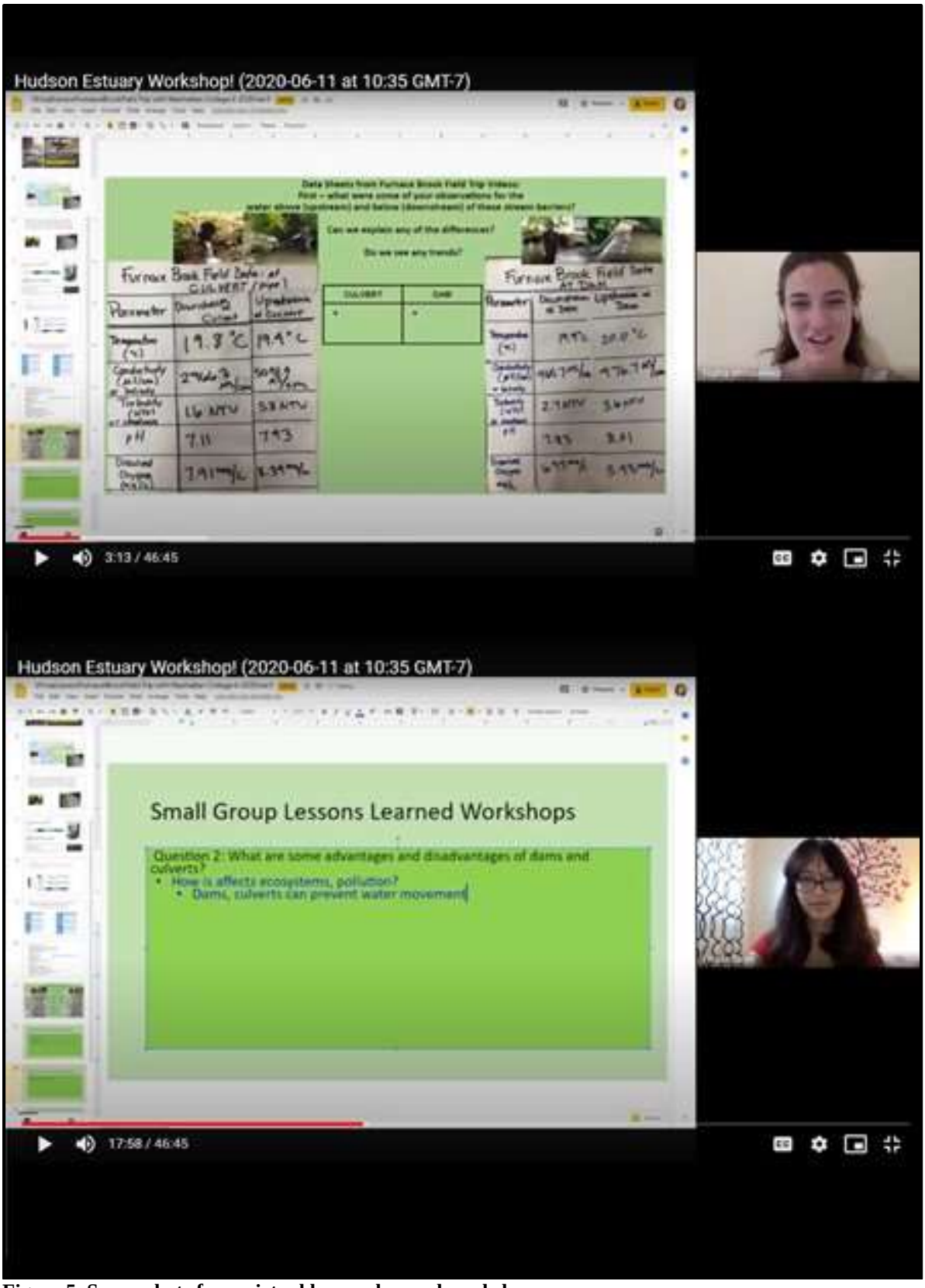

Figure 5. Screenshots from virtual lessons learned workshop.

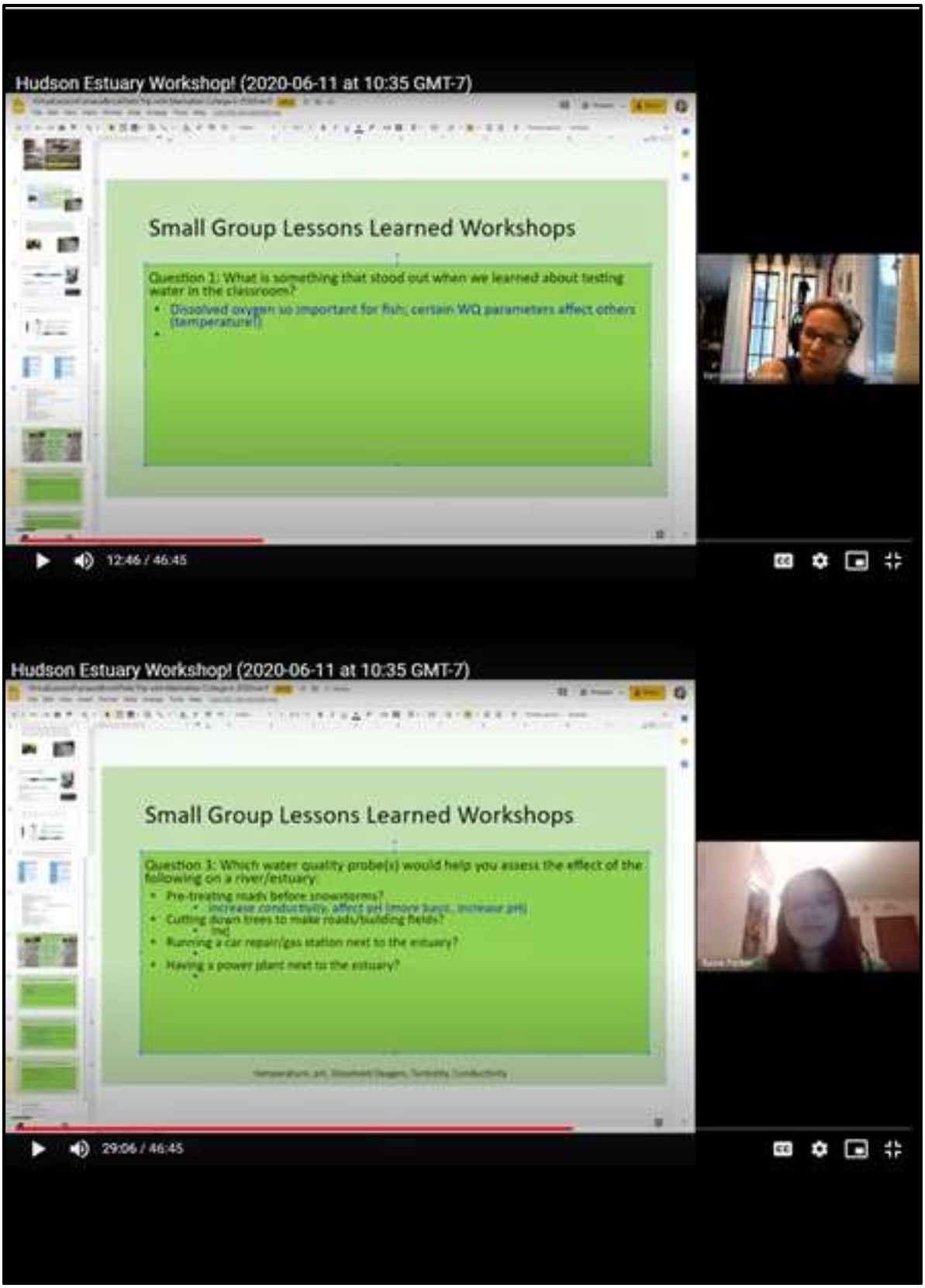

Figure 6. Screenshots from virtual lessons learned workshop.

4.0 Conclusions and Future work

Despite the challenges of remote learning, the PIs were able to complete the majority of the originally proposed work. The classroom hands on activities were well received and students gained a greater understanding of environmental engineering, water quality sample collection and parameter measurement, and estuarine ecosystems. By recording a video of the field sampling, the PIs now have a valuable resource that could be reused for future outreach and education. The PIs plan to continue this outreach, either virtually or in person in Fall 2020 and Spring 2021.