Implementing Real-World Examples into the Main Framework of Design Courses

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Why did I do this research?

Capstone Design Course Assessments:
- An ability to apply knowledge of mathematics, science, and engineering
- An ability to design a system, components, or process to meet desired needs
- An ability to identify, formulate, and solve engineering problems
- An ability to function on multi-disciplinary teams
- An ability to communicate effectively
Objective

Civil Engineering

- Structural Engineering
- Geotechnical Engineering
- Environmental Engineering
- Materials Engineering
- Transportation Engineering
- Construction Engineering

Theory -> Practice

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Prerequisite requirements:

- Statics
- Mechanics of Materials
- Structural Analysis
- Structural Design
Learning objective

- Statics
- Mechanics of Materials
- Structural Design
- Structural Analysis
Why did I do this research?

Comparisons of Teaching Methods

- Traditional Teaching Method
  - Deductive

- Proposed Teaching Method
  - Inductive
    1. Inquiry-based learning
    2. Problem-based learning
Deductive Teaching Method
Traditional Teaching Method

Theory → Design formula → Example
Steel Column Design

Theory

Design formula

Example

\[ P_E = \frac{\pi^2 EI}{L^2} \]

\[ F_{cr} = \left[ 0.658 \frac{F_y}{F_e} \right] F_y \]

\[ F_e = \frac{\pi^2 E}{\left( \frac{KL}{r} \right)^2} \]

Bending about x-axis

Bending about y-axis
Anticipated Learning Outcome

- Mechanics of Materials
- Structural Analysis
- Statics
- Structural Design

Design Project
Inductive Teaching Method
Steel Column Design

- Inductive Teaching Method
  - Inquiry-based learning
  - Discussion – Column strength (Mechanics of Materials)
    - Material properties
    - Cross-sectional area
    - Column will bend when it fails
  - Buckling Theory
  - Design Formula
    \[ P_E = \frac{\pi^2 EI}{L^2} \]
Steel Column Design

- Problem-based learning
- Real-world design example
  - Determine loads
  - Load path
  - Determine member force
  - Design
Proposed Teaching Method

- Statics
- Real-World Example
- Mechanics of Materials
- Structural Analysis
- Structural Design

Diagram showing the flow between the elements.
Team Work

- Used Google document to share information and ideas
- Students worked together to solve a real-world design problem
Results

- Help students to:
  - See the big picture
  - See connection between theory and practice
  - Become an effective team player
- See improvements in students’ performance
Summary

- Applied inductive teaching method
  - Inquiry-Based Learning
  - Problem-Based Learning – Real world examples
- Google Document – Think and share
- Teamwork
QUESTIONS?

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