



NATIONAL ACADEMY OF ENGINEERING

OF THE NATIONAL ACADEMIES

Center for the Advancement of Scholarship on Engineering Education

Engineering Education Research?

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ECE Department Heads Association

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CASEE



Agenda

- **Very brief background on CASEE**
- **Preview key questions about ECE “traditional” and education research.**
- **Gain your input as key mentors and guides to ECE faculty.**
- **Determine if there would be value in having an expanded conversation with other chairs.**



CASEE Mission

Better meet the needs of engineering's stakeholders

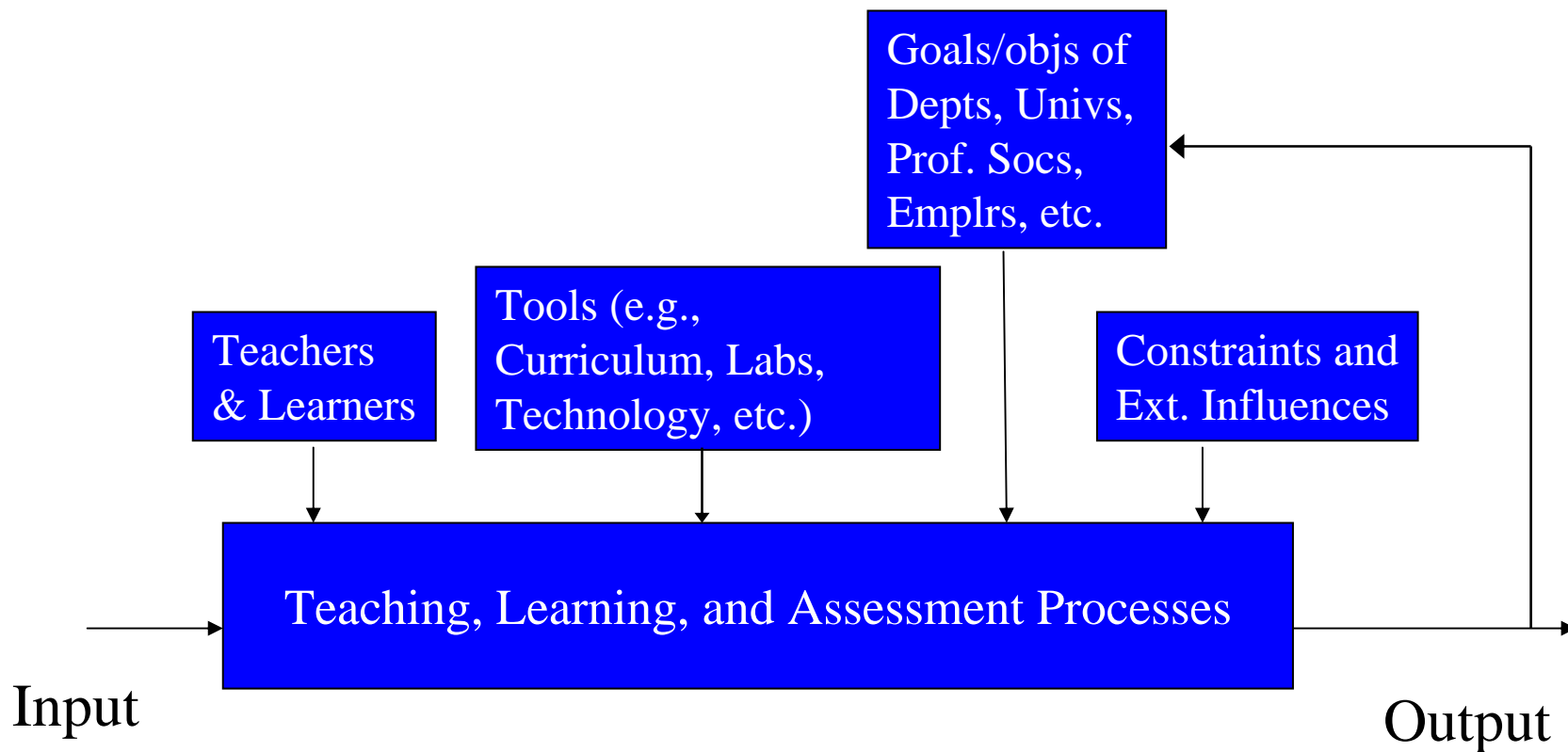
CASEE Objectives

Working collaboratively with key stakeholders, CASEE

- **Encourages research on engineering education, and**
- **Disseminates and encourages use of research findings.**

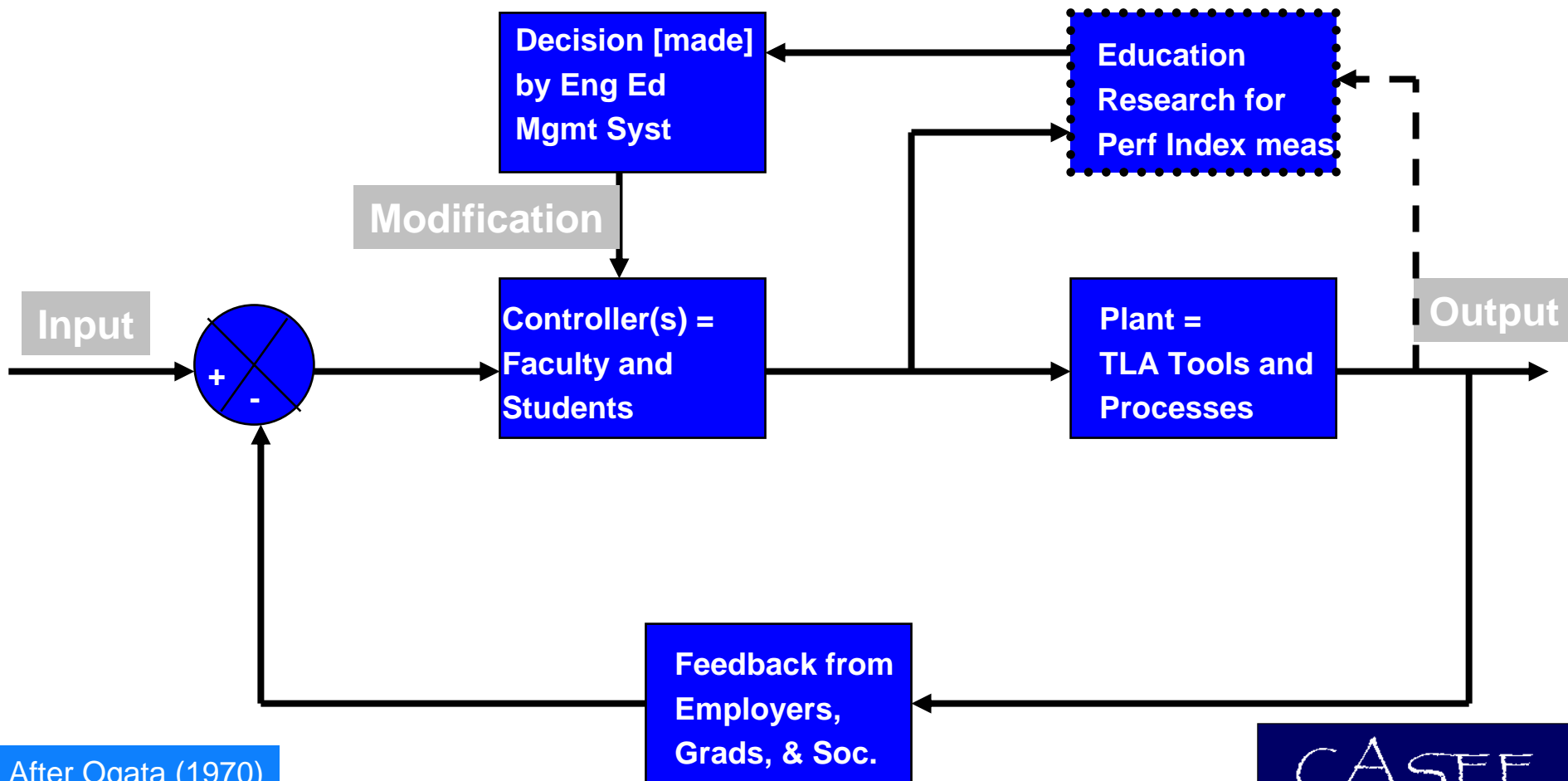


CASEE Research Examines the Engineering Education System





Education Research Enables Adaptive Control of Engineering Education Systems



After Ogata (1970)

CASEE



CASEE Goal

Excellence in engineering education:

- Effectiveness
 - » (e.g., Twice the depth of learning)
- Engagement,
 - » (e.g., Twice the diversity)
- Efficiency
 - » (e.g., Half the attrition)



Research Thrust Areas

- 1. Bodies-of-knowledge**
- 2. Diversity**
- 3. Cost-effective and time-efficient instruction and learning**
- 4. Assessment**



Key Lessons to Learn

- 1. Scale-up of pilots**
- 2. Transfer of knowledge**
- 3. Achieving sustainability**



CASEE Advisory Committee

● **Chair: Alice Gast (NAE), MIT**

● **Alfredo de los Santos**

Arizona State Univ

● **Diane Ebert-May**

Michigan State Univ.

● **Lawrence Evans (NAE),**

AspenTech

● **Domenico Grasso**

Smith College

● **Sherra Kerns**

Olin College

● **C. Judson King (NAE)**

U of California System

● **C. Bradley Moore (NAS)**

Northwestern U

● **Willie Pearson**

Georgia Tech

● **George Peterson**

ABET

● **Edward Redish**

Univ of Maryland

● **Lee Shulman**

Carnegie Foundation

● **Karl Smith**

Univ of Minn.

● **Michael Teitelbaum**

Sloan Foundation

● **Alan Tucker**

SUNY-Stony Brook

● **Stephen Director (NAE),**

Univ of Michigan, ex-officio



Organizational Affiliates

Research Community

- AZ State COE
- Colorado Schl of Mines
- CPST
- Georgia Tech WST
- TX A&M TEES-EAD
- Penn State
- Berkeley COE
- MIT – DUE/TLL
- NSF CAEE CLT
- NSF VaNTH ERC
- Stanford COE
- U of WA COE

Implementation Network

- ASCE BOK Cur Cmte
- Auburn LITEE
- Cornell COE
- Georgia Tech COE
- Iowa State U COE
- Purdue Schls of Eng
- SUNY Stony Brook
- Texas A&M Univ COE
- Univ of Mich COE
- U of TX COE

Dissemination Channels

- Rose Hulman
- Foundation Coalition
- Auburn
- NETI



Senior Fellows

Founding Fellows

- Myron Tribus, NAE
- Don Evans, AZ State
- Karan Watson, TAMU

Walter L. Robb Fellow

- Phil Wankat, Purdue

Scholar-in-Residence

- Myles Boylan, NSF

Research Areas

Bodies-of-Knowledge

Assessment

Diversity

Effective and Efficient T&L

Dissemination and Diffusion



Research Process

Activity: How would you summarize the engineering research process and the fundamental principles that guide that process?

(e.g., the scientific research process is hypothesis → experiment → observation → analysis → hypothesis)



Education Research Principles

- **Pose significant questions that can be investigated empirically,**
- **Link research to relevant theory,**
- **Use methods that permit direct investigation of the question,**
- **Provide a coherent and explicit chain of reasoning,**
- **Replicate and generalize across studies, and**
- **Disclose research to encourage professional scrutiny and critique.**



Researchable(?) Questions in Engineering Education (1/2)

- How might we close the gap between engineering practice and education?
- How might we increase the graduation rate at the undergraduate and graduate levels?
- How might faculty increase the quality of their instructional skills?



Researchable(?) Questions in Engineering Education (2/2)

For a given set of actors and circumstances:

- **How is engineering knowledge most effectively acquired?**
- **How is engineering knowledge most effectively internalized/integrated?**
- **How is engineering knowledge most effectively applied?**
- **How is engineering knowledge most effectively transmitted?**



Is there a Role for ECE Faculty?

- **Unique knowledge of the profession and how it's knowledge is transmitted.**
- **Access to peers and students.**
- **Past activities imply thought about “what to teach” and “how to teach it”.**



Can ECE Faculty also be Education Researchers? (1/3)

- **The physics community has built the theoretical underpinnings to support education research efforts, can/should ECE faculty do likewise?**

Concerns were fundamental misconceptions held by very bright students and declining enrollments.



Can ECE Faculty also be Education Researchers? (2/3)

- **Sources of support exist (NSF – BEE, ASA, ROLE, HSD, SLC; Sloan Fdn, etc.)**
- **Presentation venues exist**
 - Journals (IEEE Transactions on Education, JEE, IJEE, IJEEE, etc.)_
 - Conferences (Frontiers in Education, etc.)
- **Will the Engineering community accept education research as “research” and not simply another form of “teaching”?**



Can ECE Faculty also be Education Researchers? (3/3)

- **Two Oversimplified Examples:**
 - Ed Ernst had distinguished “traditional” career at the University of Illinois, then became a tireless advocate for enhancing engineering education from within ABET, IEEE, NSF, etc.
 - Eli Fromm was an engineer in industry, Congressional staffer, NSF program officer, founding editor of the Journal of Eng. Ed., visiting scientist in the PA state legislature, Drexel VP Research and Grad Studies, and Drexel VP for Educational Research and winner of Gordon Prize.
- **Does this imply need to focus on post-tenure full professors or “imports”?**



If ECE Education Researchers- Implications for ECE?

- **What are your concerns and how could they be addressed?**
 - Implications for departmental operations, especially for faculty workload and rewards?
 - Implications for departmental reputation?
 - ???



If ECE Education Researchers- Implications for Ed. Research?

- How might the Engineering community build the capacity for the conduct, review, and communication of rigorous education research? Until such capacity is built, how do we manage the transition; that is, who judges the early efforts?
- How is a community of researchers best built and maintained? Can this be done effectively if done only on nights and weekends? Is there room for a single specialist in a large department?



Results of Survey of 28 CE Chairs

(92% male; 93% White – 7% not reporting) at 23 public and 5 private institutions (82% docs)

- **85% agreed changes needed in scope, sequence, and delivery of CE curriculum.**
- **80% believed education research could provide some benefit to CE education.**
- **96% agreed CE faculty should influence the conduct and interpretation of such research**
- **53.5% believed any participating CE faculty should be post-tenure**
- **71.3% believed their department could accommodate a CE faculty member during education research**
- **Greatest concerns were impact on department's workload (43%) and research output (39%)**



Expanding the Conversation

- **How might this conversation be productively continued?**