

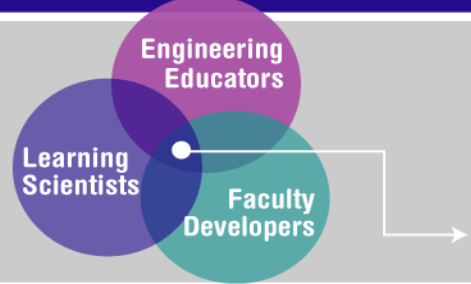
Conducting Rigorous Research in Engineering Education

The Community of Practice



What IS Rigorous Research in Engineering Education?

- **Ruth Streveler**
 - Purdue University
- **Ron Miller**
 - Colorado School of Mines
- **Karl Smith**
 - Purdue University
 - University of Minnesota



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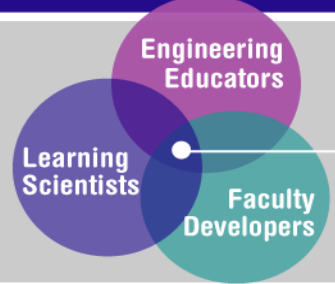
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Objectives

- **Compare and contrast engineering and educational research**
- **Use the Six Principles of Scientific Research in Education to construct a definition of rigorous engineering education research**





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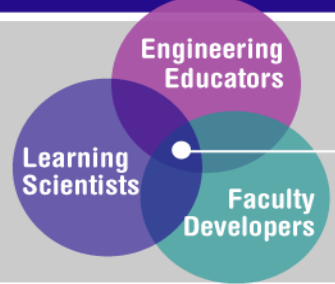
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Engineering Research

- ? What are the guiding principles for rigorous technical research in your engineering discipline?
- Take a few moments **individually** to list the qualities and characteristics of rigorous research in engineering.
- **As a group**, develop a list of research standards in Engineering.

	Engineering Research	Educational Research
Purpose		
Subject of Inquiry		
Research Context		
Values		
Theoretical Perspectives		
Research Methods & Tools		
Measurement Techniques		
Threats to Validity		
Ethical Considerations		
Evaluation of Research PROCESS		
Evaluation of Research OUTCOMES		



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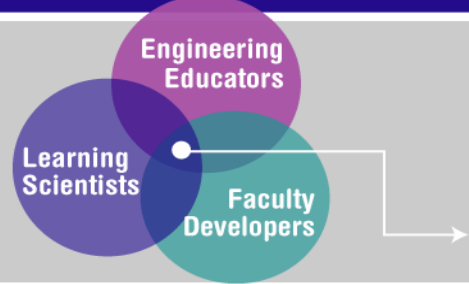


Education Research

? What are the guiding principles for rigorous research in Engineering Education?

→ Take a few moments **individually** to list the qualities and characteristics of rigorous engineering education research.

→ **As a group**, develop a list of research standards in Engineering Education research.



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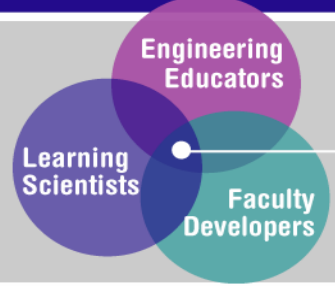
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Guiding Principles for Scientific Research in Education

1. **Question:** pose significant question that can be investigated empirically
2. **Theory:** link research to relevant theory
3. **Methods:** use methods that permit direct investigation of the question
4. **Reasoning:** provide coherent, explicit chain of reasoning
5. **Replicate and generalize** across studies
6. **Disclose** research to encourage professional scrutiny and critique

National Research Council, 2002



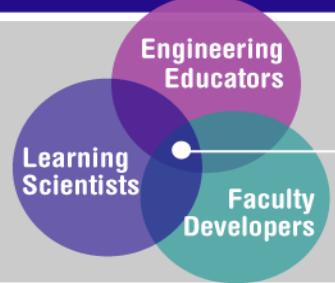
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1. Significant questions that can be investigated empirically

- **Who would care about your results?**
- **What data will you need to gather to answer your question?**



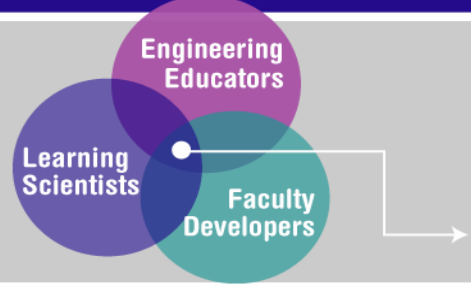
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2. Link research to relevant theory

- **Learning theories**
- **Psychometrics (measurement)**
- **Adult Development**
- **Moral Development**
- **Socialization**
- **Cognition**
- **Expertise**
- **Social context of education**



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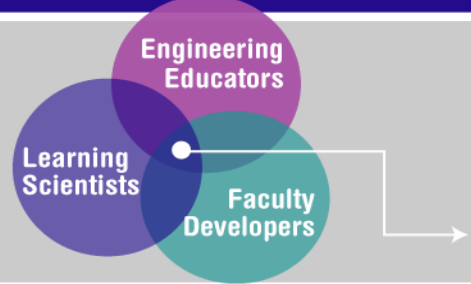
3. Methods for Direct Investigation (examples)

Quantitative methods

- Tests
- Surveys & questionnaires (defined response)
- Faculty or peer ratings

Qualitative methods

- Focus groups
- Interviews
- Observations



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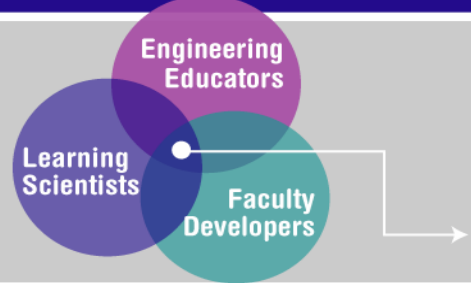
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4. Reasoning

What makes a convincing argument

- **Theoretical foundation - results fit with expectations**
- **Strength of observed relationships**
- **Elegance - conciseness, simplicity, explanatory power**
- **Elimination of alternative explanations**
 - **Study design**
 - **Confounding variables**



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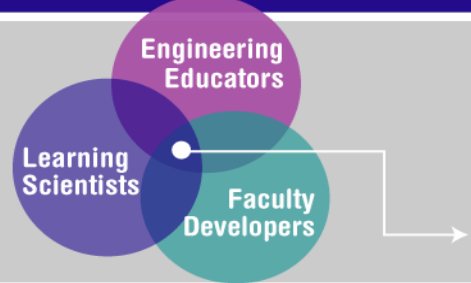
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5. Replicate and Generalize

Setting the results in a larger context

- **MUST** know the literature
- **Strict replication is rare in educational research**
- **Replication with extension - to new topic, setting, learners, etc.**



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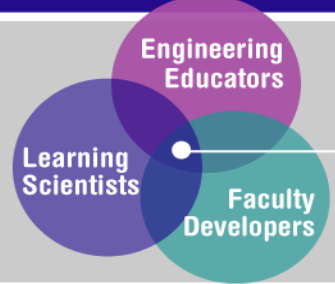
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6. Disclose

- **Scholarly journals**
- **Conference presentations**

- **Peer-review is the core issue**
 - **One of the few quality controls we have**



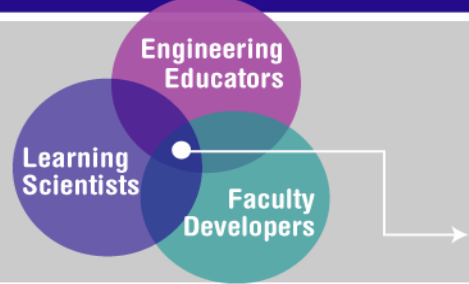
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Informal -- Formal Research

- Take a few moments **individually** to review the matrix handout
 - Choose 1-2 categories and improve the descriptions shown in the matrix
- Turn to a neighbor and compare your critiques
- Be prepared to report to the full group



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- **Project website**
 - www.mines.edu/research/cee/ND.htm