Need for and Benefits of Collaboration and Networking among Centers of Advancement, Research and Excellence for Engineering Education (Teaching & Learning) in Europe
ENGINEERING
EDUCATION
GENERAL OUTLOOK
How do we see ourselves, how do the employers see us?
«Current undergraduate engineering education is sufficiently flexible to adequately meet the needs of 21st century engineers»*

Institutions all around the world to help motivate, foster, realize, sustain this inevitable change

Engineering Education
Research and Teaching (Excellence, Advancement, etc.)
Centers / Groups

- Numerous in USA
- Few in EU (i.e., TUDelft-The Netherlands, Aalborg Univ-Denmark, Tampere Univ of Technol.-Finland, Technical Univ Lisbon-Portugal, etc.)
- Note: A long-list can be found at the following link:

www.engineeringeducationlist.pbworks.com
Engineering Education Research and Teaching Centers

These lists include centers and research groups that engage in engineering education research and/or teaching and learning, including outreach; assessment; Center staff might be interested in subscribing to an e-mail list dedicated to engineering education centers and programs. The EECP list is currently maintained on the list, visit this web page: http://www.eecp.org

1. National and Regional Centers
2. Campus Centers, Labs, & Research Groups

Campus Centers, Labs, & Research Groups

<table>
<thead>
<tr>
<th>Institution</th>
<th>Center</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aalborg University (Denmark)</td>
<td>PB in Engineering Education Research Group</td>
</tr>
<tr>
<td>Aalto University (Finland)</td>
<td>Learning &amp; Technology Group (LaTe)</td>
</tr>
<tr>
<td>Arizona State University</td>
<td>Center for Research on Education in Science, Mathematics, Engineering, &amp; Technology (CREST)</td>
</tr>
<tr>
<td>Aston University</td>
<td>Engineering Education Research Group</td>
</tr>
<tr>
<td>Auburn University</td>
<td>Laboratory for Innovative Technology and Engineering Education (LITE)</td>
</tr>
<tr>
<td>Black Hills State University</td>
<td>Center for the Advancement of Mathematics and Science Education (CAMSE)</td>
</tr>
<tr>
<td>Boise State University</td>
<td>STEM Studio</td>
</tr>
<tr>
<td>California Polytechnic State University, San Luis Obispo</td>
<td>Center for Teaching and Learning (C4T)</td>
</tr>
<tr>
<td>University of Cape Town (South Africa)</td>
<td>Center for Research in Engineering Education (CREE)</td>
</tr>
<tr>
<td>Carnegie Mellon University</td>
<td>Basic Center for Teaching Excellence</td>
</tr>
<tr>
<td>University of Cincinnati</td>
<td>The Learning Center</td>
</tr>
<tr>
<td>University of Colorado at Boulder</td>
<td>Center for Engineering Education Research &amp; Assessment (CERAS)</td>
</tr>
<tr>
<td>Colorado School of Mines</td>
<td>Integrated Teaching and Learning Program and Laboratory (ITL)</td>
</tr>
<tr>
<td>Czech Technical University (Czech Republic)</td>
<td>Center for Innovative Teaching and Learning</td>
</tr>
<tr>
<td>University of Delaware</td>
<td>Teaching Institute for Educational Innovation</td>
</tr>
<tr>
<td>Delft University of Technology (Netherlands)</td>
<td>Center for Assessment Science, Technology, Engineering, and Mathematics (CALLSTM)</td>
</tr>
<tr>
<td>Duke University</td>
<td>Center for Professional Education (CPE)</td>
</tr>
<tr>
<td>Drexel University</td>
<td>Center for Innovative Teaching and Learning</td>
</tr>
<tr>
<td>Florida International University</td>
<td>FOCUS Centre of Expertise in Education</td>
</tr>
<tr>
<td>Georgia Institute of Technology</td>
<td>Center for Technology and Learning (CTL)</td>
</tr>
<tr>
<td>Georgia State University</td>
<td>Center for Technology and Learning (CTL)</td>
</tr>
<tr>
<td>Georgia State University, Downtown Campus</td>
<td>Bruce A.imestone Center for Teaching and Learning (BAC)</td>
</tr>
<tr>
<td>Georgetown University</td>
<td>Center for Internship in Engineering and Science</td>
</tr>
<tr>
<td>University of Georgia</td>
<td>Engineering Education Research - Collaborative Source for Undergraduate Roles and Technical Skills (CERUS)</td>
</tr>
<tr>
<td>Georgia Institute of Technology</td>
<td>Center for the Enhancement of Teaching and Learning (CETL)</td>
</tr>
<tr>
<td>Georgia Tech</td>
<td>The Center for Education Integrating Science, Mathematics, and Computing (CEISMC)</td>
</tr>
<tr>
<td>Georgia Tech</td>
<td>Center for Design Education</td>
</tr>
<tr>
<td>Georgia Institute of Technology (Finland)</td>
<td>Computer Science Education Research Group (COSER)</td>
</tr>
<tr>
<td>The University of Hong Kong</td>
<td>Center for the Enhancement of Teaching and Learning</td>
</tr>
</tbody>
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NEED for CHANGE, NOW!!

Engineering in higher education: what CHANGES are NEEDED?

“Educating Engineers for the 21st century”*

**Teacher-Centered Approach to Learning**

Teachers are the main authority figure in this model. Students are viewed as “empty vessels” whose primary role is to passively receive information (via lectures and direct instruction) with an end goal of testing and assessment. It is the primary role of teachers to pass knowledge and information onto their students. In this model, teaching and assessment are viewed as two separate entities. Student learning is measured through objectively scored tests and assessments.

**Student-Centered Approach to Learning**

While teachers are an authority figure in this model, teachers and students play an equally active role in the learning process. The teacher’s primary role is to coach and facilitate student learning and overall comprehension of material. Student learning is measured through both formal and informal forms of assessment, including group projects, student portfolios, and class participation. Teaching &assessment are connected; student learning is continuously measured during teacher instruction.

Educating Engineers for the 21st Century: The Role of Engineering Education and Accreditation

John W. Prados

AIChE Local Section Talk, Local Section Talk
Spring 1997
Major driver for engineering employment has shifted from defense to **global competition**; ➔ focus on time-to-market, cost, quality, customer orientation

Intelligent technologies offer opportunities to be more creative, **work smarter**; ➔ can **revolutionize learning**

Constantly-changing work environ. calls for **smart interpersonal skills**; ➔ employment opport. shifting to smaller firms, non-traditional areas

Massively integrated populations, place environment, health and safety **at the front end of design**; ➔ zero discharge, life-cycle costs, social and political concerns; **change the classical economic balance**
The IDEAL

21st Century Engineering Skills ESSENTIAL for a Competitive Enterprise

• Strong technical capability
• Skills in communication and persuasion
• Ability to lead and work effectively as a member of a team
• Ability to function in multidisciplinary environments
• Understanding of the non-technical forces that profoundly influence engineering decisions
  “Engineering is design under constraint”, NAE President William Wulf
• Commitment to lifelong learning
• Skills in design and project management

Looks familiar? ➔ ABET Student Outcomes
The REALITY

Broad Agreement on the NEED for CHANGE

• Multiple reports over the past 20 years show remarkable consistency in the attributes needed in 21st Century engineering graduates and in the NEED for a NEW EDUCATIONAL PARADIGM to develop these attributes.

• There is also broad agreement that systemic reform of engineering education will require a concurrent change from the predominant engineering school culture based on compartmentalization of knowledge, individual specialization, and a wholly research-based reward structure to one that values integration as well as specialization, teamwork as well as individual achievement, and educational research and innovation as well as research in the engineering sciences.
FORCES for Change

- **Engineering college and departmental ADVISORY BOARDS**

- **Engineering PROFESSIONAL SOCIETIES**, for example:
  - American Society for Engineering Education Engineering (ASEE)
  - Institute of Electrical and Electronics Engineers Education (IEEE)

- **PRIVATE FOUNDATIONS**, for example:
  - the F. W. Olin Foundation (Olin College); the Lemelson Foundation (National Collegiate Inventors and Innovators Alliance)

- **The National Science Foundation (NSF)**

- **The ACCREDITATION Board for Engineering and Technology (ABET)**

- **INFORMATION TECHNOLOGY and COGNITIVE science (enablers)**
Who wants change?

Who wants to change?
WHAT CHANGED?

How reflected on ENGINEERING EDUCATION?

21st Century Pedagogy

- Encouraging Reflection with Self review
- Teaching & Developing Thinking Skills with Peer review
- Encouraging Collaboration with HOTS: Higher Order Thinking Skills
- Enabling Technologies with Suitable technologies
- Inter Disciplinary approach with Effective Communications
- Collaborative mediums with Team Skills
- Digital Tools with Collaborative approaches
- Clear transparent goals & objectives with Media Fluency
- Enabling Technologies with 21st Century Pedagogy
- Technology Fluency with Developing
- Teaching using Project-Based Learning with Developing
- Problem Solving using
- Assessing Students with
- Incorporating suitable technologies with
- Inter Disciplinary approach with
- In Context of learning with
- Real World Problems with
- Timely and appropriate Feedback with
- Relevant tasks with
- Self and peer assessment with
- Collaboration with
The Engineer of 2020 Project
A high-risk, high-pay-off approach for the future of U.S. engineering education
-National Academy of Engineering-

Dr. Wayne Clough
President, Georgia Institute of Technology
The American Society for Engineering Education
June 13, 2005
The PREMISE

PAST

• Engineering and engineering education → reactive: responding to change

TODAY

• Rapid change signals that it is time to **REVERSE the PARADIGM**

PREMISE

• If we anticipate the future and are proactive about **CHANGING engineering and engineering education**, we can shape a significant, dynamic role for our profession and meaningfully and efficiently contribute to the society, as we are assigned to
What kind of ENGINEER? → 21. century

TARGETS for the Engineers of 2020

**Engineering a SUSTAINABLE SOCIETY**
- Lead the way towards wise, informed, economical, and sustainable development
- Assist in creating an ethical balance in standard of living for developing and developed countries alike

**EDUCATING the ENGINEERS of 2020**
- Reconstitute engineering curricula and related educational programs to prepare today’s engineering students for the careers of the future
- Create a well-rounded education that prepares students for positions of leadership and a creative and productive life
What kind of ENGINEER? ➔ 21. century

_Braing storming ➔ WHERE to START from?_

- Begin the curriculum with «grand challenges»
- Integrate more directly with the sciences
- Provide multiple entry points to the curriculum
- Build working interdisciplinary partnerships
- Give students self-confidence early on
- Stop tinkering around the edges and shake things up

by; Gretchen Kalonji
Brainstorming ➔ WHERE to START from?

• Research/co-op experience with real problems
• Experience with real-world tools and teams
• Encourage and recognize diversity
• Social, ethical aspects of engineering
• Creative and practical thinking
• **WHAT STUDENTS LEARN** instead of what we want to teach

by: Arden Bement
LESSONS to take

• We may have only one chance to achieve our aspirations; that time may be NOW.

• The momentum generated by the «Engineer of 2020 Project» should be used to advantage.

• Strategically engage those outside of engineering who are needed to help in our cause.

• Success is tied to innovation and marketing.

• Think as engineer/scientist, not “specialty name here” engineer.

• The future of engineering lies in the balance: engineering education needs to lead the charge to a time of new energy and opportunity.
Students are the **SEEDS** of **TODAY** and are the **CROPS** of the **FUTURE**

In order to **MOTIVATE** our **STUDENT**, **WE** need to **MOTIVATE** **OURSELVES FIRST**
Our MOTTO

TEACHING and LEARNING WELL and in GOOD SPIRITS,
INTEGRATING LEARNING with KNOWLEDGE HANDLING and IMPLEMENTATION...
ITU - CENTER for EXCELLENCE in ENGINEERING EDUCATION

VISION

Being a Leading and Exemplary Hub
Sustaining the Development of the
Next-Generation Academics, Engineers, and Leaders
MISSION

• Embrace, manage, **lead change** rather than being managed by it
• **Adapt** engineering education to cope with the challenges of the 21st century
• **Transform** the engineering education with the help of **creative, innovative, interactive, and inspiring** teaching, learning, and research experiences
• Foster **transformational** learning / teaching experiences
• Augment the culture of **leadership, entrepreneurship, and innovation**
• Function **proactively** for **continuous improvement** and **quality-assurance** in **sustainable engineering education** able to meet the demands of the future
A. PEOPLE-focused MODULES
   1. STUDENT Module
   2. INSTRUCTOR Module

B. TASK-based MODULES
   1. SYSTEMATIC Tasks / Services
   2. PARTICULAR Tasks / Services

Learning objectives and intended outcomes
Pedagogic approaches (teaching models)
Teaching and learning strategies and techniques
Conditions for learning
Climate for learning
Class organisation
A. PEOPLE-focused MODULES

A.1. STUDENT MODULES

• Reframing the CURRENT POSITION
  • Getting to know the students better
  • Direct feedback from students (surveys, interviews, meetings, forums, etc.)
    • How better the lectures be delivered? Students’ perspective
    • What are the major constraints that are restricting your learning abilities?
    • What might be the strategies/ approaches that might provide solutions for those problems/difficulties?, etc.
  • Investigating the students’ learning attributes
  • Reviewing students’ academic problems/difficulties

• STRATEGIC PLANNING and IMPROVEMENT
  • Strategy development and improvement based on current situation and future targets
A. PEOPLE-focused MODULES

A.1. STUDENT MODULES

• FUTURE TRENDS →

For our students → presentation and conveyance of and increasing awareness about the attributes (students outcomes / educational objectives) designating future trends in engineering education

✓ critical-thinking
✓ problem-based approach
✓ design-based approach
✓ cap-stone design approach
✓ innovative-thinking
✓ entrepreneurship
✓ leadership
A. PEOPLE-focused MODULES

A.1. STUDENT MODULES (example)

Student Development Programs

- Personal Skills Program
- Academic Performance Improvement Program
- Supporting Talented/Successful Students Program
A. PEOPLE-focused MODULES

A.1. STUDENT MODULES *(example)*

Personal Skills Program

Developing students skills needed in career development *(by job market)*

Special events, short courses, workshops

Voluntary community services

IT Courses, Certificate Programs, etc.

Academic Programs
A. PEOPLE-focused MODULES

A.2. INSTRUCTOR MODULES

• FUTURE TRENDS ➔

For our academics ➔ increasing awareness and implementation by reviewing the attributes (students outcomes / educational objectives) designating future trends in engineering education

✓ critical-thinking
✓ problem-based approach
✓ design-based approach
✓ cap-stone design approach
✓ innovative-thinking
✓ entrepreneurship
✓ leadership
A. PEOPLE-focused MODULES

A.2. INSTRUCTOR MODULES

• ACADEMIC ORIENTATION*

Target Group ➔ Newly hired TAs-RAs and Assist. Professors

1. Module ➔ Courses / workshops on «engineering education and contemporary developments / future trends» (pedagogic approach)

2. Module ➔ Courses / workshops on «educational psychology»

3. Module ➔ Courses / workshops on «developing / improving communication skills»

• Communicating with students, professors, admin offices, etc.

➔ PEER-REVIEW, MENTORING

*to be compulsory for new TAs-RAs and Assist Profs upon employment before starting to assist / teach
A. PEOPLE-focused MODULES

A.2. INSTRUCTOR MODULES

• ACADEMIC ORIENTATION*

Target Group → Newly hired TAs-RAs and Assist. Professors

4. Module → Courses / workshops on «improving educational skills»

• How to design, plan, prepare a lecture?
• How to assist lab-courses?
• Which type of questions for which type of lectures/assessments?
• How to motivate students to be more interactive in class? How to improve students’ learning? «Minute-papers», «Muddiest point», reading assignments, etc.
• How to grade, assess, evaluate? etc.

→ PEER-REVIEW, MENTORING

*to be compulsory for new TAs-RAs and Assist Profs upon employment before starting to assist / teach
A. PEOPLE-focused MODULES

A.2. INSTRUCTOR MODULES

• ACADEMIC ORIENTATION*

Target Group → Newly hired TAs-RAs and Assist. Professors

5. Module → Info days on «Rights and Responsibilities»

• General legal framework

• University Regulations (for students, TAs-RAs, instructors)

• Info on employee personal rights, etc.

• Info on «Occupational Health and Safety» measures, legislation, etc.

• Info on campus-wide research centers, research labs, technocities, etc. (location, working hours, safety classes, services offered, etc.)

*to be compulsory for new TAs-RAs and Assist Prof. upon employment before starting to assist / teach
A.2. INSTRUCTOR MODULES

Junior Faculty Development Program

Activities

Teaching
- International, national and on-site (campus) workshops & conferences
- Peer consultation
- Course coordination assignment
- Technical and learning grants
- Mentoring
- Teaching exchange program
- Certification program

Research
- Research Workshops
- Mentoring
- Junior faculty grant
- Industrial Experience
- Summer Assignment
A. PEOPLE-focused MODULES

A.2. INSTRUCTOR MODULES

• TEACHING SUPPORT / DEVELOPMENT and EDUCATIONAL QUALITY ASSURANCE

Target Group → Senior Assist. Profs, Assoc. Profs, Full Professors

1. Module → Curriculum-design:
   • Course categories & the appropriate mix →
     General Edu (GE), Basic Sci (BS), Engr Sci (ES), Engr Design (ED)
   • Example (ABET EAC): %20 GE + 25% BS + min 50% [ES+ED]
   • Which teaching strategies and course delivery approaches / techniques are appropriate for which course category?

2. Module → Contemporary teaching approaches / techniques:
   Problem-based learning, Design-based learning, Project-based learning, etc.
   • What do they mean?
   • How and to what extend do they contribute to realization of student outcomes?
   • How could you implement those teaching-learning techniques to your course?
A. PEOPLE-focused MODULES

A.2. INSTRUCTOR MODULES

• TEACHING SUPPORT / DEVELOPMENT and EDUCATIONAL QUALITY ASSURANCE

Target Group ⇒ Senior Assist. Profs, Assoc. Profs, Full Professors

3. Module ⇒ IT and new media for education
   E-learning, blended-learning, flipped classroom, etc.

4. Module ⇒ Assessment and evaluation approaches, techniques, tools for A&E of student outcomes and performance of instructors
   • INTRO: What is A&E? techniques, surveys, rubrics, Bloom’s Taxonomy of Edu, etc.
   • How to select the A&E tool/technique best suiting your course? Which A&E tool/technique is most appropriate and efficient for a designated course?
   • RUBRICs: How to prepare an efficient rubric?
   • FOCUS-GROUP: How to structure a realistically representative focus-group? How to evaluate focus-group results?
   • etc.
A. PEOPLE-focused MODULES

A.2. INSTRUCTOR MODULES

• TEACHING SUPPORT / DEVELOPMENT and EDUCATIONAL QUALITY ASSURANCE

Target Group → Senior Assist. Profs, Assoc. Profs, Full Professors

5. Module → Summer professional development programs in collaboration with industry

6. Module → Incorporating the experts from professional life into engineering education
B. TASK-based MODULES

PROPOSED APPROACH

CURRICULUM DESIGN

INTRODUCTION – DEVELOPMENT of TEACHING – LEARNING METHODS

PARTICIPATING - ORGANIZING LOCAL / INT. CONFERENCES, WORKSHOPS on ENGINEERING EDUCATION, COLLABORATING with LOCAL and INTERNATIONAL INSTITUTIONS
ITU – CE3 Board Members
Prof Yılmaz TAPTİK
Prof Orhan Metin KAYA
Prof Fahri ESENLI
Prof Sema OKTUĞ
Prof İsmail Hakkı HELVACIOĞLU
Prof Melike GÜREL
Assoc. Prof Gülçin ÇİVİ
Assoc. Prof Çiğdem GÖKSEL
Assoc. Prof Semra AHMETOLAN
Assoc. Prof Ebru DÜLEKGÜRGEN
Assist. Prof Fuat ERGENÇ

ITU - CENTER of EXCELLENCE in ENGINEERING EDUCATION
COLLABORATIONS, Internal Partners

- ITU SEED
- ITU GINOVA
- ITU ODoS (Office of Dean of Students)
- ITU OSoA (Office of Student Affairs)
- FACULTIES, DEPARTMENTS
- ITU ABET ACCREDITATION HIGHER BOARD
- ITU EDUCATION HIGHER BOARD
- ITU STRATEGY DEVELOPMENT DEPARTMENT
- ITU IT Office
- ITU WORKING GROUPS
- ITU CENTRAL RESEARCH LABS
- ITU LIBRARIES
- ITU UZEM, etc.
  - ITUNOVA Technology Transfer Office
  - ITU GATE Start-up Challenge Program
Possible COLLABORATIONs (External)

- Fund-raising
- ISTKA PROJECTS
- EU PROJECTS
- Similar or Relevant International Institutions
  - ASEE → American Society for Engineering Education, USA
  - ACTE → Association for Career and Technology Education, USA
  - AE3 → Academy for Excellence in Engineering Education, USA
  - CAEE → Center for the Advancement of Engineering Education, USA
  - SEFI → European Society for Engineering Education, EU
  - CESAER → Conference of European Schools for Advanced Engineering Education and Research, EU
  - Higher Education Academy Engineering Subject Centre, EU
  - etc.....
- INVITED PROFESSORS from EU and US Universities
- INVITED EXPERTS, LEADERS, ADMINS from the INDUSTRY
- REAL-WORLD INDUSTRIAL CASE-STUDIES
  - etc.
REFERENCES

http://ijtee.org/ijtee/system/db/pdf/72.pdf#page=5

http://www.raeng.org.uk/publications/reports/educating-engineers-21st-century

• John W. Prados, «Educating Engineers for the 21st Century: The Role of Engineering Education and Accreditation”» AIChE Local Section Talk, Spring 1997, USA
http://www.slideshare.net/sachinbn/educatting-engineers-21st-century


• http://teach.com/what/teachers-teach/teaching-methods
Do you have a Center for Excellence-Advancement / Teaching-Learning Research Center at your university?

**YES** → Are you using their services?
   → Is it working for you / for your students?

**NO** → Do you think such a center will be useful for you / for your students?
   → Which services would you like to receive?