

A University-County Collaboration to Excite Students about Citizen Science

Dr. Leigh S McCue, George Mason University

Leigh McCue is Chair of George Mason University's Department of Mechanical Engineering.

Brianne Elizabeth Bell

Elliot Foster

A University-County Collaboration to Excite Students about Citizen Science with Maritime Robotics

Leigh McCue¹, Wren Bell², Elliot Foster²

1 George Mason University, 2 Prince William County

Abstract

This paper builds on a prior ASEE-SE contribution [1] which described implementation of SeaPerch and SeaGlide [2] into University-hosted robotics summer camps intended for middle and high school aged students, respectively. During the 2022 camp events, students displayed reluctance participating in tasks viewed as competitive, which created reason to reframe camp activities for a more collaborative approach. In parallel, two University alumni currently employed by Prince William County were in pursuit of opportunities to leverage maritime robotics in citizen science to benefit endeavors of the Watershed Division. This was part of a specific effort to assess the success of freshwater mussel reintroduction projects in local rivers and streams. With complimentary goals, the University and County began collaborating, where the County provided middle school aged campers an introduction to the ecological importance of freshwater mussels, scientific reasoning for population surveys, and basic operational requirements of robotic surveying equipment. In lieu of a final competition, the middle schoolers showcased how the SeaPerches they designed and built could be utilized in conducting freshwater mussel surveys for County employees. This paper provides a brief overview of the camp structure documented comprehensively in [1], followed by discussion of the scientific tasking provided to the campers, and observations on student engagement leveraging this citizen science emphasis.

Keywords

Summer camps, underwater robotics, University-County collaboration, citizen science

Introduction

In [1], we describe the implementation of two maritime robotics camps, one, using SeaPerch kits, aimed at middle school aged students and the second, using SeaGlide kits, targeting high school aged learners. Both kits are developed by RoboNation [2]. As noted in [1], a key finding from the 2022 camp offerings was the middle school students' hesitation around a culminating "competition" during the camp. We noted the need in future years for this camp offering to focus on the design spiral and testing rather than invoking competitive language. In parallel, representatives from the surrounding county reached out to Mason seeking guidance on the use of maritime robotics to monitor mussel populations in inland waterways, part of a County ecological initiative. This sparked the idea for a collaborative tasking to SeaPerch campers to develop robotic platforms for citizen science mussel surveying. The sections that follow describe the scientific tasking, provide feedback on student engagement, and describe the partnership logistics. It is relevant to note that an emphasis on the underlying scientific applications of maritime robotics has also featured prominently in RoboNation's competition space; for example, the 2023 International Seaperch Challenge included a partnership with NOAA's Ocean Exploration Cooperative Institute

to weave a season theme of ocean exploration, including challenge courses that emulated underwater surveying, sample retrieval, and safe interactions with marine wildlife, and included an optional “real-world innovation” component [3].

Scientific Tasking

Prince William County (PWC) Environmental Management, Watershed Division is committed to improving water quality through stream restoration, rehabilitation, and education. One of the County’s current initiatives is to conduct freshwater mussel surveys in their restored streams in order to assess the success of an upcoming reintroduction project. Two County technicians, both Mason alumni, inquired with Mason’s Potomac Science Center about the use of an autonomous underwater vehicle (AUV) for such purposes, as local streams are difficult to survey by traditional means [4]. While an AUV could not be provided at the time, Mason’s use of the Seaperch program aligned with the department's interests, and a plan for collaboration was put forth.

The county’s involvement occurred in two parts.

1. Develop a challenge that would be relevant to solving current environmental problems that are occurring in the same area where the campers live.
2. Assess success and provide support during the completed project demonstration.

A presentation consisting of information pertaining to the challenge was developed by PWC. It included information about the important roles freshwater mussels have in their environments, several engaging videos, an outline of our goal, and the parameters of the challenge. Information was provided at an accessible level and was engaging enough to have campers excited about the challenge. We provided the requirements for the campers' projects as:

1. Must be able to take video of stream beds.
2. Vehicle must be able to control buoyancy and be able to move upstream against the current.
3. Vehicle must be reasonably durable.
4. Must include retrieval method such as a rope.
5. (Optional) Must be able to take water quality readings (pH, dissolved oxygen, nitrates, temperature).

We also provided stream parameters that the campers should be aware of while designing their vehicles:

1. Pools are 3-7 feet deep
2. Stream is 5-7 feet wide
3. Flow rate is > 5 CFS

The second engagement took place after the campers had finished their projects. County technicians traveled to the camp’s building and observed as each camper tested their vehicle. If the vehicle did not function properly, technicians gave advice and encouragement. Overall, the County is pleased with how well the campers rose to the challenge we provided.

Student Engagement

A brief survey (included as Appendix A) was sent to parents of 2022 and 2023 camp participants. The intent of the survey was to gauge parent perspectives on their child's responsiveness to having a culminating competition versus citizen science as the overarching theme for the camp. The 2022 camp included 11 campers; the 2023 camp included 20 campers. We received 7 responses to the survey, one from a 2022 camper parent, five from 2023 camp parents, and 1 from a parent of a camper who participated in both 2022 and 2023. Reviewing the questions related to campers' responsiveness to competitive environments versus scientific challenges, the parents indicated their children benefit from a scientific challenge, though the sample size was too small to draw a conclusion on relative comparison on the use of a competition versus a scientific challenge as the motivating theme. The relevant questions, assessed on a 5-point Likert scale (1=strongly disagree; 5=strongly agree), are provided in Table 1.

Statement	Average Score (N)
My child thrives in a competitive environment.	3.43 (N=7)
My child enjoys a competitive environment.	3.71 (N=7)
My child thrives when given a scientific challenge to solve.	4.00 (N=6)
My child enjoys being given a scientific challenge to solve.	4.17 (N=6)

Table 1: Parent perceptions of child's engagement with competitive environments and scientific challenges.

Partnership Logistics

A key aim of this camp is to provide access to maritime robotics to learners who might not otherwise have these opportunities. As such, the camp is offered at no cost to families thanks to financial supports noted in the Acknowledgements section of this paper. Therefore, the collaboration between the County and the University included no financial commitment from either party to the other. The University planned and implemented the camp, largely following the same model described in [1], with the major alterations coming in the first and last day of the agenda. Specifically, on the first day of the camp, representatives from the County presented the campers with the scientific tasking described previously. They set the stage for the campers to better understand why reintroducing mussels into county rivers and streams is important, the current state of the art for mussel surveys, and what design limitations apply to any robotic system used to survey mussels. The campers were then reminded of this tasking by the University team as they developed their SeaPerch platforms. On the final day of the camp, rather than a culminating competition, the County representatives returned to the camp to see the students' design demonstrations. A simulated survey environment was developed in a water tank on campus, using washers to emulate mussels. The students were provided access to GoPro cameras to mount on their SeaPerches, and demonstrated how they would use their SeaPerch to survey the emulated environment. Photos are provided in Figure 1.

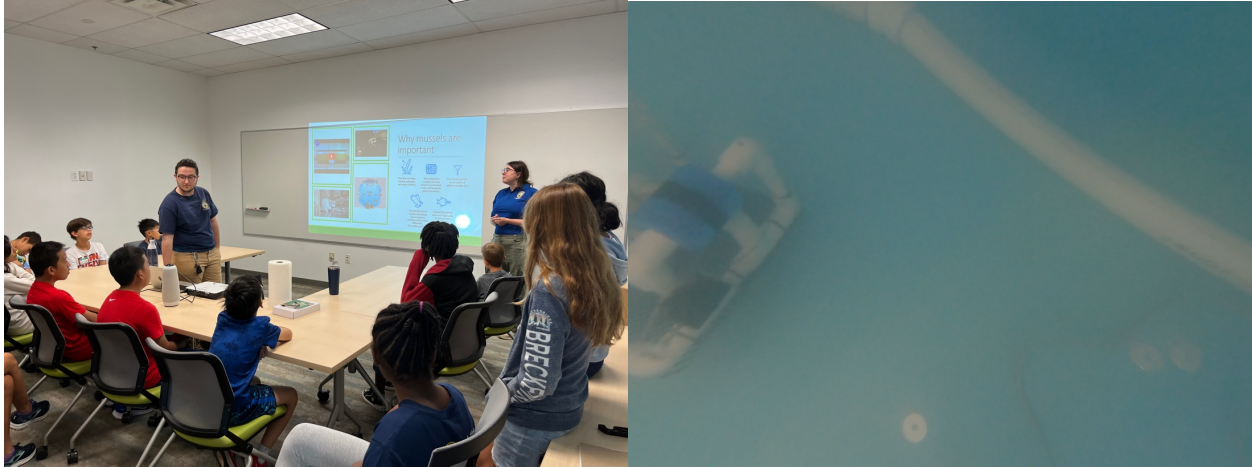


Figure 1: County representatives briefing campers on mussels (left) and image captured from GoPro on camper SeaPerch demonstrating ability to image washers (as a proxy for mussels), with a second SeaPerch in view (right).

Conclusions

In summary, this modification to the previously developed and described SeaPerch camp [1] supported student learning and engagement by emphasizing the scientific application of the technology campers are working with, rather than promoting competition. Within the constraints of a small sample size, camper parent feedback appeared to affirm this pedagogical pivot. The University-County collaboration, made particularly effective through the Prince William County partners being Mason alumni, provided an avenue to emphasize citizen science of direct relevance to the geographic region.

Acknowledgements

The camp described in this paper was supported by NSF funding under grant CMMI 2135619. Additional financial and personnel support was provided by George Mason University's College of Engineering and Computing. And thanks are due to the faculty, staff, and graduate students who went above and beyond in support of these camps.

References

- 1 McCue, Leigh, Vanessa Barth and Johnnie Hall, "SeaPerch and SeaGlide Camp Implementation," 2023 ASEE Southeastern Section Conference, March 2023, Virginia.
- 2 RoboNation, "Programs," <https://robonation.org/programs/>, last accessed December, 2023
- 3 RoboNation, "2023 SeaPerch Season," <https://seaperch.org/programs/2023-season/>, last accessed December, 2023.
- 4 Sterrett, S., Roy, A., Hazelton, P., Watson, B., Swartz, B., Rust, T. R., Holst, R., Marchand, M., Wisniewski, J., Ashton, M., & Wicklow, B. (2018). *Brook Floater rapid assessment monitoring protocol | U.S. Geological Survey* (132–2018; Cooperator Science Series). Coop Res Unit Leetown. <https://www.usgs.gov/publications/brook-floater-rapid-assessment-monitoring-protocol>

Appendix A: SeaPerch Camp Survey

Which year(s) did your child participate in Mason's SeaPerch summer camp? (SeaPerch is a remote control underwater vehicle made of PVC pipe.)

☐ 2022

☐ 2023

☐ 2022 and 2023

Please indicate to what extent you agree with the following statements as it relates to your SeaPerch camper.

	Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
My child thrives in a competitive environment.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
My child enjoys a competitive environment.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
My child thrives when given a scientific challenge to solve.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
My child enjoys being given a scientific challenge to solve.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
My child learned at Mason's SeaPerch camp.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
My child enjoyed Mason's SeaPerch camp.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I would recommend Mason's SeaPerch camp to other families.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Were there any non-SeaPerch activities or experiences included in the camp that your child seemed to particularly enjoy? If so, please briefly describe which activities or experiences resonated.

If you have any additional feedback for the camp organizers, please feel free to share it here or email lmccuewe@gmu.edu.