Transforming How We Teach Power Engineering

Dr. Allison Kipple
Assistant Professor, Electrical Engineering
Northern Arizona University
Flagstaff, Arizona
Allison.Kipple@nau.edu

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Reforming Electric Energy Systems Curriculum
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Progression of UMN Initiatives

- Updated technical learning objectives
  - Developed textbooks to address objectives
  - Designed new lab activities & equipment
  - Hosted workshops, webinars, continuing ed

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- Designing in-class activities
  - Outlining graduate-level courses
  - Integrating research & teaching

Industry Involvement
Faculty Mentoring
Motivation...

Video clip from “Minds of Our Own”
University graduates struggle with batteries & bulbs
Motivation...

How do you encourage deep, lasting learning?

• Response 1: Bill motivates students by discussing common, real-life applications of the technical content (e.g., power supplies for the students’ personal electronic devices)

• Response 2: Bruce engages the students with pictures and movies of power system disasters, while discussing the technical details behind how these disasters occurred

• Response 3: Paul wraps a story around an important concept, which humans are naturally inclined to pay attention to and remember

• Response 4: Another audience member uses open-ended design problems to encourage deeper understanding of technical content

• Response 5: Another audience member uses hands-on but not “cookbook” activities, so students experience applications of the technical knowledge but don’t mindlessly follow a written set of procedures
Transforming How We Teach

For student learning, move from:
• "Covering it"
• Transferring instructors’ notes into students’ notes

Move to:
• Active engagement, “minds-on” more than “hands-on”
• Relevant, real-world problems of student interest
• Collaborative peer interactions
• Face-to-face, meaningful faculty interactions
• Higher-level critical thinking and problem solving
Transforming How We Teach

For instructors, move from:

- Fear of teaching unknown content
- Hiding behind the podium, sticking with “safe” material
- Telling
- Ineffective use of time

Move to:

- Well designed, evaluated class activities
- More enjoyable student interactions
- Support from highly qualified colleagues
- Rapid proficiency, success in new teaching methods
- Improved student enrollment, retention, grades
Step 1: Recording Experts’ Stories

Save institutional knowledge in case studies

Example contributors:

- Chris Henze - Designed charger for 1st electric car
- Jim Hendershot - Designed numerous motors & generators
- Jack Christofersen - 40 yrs working on T&D
- Pratap Mysore - 30 yrs working on protection systems

Jack is writing his first case...
Reforming Electric Energy Systems Curriculum

Ned Mohan’s Reform School
3 Gorges Project 22,500 MW
2nd largest civil engineering project
An early thyristor valve system commissioned in 1979. Real-world case studies from initial design, permitting and commissioning to present life extension projects after operating over 30 years.
The primary applications for HVDC:

- The economic alternative for transmitting power over long distances.
- Transmitting power underground or undersea at transmission voltage levels with distances over 30 km.
- The only alternative for power transfer between asynchronous systems.

HVDC was chosen for the CU Project because of the long distance and system stability.

- Definition of HVDC Terminal Components
- CU One-line Diagram and Project Specifications
- Performance Review
  - Transmission Line and Electrode
  - Electric and Magnetic Fields
  - Converter Configuration
    - Thyristor Valve
    - Bipolar and Monopolar
- National Electrical Safety Code (NESC)

Hope to see you during the Poster Session
Step 2: Develop In-Class Activities

• Instructors identify core, important concepts in each case

• Instructors coordinate with engineering education specialist to outline each activity

• Support materials for teachers & students are developed

• Ned records on-line 30-minute video modules (lecture material to support case)
Step 3: Assess In-Class Activities

• Materials tested at UMN and NAU

• Implementation and results of each activity professionally assessed & revised

• Timeline:
  - Power Electronics, Fall 2010
  - Power Systems, Fall 2011
  - Electric Drives, Fall 2012
Step 4: Dissemination

• Spring/summer dissemination workshops after each assessment

• New instructors additionally supported by:
  - Ned’s video modules
  - Weekly teleconferences with resource faculty
Possible Follow-on Activities

• Implementation, assessment, and revision at several other institutions

• Collection & distribution of other outstanding in-class activities, homework assignments, simulations, tricks & techniques, etc.
  - Emphasis on integrating research and contemporary issues into the curriculum

• More intensive training sessions
Resources


