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Enhancing First-Year Engineering Student Engagement through the Development of an Open-Hardware Teaching Platform: A Pilot Study

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Background

- The success of undergraduate engineering students depends on high levels of **engagement and motivation** [1][2]
- One of the most effective pedagogical approaches to teaching engineering and increasing self-concept and self-efficacy is **active learning** [3][4]
- The use of **technologies that promote active learning** through hands-on activities in classroom is now an integral aspect of active learning in Science, Technology, Engineering, and Math (STEM) learning.
- **Making sense of the use of technology in STEM is not straightforward**. Integrating technology into engineering courses without reassessing and reimagining core educational features is challenging.

Research Goal

- We propose an **educational framework** to foster meaningful learning experiences and hands-on activities in a first-year engineering course at Purdue Fort Wayne (PFW) called Engineering Fundamentals II (ENGR128).
- **ENGR128** is a foundational 4-credit course required for all undergraduate engineering students, aimed to develop problem-solving skills through lectures, studios, and lab.
- This **educational framework** combines open-hardware technology and innovative story-based pedagogy to enhance learning experiences.
- **The research scope in this poster is centered on the development of an educational kit that combines prototype and existing work by students during Spring 2023.**

Preliminary Results

Kit prototype

- The educational kit (see Figure 1) comprises a versatile, modular tool included in a compact box. This adaptable box can be expanded for diverse applications, including water systems (water shield), food applications (food shield), safety systems (safety shield), and fundamental electronics (SOS shield). The kit features sensors, power systems, electronic components, and easily integrable modules.

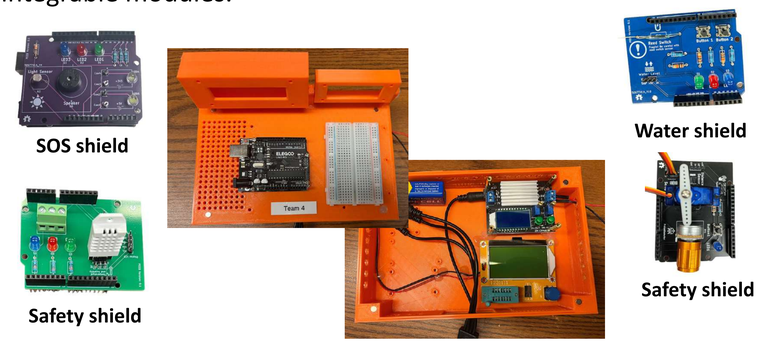

Figure 1. Educational Kit and different shields that can be incorporated into the kit

Examples of students' projects using the kit

- Figures 2 and 3 showcase examples of projects created by ENGR128 students during the Spring 2023 semester.

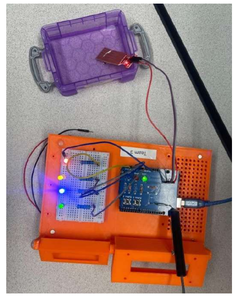

Figure 2. Water control system

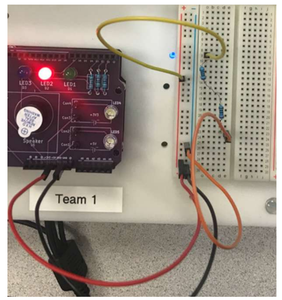

Figure 3. Morse code system

Discussion

- **Initial concept:** Students demonstrated a significant level of engagement and excitement while using the kit. As one student said: "This kit makes me feel more intelligent."
- **Challenges encountered**: Components exhibiting functional difficulties, power-related challenges, inefficient layout, and limited size.

Conclusion and Future Work

- **Enhanced learning experience:** Students using the kit demonstrated a progressive improvement in coding comprehension and its application across various applications in engineering.
- **Continuous feedback:** Student input will be collected with consent to refine and improve kit's effectiveness and usability.
- **Open resource goal:** Plans to publish this tool as an accessible, open resource tool for global access, and simplified learning.
- **Curriculum integration:** The course will be adjusted to incorporate additional applications to cover additional theories covered during ENGR128 classes.

Acknowledgment

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Reference

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[4] Hyun, J., Ediger, R., & Lee, D. Students' Satisfaction on Their Learning Process in Active Learning and Traditional Classrooms. International Journal of Teaching and Learning in Higher Education, 29(1), 108–118. 2017.