Development of student motivation in a required Electrical Engineering (EE) course for non-EE majors

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Introduction

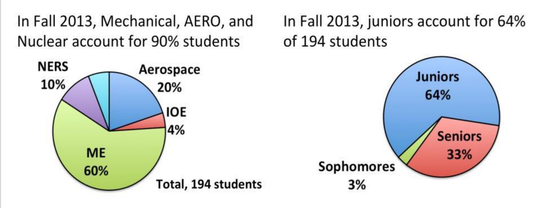
- Students, who are required to take courses outside their fields of major, might lack motivation to learn and apply the material. This is a challenge for any instructor, and a loss for students who skip valuable learning.
- We investigate how student motivation develops in *EECS 314 Electric circuits, Systems, and Applications* – required course in Electrical Engineering (EE) for non-EE majors
- This report includes quantitative and qualitative data collected in 4 surveys conducted during Fall 2013 semester.

Working Hypotheses

1. Non-EE engineering students who are taking a required EE course can develop interest in EE, become motivated and confident to apply EE to their fields of major.
2. Researchers can identify what teaching events and/or components of the course foster students' interest and motivation.
3. Researchers can find out what parts of the course material the students see as valuable, applicable to their fields of engineering.

Student Demographics

- Fall 2013: 194 students; Winter 2014: 223 students.
- Students are from several different engineering majors and academic years.



* In the left panel, the sector without label includes: Engineering Physics, Materials Science, Biomedical Engineering, unclassified undergraduate engineering, and other undeclared majors.

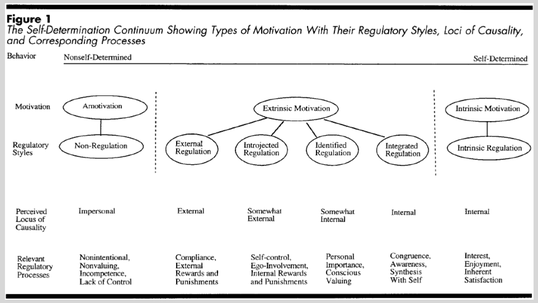
Course Structure

EECS 314 Electric circuits, Systems, and Applications is a 4-credit, one-semester course, which includes:

- 3 hours of lectures (entire class), weekly
- 1 hour of discussion (4 sections, ~50 students each), weekly
- 2 hours of in-lab work (2 students per team; 9 teams per lab section); 8 projects during the semester, each includes pre-lab, in-lab, and post-lab.
- Two midterms and a final exam, in multiple-choice format.

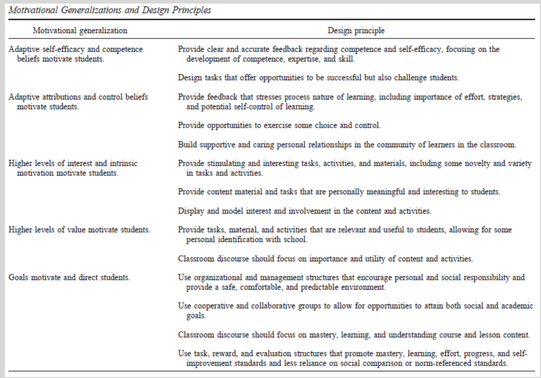
Theory of Motivation

- Motivation is a concept with a wide variety of definitions across many different fields.
- We chose to use Ryan and Deci's (2000) self-determination framework to examine the differences between intrinsic and extrinsic motivation.



* Figure adapted from Ryan, R. M., & Deci, E. L. (2000). Self-determination theory and the facilitation of intrinsic motivation, social development, and well-being. American Psychologist, 55(1), 68-78.

- Additionally, we wanted to examine our course through Pintrich's (2003) five general constructs in understanding the motivations of students in the classroom.



* Figure adapted from Pintrich, P. R. (2003). A Motivational Science Perspective on the Role of Student Motivation in Learning and Teaching Contexts. Journal Of Educational Psychology, 95(4), 667-686.

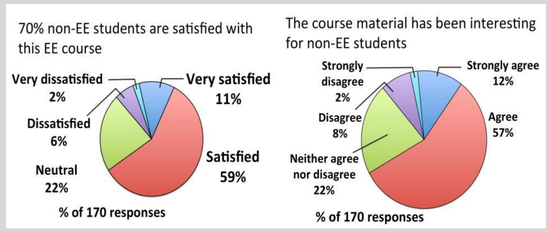
Research Design

- Four surveys administered throughout the Fall 2013 term; each survey specifically measured how students' background characteristics and instructional techniques used during the course enhanced motivation and interest in course concepts.
  - Survey 1 administered before the first class of the semester to assess the background characteristics and experiences of the incoming students in the course.
  - Survey 2 conducted in the first two weeks of class, focused on the types of motivation (intrinsic vs. extrinsic) and identified what course topics were most applicable to their studies.
  - Surveys 3 and 4 implemented at the middle and at the end of the semester, respectively, to measure students' satisfaction with the course and identify the instructional strategies, which students found most beneficial for their learning.

Preliminary Findings and Conclusions

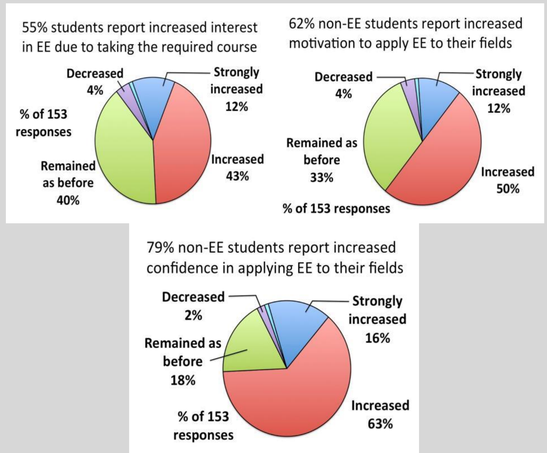
Satisfaction and Interest in the Course

- In their responses to the midterm survey (given ~2 months after the beginning of the 14-week semester) students reported high satisfaction and interest in the course material.



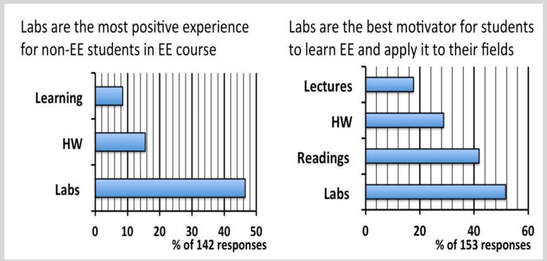
Change in Interest, Motivation, and Applicability

•In the final survey (after the last lecture, before the final exam) students report increase of interest, motivation, and confidence



Labs provide Most Positive Experiences and serve as Most Influential Motivators

- The results from the final survey:

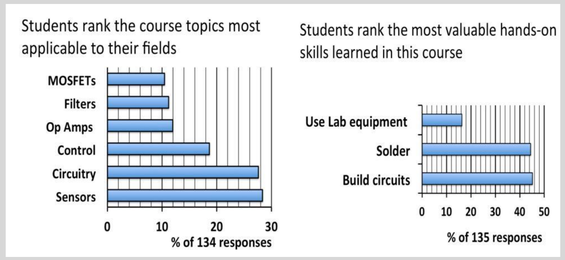


- In the left panel, the top entry belongs to "Learning new concepts"
- In the right panel, "Readings" mean the required chapters, assigned weekly for homework.

Conclusions

Advice for Instructors of Required Courses for Non-Majors

1.
Avoid talking about your course as an abstract field: make sure that each concept is "presented in a context that would be useful" (direct quote from a student).
2.
Include the labs in your course, and focus them on applications of EE to non-EE fields.
3.
Do *not* to assume that you know *what* your students find interesting; instead, ask them directly.
   - Motivation depends on many factors, most of which are beyond the instructor's control.
   - Create and conduct surveys to find out what motivates your students; foster their interests to help them learn.
4.
You can discover what parts of the course material the students see as valuable, applicable to their fields of engineering.
   - For example, here is what we found in our course:



Further Research

We plan to pursue the following goals:

1. Summative, including:
   a) Analyze the rich information already collected, using quantitative and qualitative techniques
   b) Verify whether the results reported here are reproducible/sustainalble in future semesters.
2. Formative, including:
   a) Design of the course structure and assignments to foster students' internal motivation, interest, and confidence
   b) Apply the methods, which have been successful in this course, to other courses for non-majors.

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