

Sustainability Inclusion in First-Year Engineering Projects Courses

Katherine Ramos
Teaching Assistant Professor / Integrated Design Engineering
Angela R. Bielefeldt
Professor / Integrated Design Engineering
Joan Tisdale
Teaching Assistant Professor / Integrated Design Engineering

1 INTRODUCTION

Recognizing the importance of sustainability in engineering education, we have developed a comprehensive set of resources and lectures, lab activities, shared design project ideas, and updated project evaluation rubrics. These tools are designed to seamlessly integrate sustainability principles into the FYEP curriculum. Our overarching goal is to foster increased awareness of sustainability among approximately 690 students annually, promoting a shift in their perspective both within the field of engineering and in their daily lives. By targeting a 50% increase in faculty incorporating sustainability into FYEP, we aim to create a lasting impact, aligning with the Engineering One Planet (EOP) framework and emphasizing elements such as systems thinking, environmental impact assessment, and social responsibility.

2 METHODS

- ❖ resources and lectures
- ❖ lab activities
- ❖ shared design project ideas
- ❖ project evaluation rubrics

Lecture Notes on the Engineering Design Process

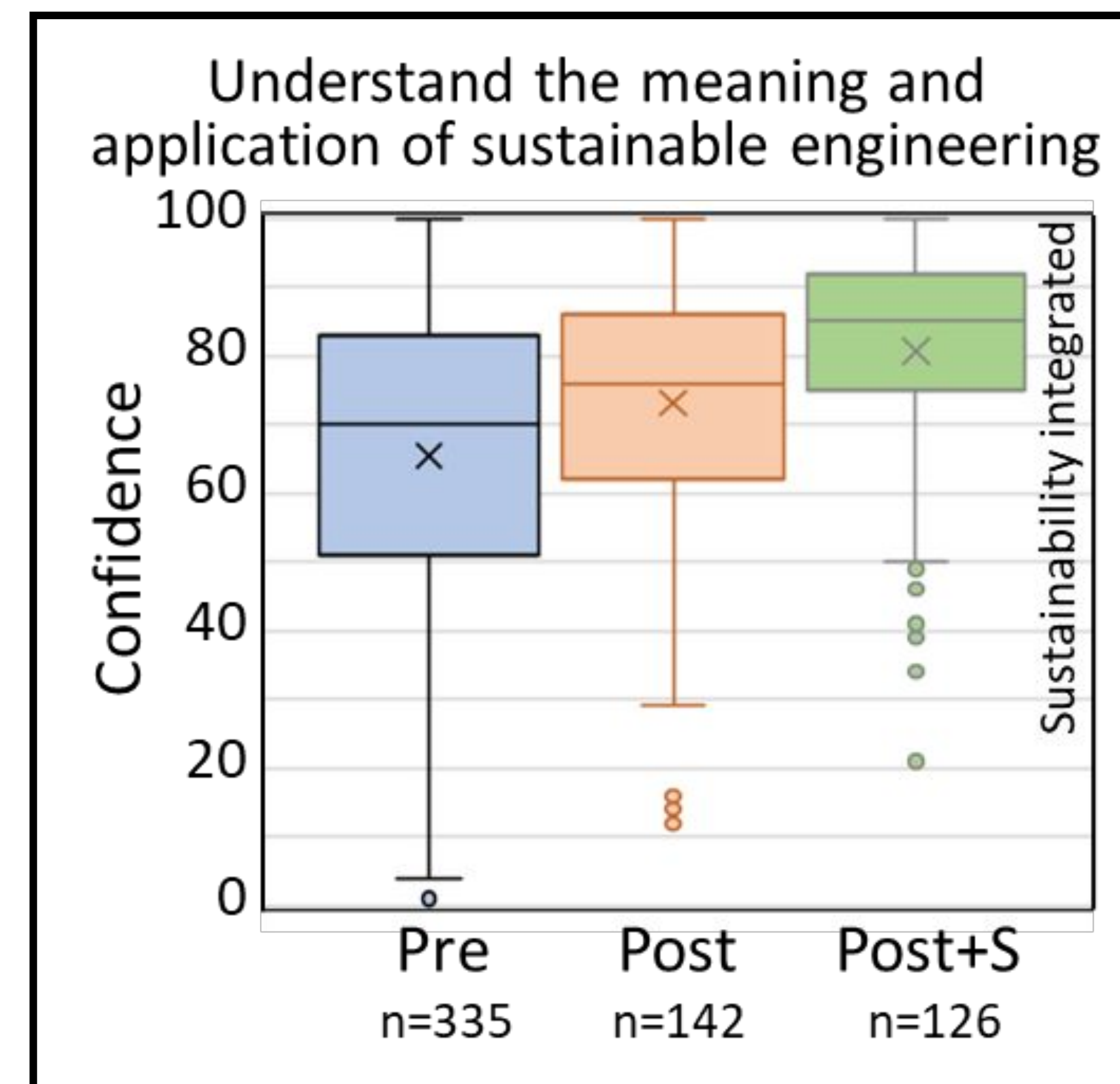
- Ask. Identify the need and constraints**
- Recognize the wants and needs of your users!
- How does Sustainability play a role in the EDP?**
- **Social Responsibility** - How does your eng. design directly and indirectly cause positive and negative social/cultural impacts?
 - **Materials Selection** - Can you identify potential impacts of materials selected (e.g., emissions, toxicity)? Can you design with lower impact or natural materials (e.g., bamboo)?
 - **Design** - How can you design for the environment, society, reparability, durability, flexibility, reuse, part or whole recovery?

Sustainability elements evident in student posters (mapped to EOP categories)			
Category	Not evident (0 points)	Some evidence (1 point)	Strong Evidence (2 points)
Environmental impact assessment	Not evident	considered lifecycle environmental elements for 1 aspect (eg CO2e)	considered lifecycle environmental elements for multiple elements (eg GHG, water, toxicity, air pollutants)
Materials selection	Not evident	Discussed choices of 1 material that considered 1 or more sustainability elements (reuse, recycled, non-toxic, local sourced)	Discussed choices of multiple materials that considered 1 or more sustainability elements (reuse, recycled, non-toxic, local sourced)
Social responsibility / ethics	Not evident	Evidence some consideration of safety, human health, or welfare	Considered safety, human health, and welfare in multiple stages of the product lifecycle
Responsible economics (costs)	Cost info lacking	Clear communication of costs (spent and product if not able to borrow from ITLP)	Clear communication of costs, considered in build and operation / maintenance
Environmental literacy	No evidence	Could be linked to 1 or more SDGs	Linked to one or more SDGs on poster
Regulatory & stds compliance	No evidence	Evidence considered 1	More than 1 considered
TOTAL		MAX 12 pts	

NEW Sustainability Award at the Design Expo

3 PROGRESS

Student survey (IRB 11-0651)



Pre-existing course survey across all sections measured increase in student confidence related to sustainable engineering, higher in sections with explicit integration of EOP materials (Fig. at left)

New IRB approved Dec. 2023; future:

- faculty survey
- request students allow their final design report and ethics assignments to be explored
- students complete a design scenario and score responses with a sustainability rubric

Faculty Involvement

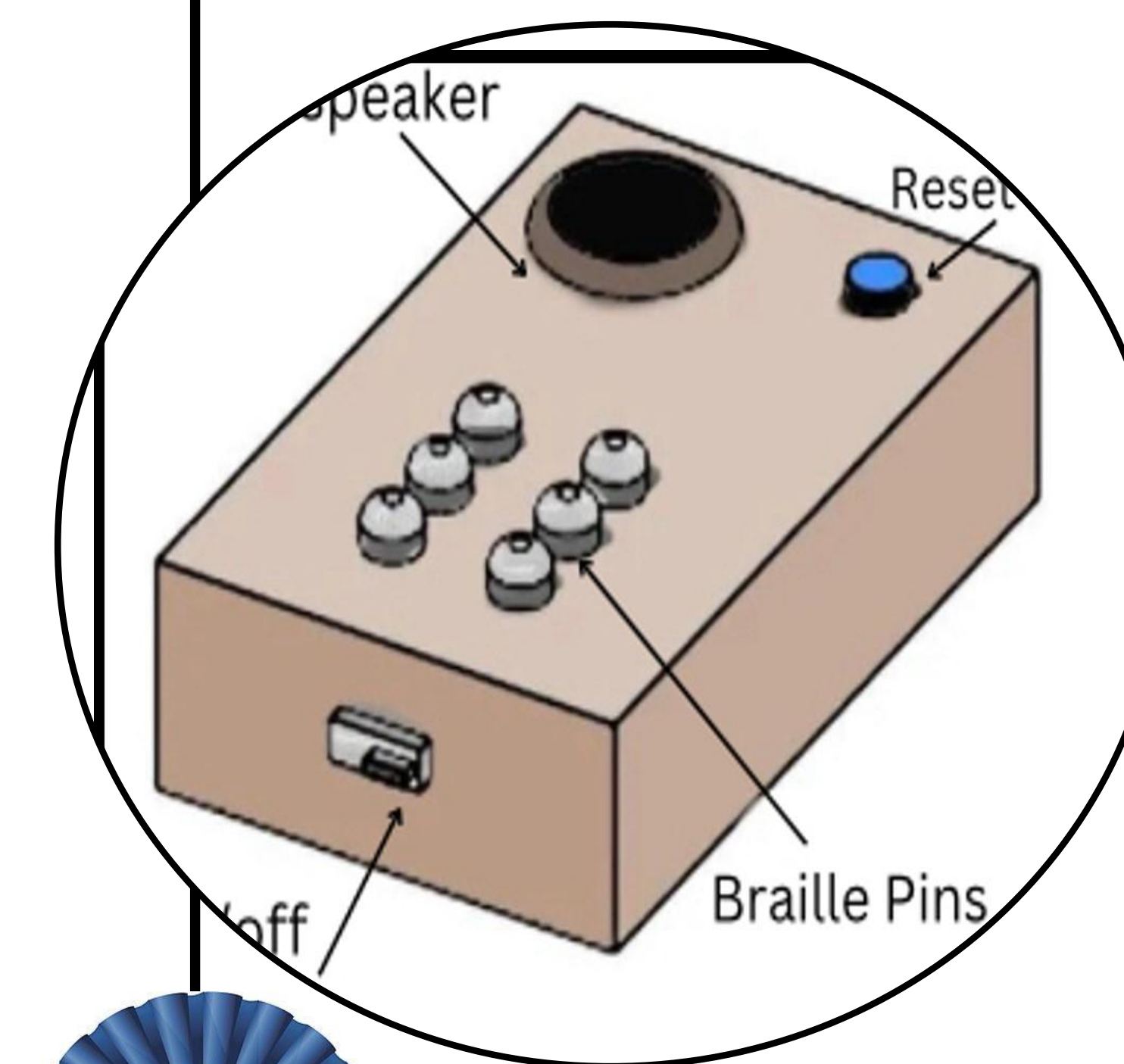


Student Design Teams **42/83**

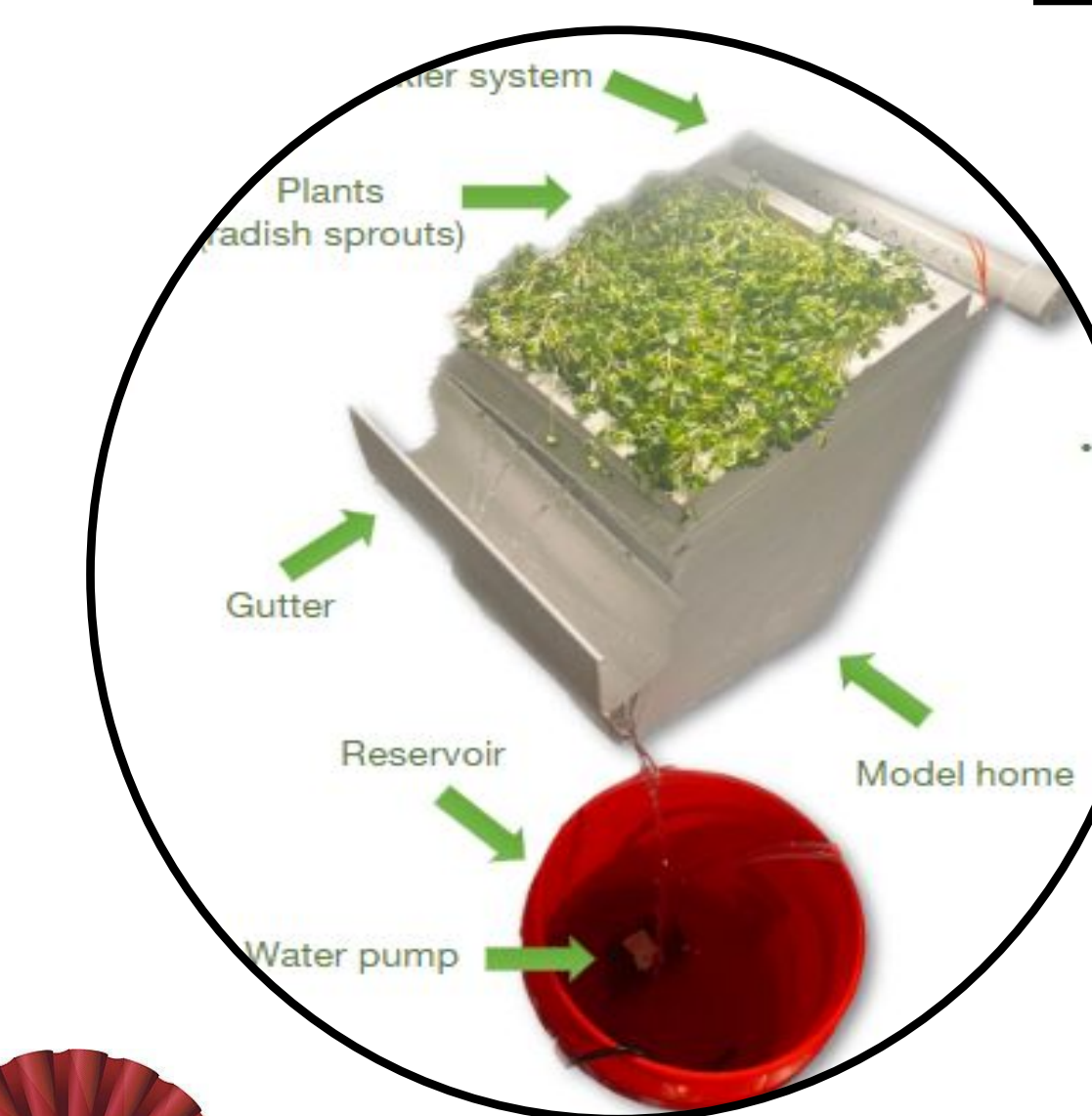
4 EVALUATION & IMPACT

Posters from 39 design teams were evaluated for sustainability components

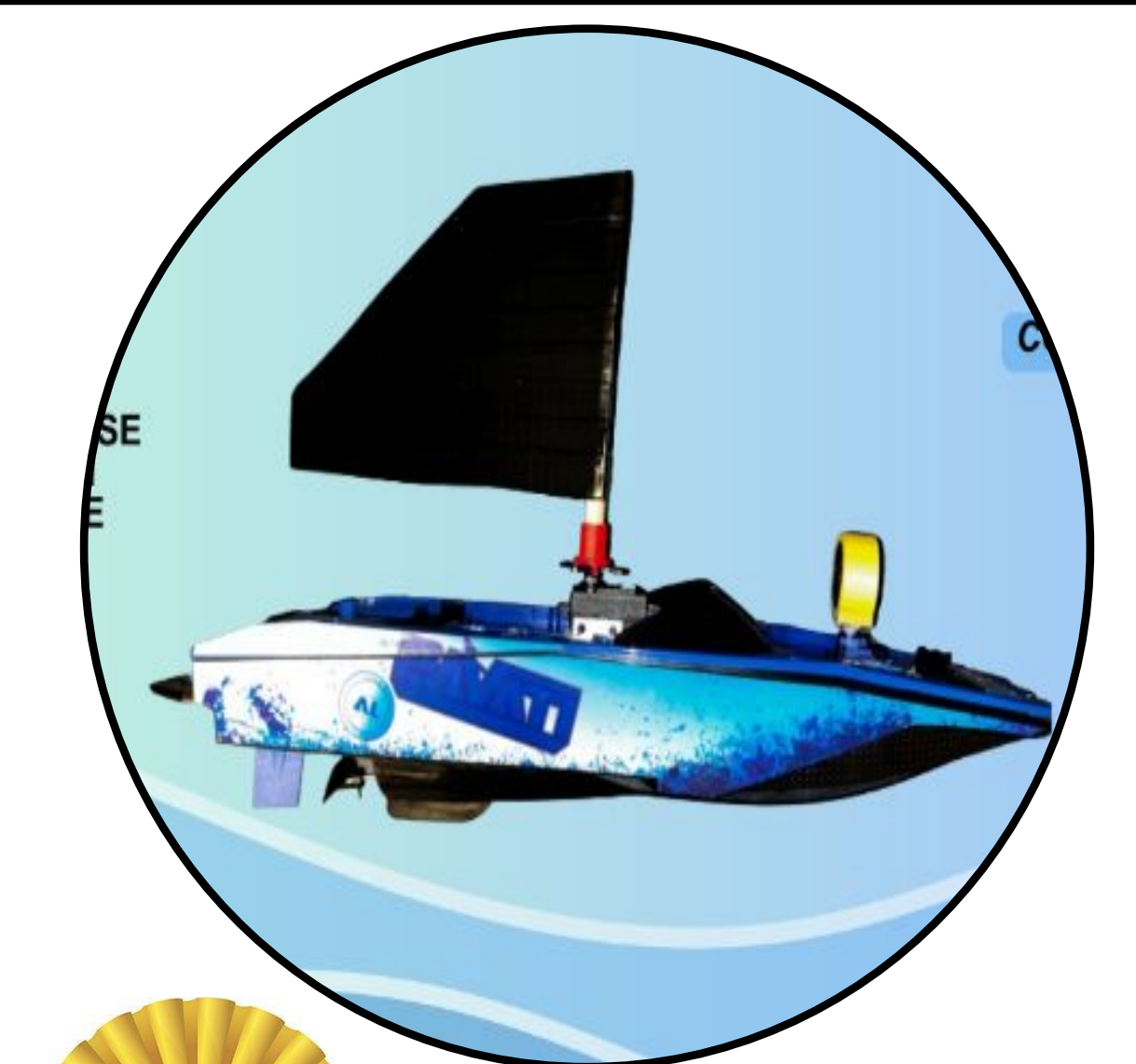
The top 3 were selected for sustainability awards, and were awarded at the Design Expo



1 **Braille Learning Device**
Meeting a need of a vulnerable population
Included sustainable materials considerations



2 **Hydroponic Roof Tiles**
Working to reduce carbon footprint both by reducing production and by CO2 removal from the air



3 **Sail Power**
Reduction of CO2 emissions in the maritime industry

ACKNOWLEDGEMENTS:

Lemelson Foundation, ASEE. We would also like to thank our EOP Mentors: Christin M. Datz and Benjamin Linder. Special thanks to Katie Spencer who helped with judging posters.