Standards Modules for Engineering Curriculum: A Case Study Approach

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Overview

- Goals & Objectives
- Approach / Methodology
- Communication Plan
- Resources
- Current Work

Goals & Objectives

- Primary Goal
  - Develop standards education modules centered on case studies, suitable for remote or on-site learning.
  - Modules are intended for integration into first year (Introduction to BME), senior year (capstone BME/Macro/Electrical), and graduate-level engineering courses at CWRU. Also to be tested at University of Mount Union.
- Short Term
  - Needs analysis (underway)
  - Content identification & acquisition
  - Content integration & testing
- Long Term
  - Module Assessment
  - Refinement
  - Release

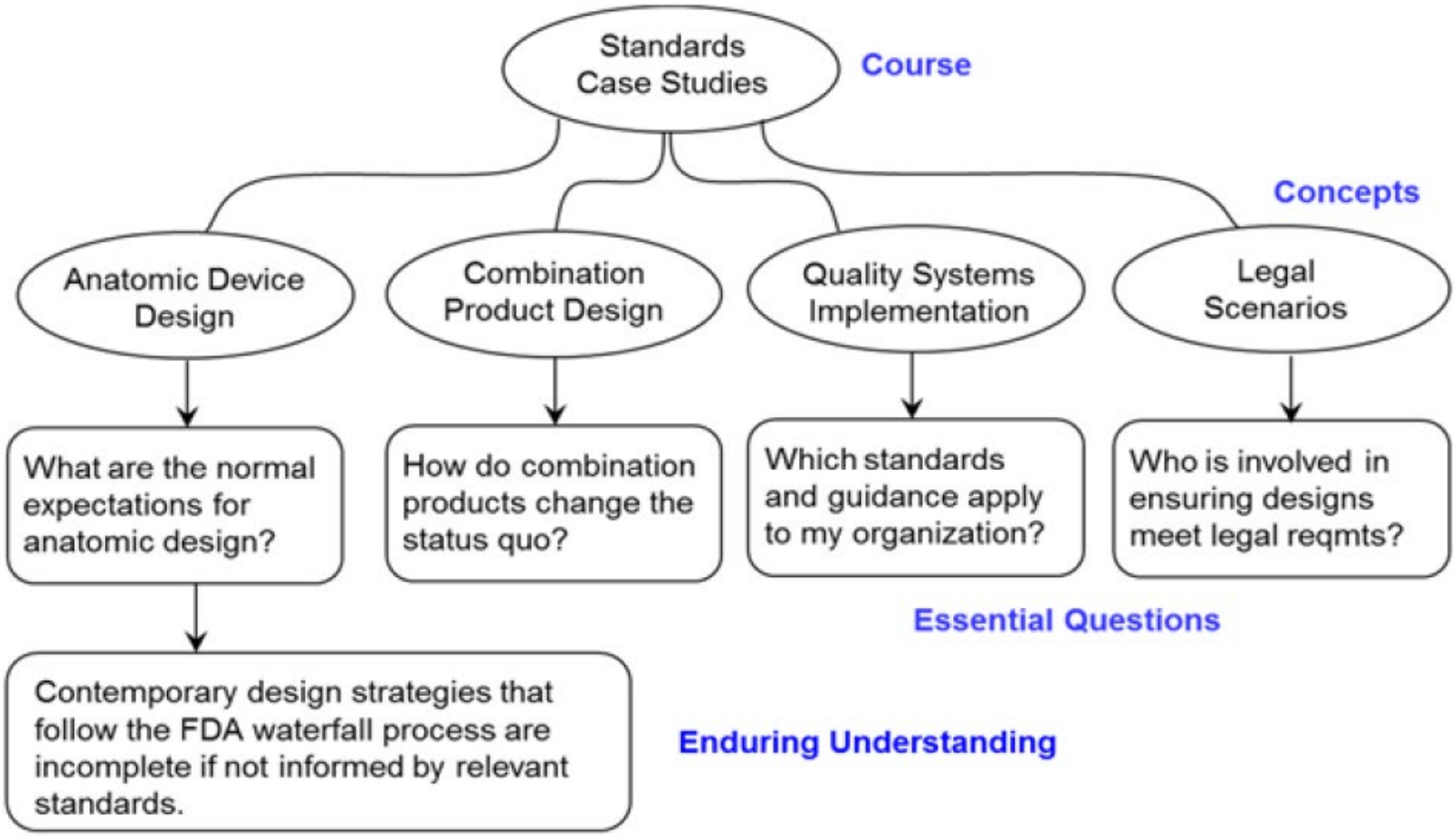
Approach / Methodology – Part 1

- Content Identification and Acquisition
  - Interviews with device designers working in the field
  - Cross-cutting analysis to identify common themes
  - Development of two case studies
    - Materials selection for a joint replacement device
    - Investigation of the complexity of a closed-loop diabetic pump with software control
    - Module content would include all pertinent write-ups, forms, references, and videos for seamless integration into current courses
  - Key standards incorporated into curriculum
    - ISO 10993-1: 2018 (Biocompatibility)
    - ISO 13485:2016 (QSR)
    - IEEE 829 (Software and System Testing Documentation)
- Content Integration
  - First-year “Introduction to Engineering” traditional case study activities
  - Senior year “moot court” exercise
  - Graduate-level “deep dive” on medical device design

Approach / Methodology – Part 2

- Initial Testing (year 1)
  - Senior Design courses at CWRU (BME, EE, and MacroE) & UMU
  - Assessment of curriculum both pre- and post-introduction (students, staff, & NIST)
- Impact Assessment
  - Identification of “hits” and “misses” regarding retention, understanding, and implementation
  - Review by third-party educational consultant
- Refinement (year 2)
  - Revision of content to ensure enduring understanding of the material
  - Apply “lessons learned” in implementation to expanding curriculum materials

Example Case Study Development Structure



Communication & Information Sharing

- Licensed under Creative Commons 4.0
- Publicly available on the Open Science Framework (OSF) and hosted by CWRU
  - Complete “kits” for implementation in pertinent engineering courses
  - Final summary report
- Modules shared to the Canvas LMS Commons
- Publications & Conference Presentations
  - Journal of Engineering Education
  - Annual Meetings of the Biomedical Engineering Society (BMES) & American Society for Engineering Education (ASEE)
  - Other local and regional conferences

Resources & Collaborators

- Staff
  - Colin Drummond, PhD
    - 20 years in industry
    - Former director Coulter-Case Translational Research Partnership
    - Current instructor of applicable senior capstone and graduate courses
  - Matthew Williams
    - Focus on experiential learning
    - Current instructor of applicable first-year and senior capstone courses
  - Daniela Solomon
    - Research Services Librarian liaison to the Case School of Engineering
    - Actively involved in increasing standards awareness of engineering students through on-campus workshops
- Key Resources
  - Extensive network of industry contacts
  - CWRU institutional support
    - Access to standards via Library
    - OSF account
    - MediaVision production group
- Collaborators
  - University of Mount Union

Current Work

- Current Activities
  - Have reached out to six key opinion leaders from industry
    1. Steris Corp (2 people)
    2. US Endoscopy
    3. Lubrizol Life Sciences
    4. Invacare Corporation
    5. COTS Works (small firm)
    6. Orbital Research (small firm)
  - Interviews on “needs” underway
    - Completed one interview (Lubrizol Life Sciences)
    - Five pending
  - Have created Canvas site to develop curriculum
  - Have create OSF account for sharing with all NIST partners.
- Next Steps