Developing an Engineering Course with Contemporary Pedagogical Methodologies: Design of Experiments for Engineers

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BACKGROUND & SIGNIFICANCE

Being part of a preeminent research university, there is a need in the Mechanical Engineering Department for a course that aims to increase undergraduate and graduate students’ ability to conduct research experiments, specifically research design, data analysis, and interpretation. Planning and conducting experiments as well as analyzing the experimental data are skills that graduating engineers need to have in their unique set of educational tools derived from classroom and lab experiences. Whether students are planning to join the engineering workforce, pursue a higher degree, or even start a business, these skills are valuable.

Utilizing several contemporary teaching techniques, including active learning, within the course will benefit students and allows the teacher to spend more time interacting with students to solidify concepts instead of lecturing.

COURSE OVERVIEW

This class was created to provide an in-depth examination of experimental design and associated statistical analyses, within the context of engineering research, including human-based research. This class is an introduction to research methods, and an introduction to statistics that helps students apply select quantitative methods to planning, evaluating, and executing research.

This course emphasizes the integration of theory with application to the engineering and science disciplines. This course utilizes a hybrid of a contemporary teaching approach, where 35% of the time learning occurs individually both inside and outside the class through online videos, tutorials, and interactive materials. It is complemented by class lectures and group work with lab sessions. This class introduces the students to basic concepts in probability, statistics, and its applications in engineering.

COURSE FLOW & METHODOLOGY

Course Syllabus
- Main Concept
- In-Class Lectures
- Professor/TA
- Office Hours

Goals and Objectives
- Student Led Discussions
- Journal Article Reviews
- In-Class Problems

Class Assessment
- Mid-Class Student Feedback
- Class Evaluations
- Instructor Evaluations

%15+ of time Instructor Direct Teaching/Assistance

Canvas resources
- Lectures
- PPTs/Notes
- Video Recordings
- Open-Source Tutorials
- Assignments

25% of Time Outside of Class Learning (Individual)

20% Outside of Class Learning (Group)

30% of Time In-Class Learning (Group)

10% of Time Inside of Class Learning (Individual)

Supplementary Lab Sessions
- Group Sessions

BENEFITS

Course In General
1. Establishes a course that fills a need at the Mechanical Engineering Department, and aligns with the University’s Research Agenda.
2. Provides students with a course that includes engineering statistical methods and concepts needed to design, conduct, and analyze experimental research.
3. This course would be beneficial to students pursuing other disciplines including physical, economic, medical, social, or psychological sciences.

Course Pedagogical Methodology
1. Utilizing group projects will help students solidify concepts through discussions and applications of those concepts to solve problems. Students will also teach and lead student sessions.
2. Using teaching techniques, such as recording the lectures for students to watch before the class session and active learning will benefit students with different learning styles and elevated knowledge levels. This helps students who have difficulty staying focused during traditional lectures.

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