Community Connections: After Action and Metrics Report

Marine Energy Collegiate Competition 2024
Purdue University Team

PEARL JAAMS

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1 After Action Report

For this year, the Purdue MECC team identified the lack of K-12 awareness of marine energy concepts within local education curriculums and activities. As Indiana is a land-locked state, marine energy is a concept not commonly found in school curriculums, making it extremely challenging for students to develop an early interest in this field. Furthermore, many K-12 students have not seen large bodies of water, and display an unfamiliarity with energy conversion devices such as dams.

As the team conducted interviews with local elementary school teachers, and outreach organizations within the university community, the team identified key aspects that caused this educational gap seen in K-12 students. The team observed a lack of conceptual awareness and hands-on activities within the school curriculum, caused by a lack of resources and available time within the school year. Furthermore, there were few after-school programs that provided engaging opportunities to create and explore scientific concepts. Lastly, the prospective high school and university students were not aware of the career opportunities that were provided by the marine energy sector.

The team created a multi-level approach to address the educational gap within our community. First, the team created an educational activity that could be implemented in local elementary and middle schools and allowed a flexible lesson plan for teachers to incorporate into their curriculum. Second, the team reached out to local community and aftercare programs to provide engaging hands-on activities that targeted a broad range of age groups. Third, the team reached out to local university groups, such as the Purdue Mechanical Engineering Ambassadors (PMEA) and Purdue Engineering Outreach (PEO), to use existing connections to target the university, and incoming juniors and seniors at local high schools. Lastly, the team attended multiple research poster events within the university community to promote awareness of innovation and career opportunities within the marine energy sector.

The team designed and organized engineering kits to deliver to the local intermediary schools in collaboration with PMEA. By collaborating with PMEA, the team took advantage of the existing university connections to the local community and provided an open line of communication with teachers to understand their classroom needs. After extensive research, the team created a “Create your own paddle boat!” kit, with educational flyers and supplies provided for groups of two students. These kits were designed to be an efficient method of activity implementation for teachers while allowing students to explore the creativity and wonder of marine energy. Each kit was provided with an assortment of popsicle sticks, plastic containers, pencils, pipe cleaners, foam pieces, and rubber bands, with one instructional flyer. The flyer was designed to provide an overview of the scientific concepts but abstained from constraining the student to a single design.

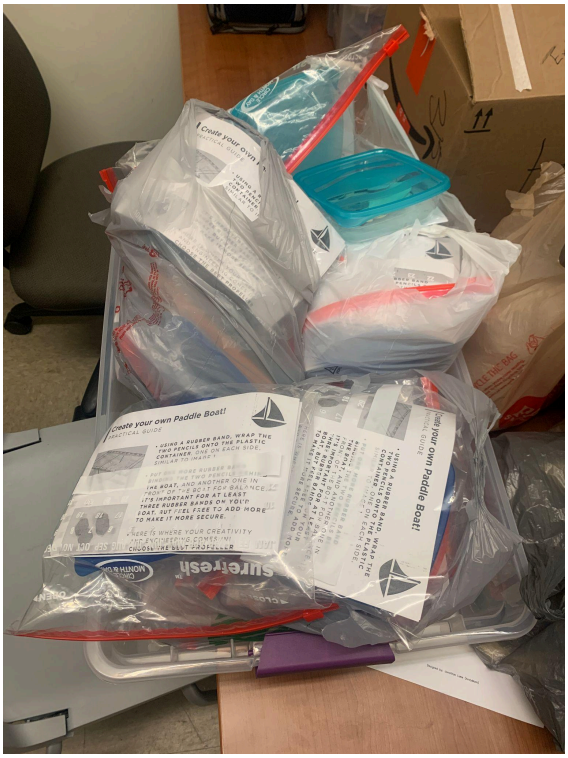

Figure 1: Consolidated Kits with a Testing Container

Our team set out to a local community center's aftercare program to display marine energy concepts through an interactive educational activity. The team collaborated with PEO, which specializes in engaging K-12 students to explore their interest in engineering through creating educational materials and interactive events. They provided the team with their connections to the local community, as well as training in how to teach and engage with students safely and professionally. At Hanna Community Center, the team was met with a wide age range of students, and the challenge of creating an adaptable lesson that could be scaled to teach a kindergartener as well as an 8th grader.

In collaboration with PEO, the team designed a water wheel design challenge that encouraged students to implement the engineering design process, while strengthening their understanding of energy concepts. Each group of students was provided with a limited amount of supplies, to create a water wheel that could freely spin on a testing device that the team provided. This activity ensures that the children can not only express their creativity in their designs, but also decreases the intimidation in learning about new concepts by using materials that they are familiar with, such as pool noodles, spoons, popsicles, pipe cleaners, and tape.

Figure 2: Waterwheel Testing Device

Prior to the activity, the team provided background on marine energy, stating its importance given the context of sustainability. The team prioritized the notion of iterative design, where groups could create water wheel designs independently and evaluate them by putting them under the water flow. Based on the performance of the wheels, the MECC team guided the groups through how their designs could be improved. The process of iterative testing, and the randomized teams of children across several age groups, encouraged a collaborative design process for both the students and the MECC team.

The Purdue MECC team experienced many challenges, in both designing the activities and implementing the activities with students. When designing activities, the primary struggle was to translate high-level concepts into bite-sized, accessible lessons that could be replicated by educators without large monetary and safety constraints. This involved researching the Indiana curriculum requirements, and methods on how to engage a student creatively while reinforcing the educational concepts. The team combatted this by connecting with on-campus outreach organizations such as PMEA and PEO, which enabled us to converse with teachers and gain knowledge on how to work with children. Furthermore, the team constrained themselves to purchasing supplies from the dollar and grocery stores, to ensure that the supplies were low-cost and accessible. Even the testing device provided in the waterwheel activity was created from scrap wood taken from our universities' labs, a plastic water container and a simple, shallow plastic storage box.

Figures 3-6: Waterwheel Activity at Hanna Community Center

Another challenge was the clashing working styles of children placed on the same team. There were instances of some members in teams being over-enthusiastic and performing most of the designing of the water wheels, however, other members were not enthusiastic and often distracted. To fix this issue, members of the Purdue MECC team went around and guided the teams, assigning tasks to each member, ensuring that their responsibilities in the design were well-defined. In some instances, the Purdue MECC team had to guide the collaboration between younger, more enthusiastic children with older, more experienced children.

There were many lessons learned through this process, such as the need and benefits of such engaging activities in expressing STEM concepts to younger children, so as to holistically educate and motivate creativity in coming up with engineering solutions for complex problems that require interdisciplinary approaches. Another lesson learned was the need for adaptability and quick adjustments built into the process of conducting the educational activity, as every child is different with a unique skill set, and they should be guided accordingly to engage in the

activity. Skills learned from this activity would be very applicable to the team's MECC design, as multiple stakeholders and interdisciplinary approaches would need to be used to come up with a resilient, holistic marine energy solution.

Figure 7: Purdue Mallot Poster Presentation

Overall, the community connection activity was a success as the students got more exposure to marine energy, and the MECC team got to help teach key concepts in engineering design such as testing and iteration.

2 Metrics Report

Industry Interviews

Name	Company Affiliation	Email	Origin of Relationship	Sector in Marine Energy	Open to continued participation
Dr. David Warsinger	*Assistant Professor of Mechanical Engineering at Purdue University*	david.warsinger@gmail.com	Professional	Professor	Yes
Dr. José Garcia-Bravo	*Associate Professor of Engineering Technology at Purdue University*	jmgarcia@purdue.edu	Professional	Professor	No
Quantum Wei	*CEO of Harmony Desalting*	water@harmonydesal.com	Professional	Industry	No
Chris Dowell	*Project Manager at FuturumCareers*	chris@futurumcareers.com	Professional	Educational Resources	No

3 Action Outcomes

Activities and Events

Activity	Number and Type of Attendees	Geographic Regions Represented	Team Participation
PMEA Engineering Kits	50 7th-8th students (2 Classrooms)	West Lafayette, IN	2 Members
Water Wheel Activity	40 students in after-school daycare	West Lafayette, IN	5 Members
Purdue College of Engineering Design EXPO	450 engineering undergraduate and graduate students and 50 faculty members	West Lafayette, IN	6 Members
Purdue Malot Poster Presentation	250 engineering undergraduate and graduate students and 50 faculty members	West Lafayette, IN	5 Members

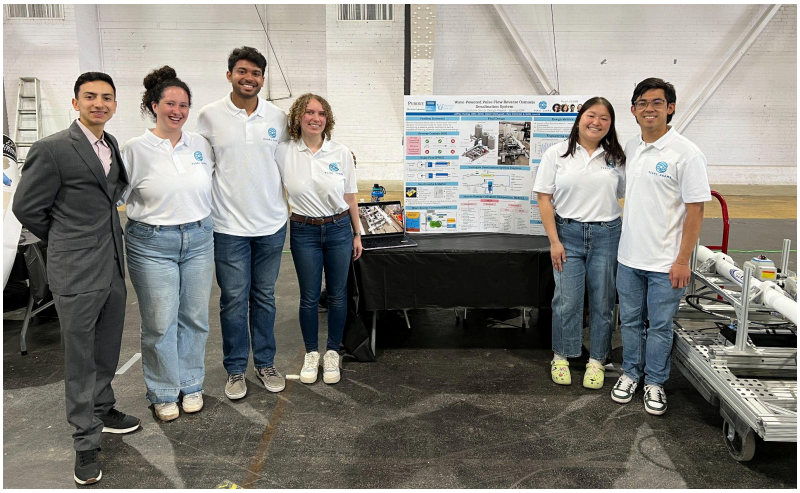

Figure 8: Purdue College of Engineering Design EXPO Presentation

Communication Materials

The MECC Team's main communication material was the MECC Poster, which was used to disseminate information about the final design, the WEC, and the PFRO components. This poster

was essential in educating the local academic community about water insecurity issues in post-disaster scenarios and the need to innovate in a device that uses wave energy to power reverse osmosis. Following the problem statement, the benchmarks, market alternatives, and design metrics were explained in the poster, followed by the experimental results from the PFRO validation conducted at Purdue University.

The poster helped convey essential information to a cumulative number of roughly 800 local members in academia, which was further promoted through the MECC team being selected for the semifinal round in the Innovation and Manufacturing and Validation categories of the Mallot Competition.

More communication materials were distributed through the PMEA educational kits, where close to 50 instructional flyers were designed to teach energy concepts such as energy conversion, as well as a general guideline on how to create a paddle boat, alongside an instructional guide for the teachers on how to conduct the event.

4 Outreach Outcomes

Outreach Outcomes

Through the outreach activities organized, the Purdue MECC team was able to interact, educate, and obtain feedback from students ranging from kindergarteners to eighth-graders, and engineering undergraduate and graduate students. Moreover, the team also presented to many faculty members, as well as judges who were industry and machining experts. In total, the team interacted with 890 people in the local community.

Social Media Outcomes

The team utilized a wide array of social media platforms. For the larger Mechanical Engineering College events, such as the Design Expo and Malott Innovation Presentations, the team's information was announced on the Purdue ME blog. This blog is used by hundreds of Purdue faculty and staff members and reaches thousands of engineering students throughout all four years of the program. The information made publicly accessible included a brief summary of the design, biographies for the team members, and the location and times at which all events took place.

Many individuals on the team also posted about the progress of the desalination design and advertised the MECC event in Portland, as well as other public displays of the system such as the presentations. Each post reached a different number of people, depending on the network of each team member. On average, they reached about 300-400 people, the vast majority of which were

past coworkers, Purdue students, and faculty. Individual team members also used Instagram to advertise these events to a greater number of attendees. These reached upwards of 500 people per post.

Purdue Engineering Outreach (PEO) also used social media to advertise the community outreach events that involved the Purdue MECC team. PEO has a very active following of over 700 people on Instagram, where they posted information and photos about the outreach event at the Hanna Community Center.