Using the EOP Framework to form a systems-thinking throughline in a first-year general education course

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APPLIED PHYSICAL SCIENCES

The University of North Carolina at Chapel Hill

ASEE | Engineering for One Planet

1. Highlights

- 100 students per semester are being trained in EOP framework systems thinking competencies in our modified course
- Using the EOP framework allowed us to identify and advertise the skills students develop in the course
- We hope the mini-grant related changes will improve student's motivation and connection to coursework – results TBA

2. Before EOP

APPL 101 is a general education course at UNC Chapel Hill, and a required course for students in the new Applied Sciences major

- ~30% engineering students, ~70 non-engineers

Sustainable engineering was discussed in 2 class periods where students discussed triple-bottom line tradeoffs of engineering designs

Prior to our mini-grant work, the course focused on three unconnected themes

↳ Simulations | Biomimicry | Sustainability

3. Acknowledgements

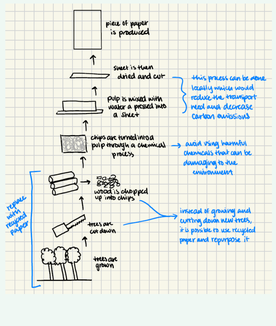
1. Funding for this work was provided by the ASEE EOP mini-grant program sponsored by the Lemelson Foundation (of course!)
2. Thank you to our mini-grant program mentor, Medha Dalal for guiding us, especially in developing assessment of student outcomes from our course!
3. The airborne wind turbine activity is adapted from the Flying Forced KEEN card #2270 by Glenn Gaudette and Sarah Wodin-Schwartz as presented at the KEEN UVT Faculty workshop by Anna Howard et al.

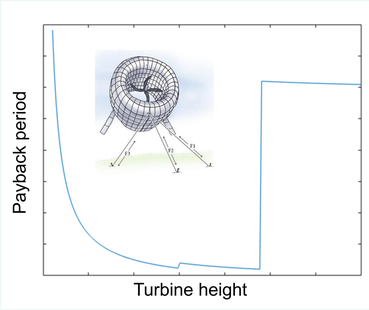
4. With EOP

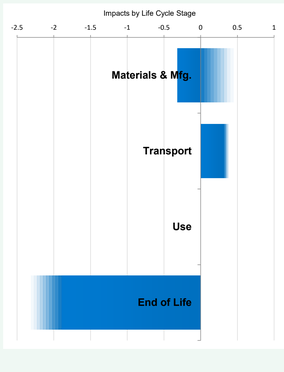
- We unified the course under two themes: Engineering impacts and systems thinking.
- We will use this to better communicate the value of the course to both engineering and non-engineering students
- Engineering for One Planet outcomes are front-and-center in our advertising and recruiting

Selected learning outcomes	Simulations	Biomimicry	Environmental impact assessment
Engineering impacts	Interpret simulation outputs to inform make recommendations	Explain how engineers use biomimicry to design useful new technologies	Estimate lifecycle environmental impacts of engineering projects
Systems thinking	Analyze a real-world system to describe a representative model	Model natural systems to extract design ideas	Define problems comprehensively using whole system mapping

5. New EOP activities







5a. Whole systems mapping

Beginning of design process to explore opportunities

5b. Airborne wind turbine simulation [3]

Students estimate social, environmental, and economic impacts of their proposed design

5c. Estimated LCA

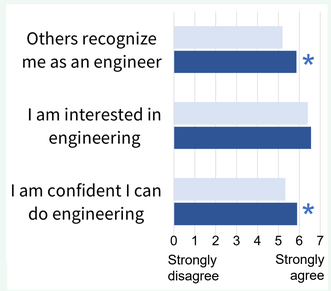
IDEMAT database & spreadsheet for an estimate to inform design choices

6. Student Attitudes

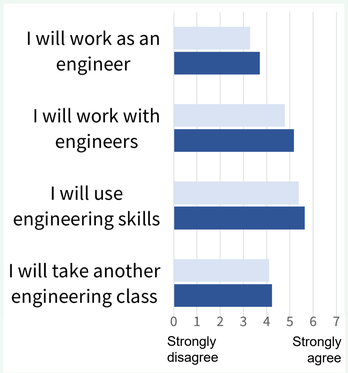
Before and after the course, we surveyed students:

Engineering identity

Engineering students significantly* increased 2 facets of engineering identity (recognition and confidence).



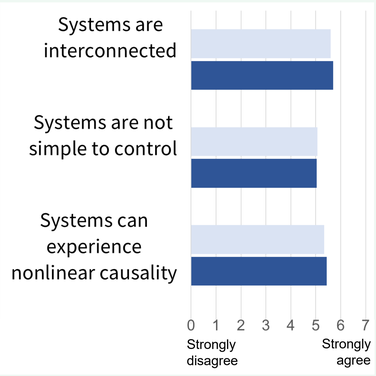
Engineering usage



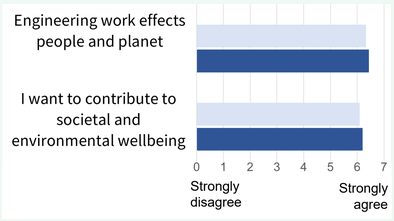
Non-engineering students did not change significantly in their expectations of using engineering.

Systems thinking attitudes

Students moderately agreed with systems-thinking attitudes (no significant change pre-post course).



Engineering values



Students strongly agreed with engineering values questions (no significant change pre-post course).

*t-test p-value < 0.01