


*We Can Do Better:
Going from Research to Impact in Engineering
Education*




*Jeremi S. London, Ph.D.
EEC Grantees Conference – Keynote Address
October 31, 2017*

If you could use an image to depict impact, what would it be? (Use dashes between multiple words.)

 Respond at PollEv.com/jeremilondon882

 Text **JEREMILONDON882** to **22333** once to join, then text your message

 No responses received yet. They will appear here...

Total Results: 0

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ASU – Tempe Campus



ASU – Polytechnic Campus



Learning Innovation Showcase, ASU Institute for the Science of Teaching and Learning, Tempe, AZ (2015)

Welcome to RISE

The Research & Impact in STEM Education (RISE) Research Group uses mixed methods research designs to investigate the impact of STEM education research, and strives to make an impact on STEM education through research.

[LEARN MORE →](#)

THE LATEST:

Dr. Jeremi London will be giving a keynote on October 31, 2017 at the 2017 NSF EEC Grantees Conference. [More here.](#)

Recent NSF award: [See who it is!](#)



NSF Summer Scholars (2011)

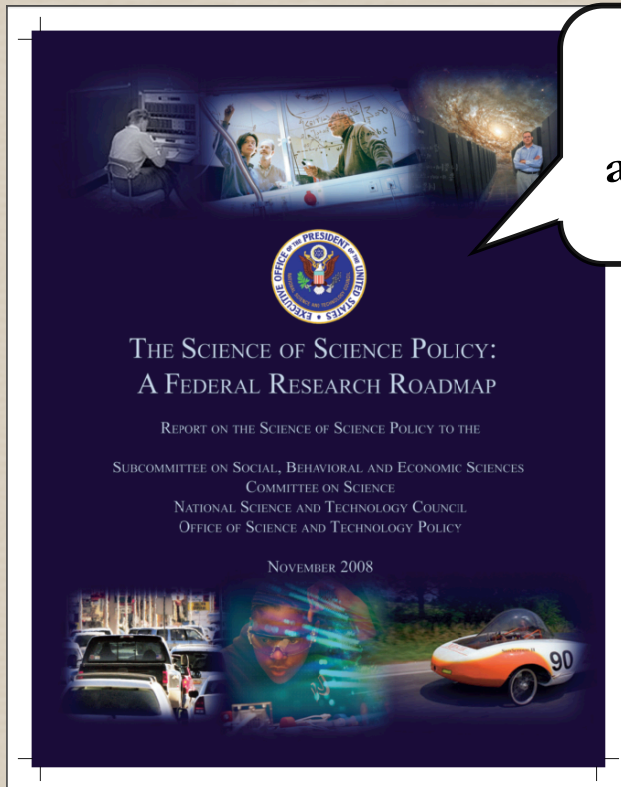




Q1: What does it mean for (my) research to have impact?

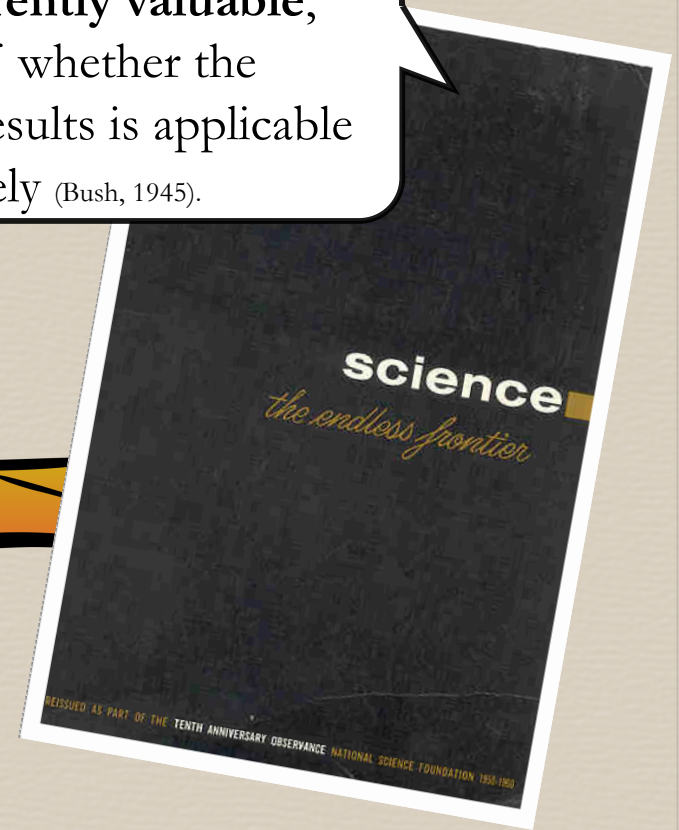
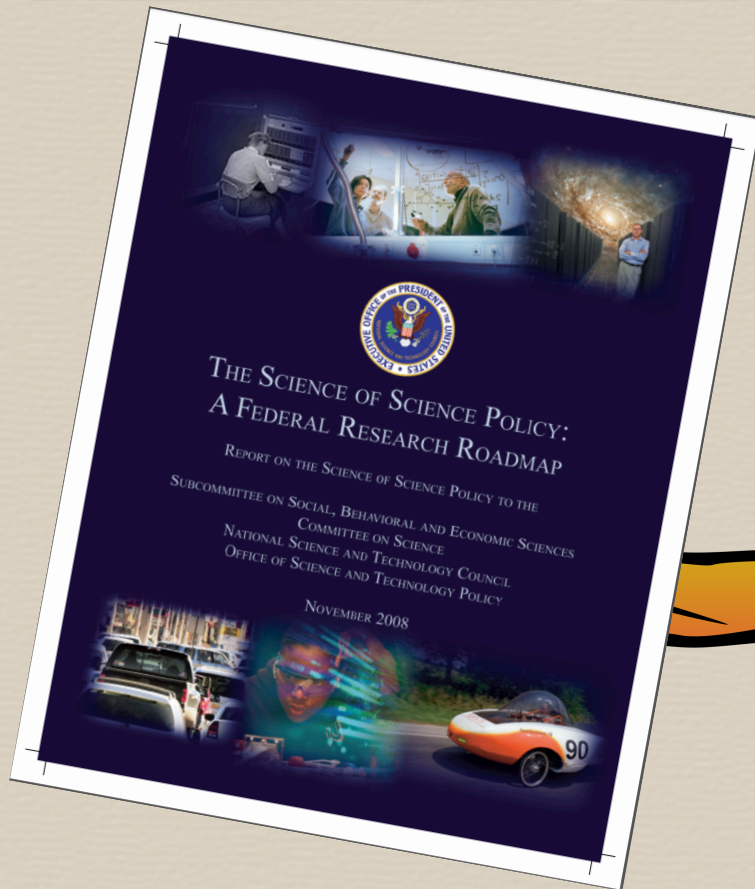
Shifts in Interest on Understanding Impact

Goal: To provide a rigorous basis from which policy makers and researchers can **assess the impact** of the Nation's scientific and engineering enterprise (NSTC, 2008).



Shifts in Interest on Understanding Impact

Science is **inherently valuable**, regardless of whether the knowledge that results is applicable immediately (Bush, 1945).



Shifts in Interest on Understanding Impact

Reasons for the change:

1. Better infrastructure supports better & decision-making
2. Stiff economic climate
3. Oversimplified view of the role of research in education
4. ...and many more.

(Bornmann, 2012; NRC, 2002; NSTC, 2008).

The research that will continue to be supported is research that demonstrates **IMPACT**.

EMBO
reports

science @

Measuring the societal impact of research
Research is less and less assessed on scientific impact alone—we should aim to quantify important contributions of science to society

Lutz Bornmann

Even before the Second World War, governments had begun to invest public funds into scientific research with the expectation that military, economic, medical and other benefits would result. This trend continued during the war and throughout the Cold War period, with increasing levels of public money being invested in science. Nuclear physics was the main beneficiary, but other fields were also supported as their military or commercial potential became apparent. Moreover, research came to be seen as a valuable enterprise in and of itself, given the value of the knowledge generated, even if advances in understanding could not be applied immediately. Vannevar Bush, science adviser to President Franklin D. Roosevelt during the Second World War, established the inherent value of basic research in his report to the President, Science, the endless frontier, and it has become the underlying rationale for public support and funding of science.

However, the growth of scientific research during the past decades has outpaced the public resources available to fund it. This has led to a problem for funding agencies and politicians: how can limited resources be most efficiently and effectively distributed among researchers and research projects? This challenge—to identify promising research—spurred both the development of scientific research and the development of the societal impact assessment. Although the first set of measures have been relatively successful and have been used to determine the quality of research, there are still many challenges to determine the quality of research.

the societal impact of research. The impact of applied research, such as drug development, IT or engineering, is obvious but the benefits of basic research are less so, harder to assess and have been under increasing scrutiny since the 1990s [1]. In fact, there is no direct link between the scientific quality of a research project and its societal value. As Paul Nightingale and Aisling Scott of the University of Sussex's Science and Technology Policy Research Centre have pointed out, "research that is highly cited or published in top journals may be good for the academic discipline but not for society" [2]. Moreover, it might take years or even decades, until a particular body of knowledge yields new products or services that affect society. By way of example, in an editorial on the topic in the British Medical Journal, editor Richard Smith cites the original research into aspirin as work that had "no measurable impact on health" [3]. He contrasts this with, for example, research into "the cost effectiveness of different incontinence pads", which is certainly not seen as high value by the scientific community, but which has had an immediate and important societal impact.

The problem actually begins with defining the "societal impact of research". A series of different concepts has been introduced: "stream research" [4], "societal benefits" [6], "public activities" [4], "societal benefits" [6], "public value" [7], "knowledge transfer" [8] and "societal relevance" [9,10]. Yet, each of these concepts is ultimately concerned with measuring the social, cultural, environmental and economic returns from publicly funded research. There are also no criteria or methods that

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Given the variability and the complexity of evaluating the societal impact of research, Barteld van der Meulen at the Rathenau Institute for research and debate on science and technology in the Netherlands and Alek Rip at the School of Management and Governance of the University of Twente, the Netherlands, have noted that "it is not clear how to evaluate societal quality, especially for basic and strategic research" [5]. There is no accepted framework with adequate datasets comparable to work with adequate datasets comparable to, for example, Thomson Reuters' Web of Science, which enables the calculation of bibliometric values such as the h-index [12] or journal impact factor [13]. There are also no criteria or methods that

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the endless journey

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Three Difficulties Associated with Studying Research Impact

**Attribution:
Connecting
Impact with
Research or
the
Researcher**

**Assessment
& Evaluation
of Research
Impact**

**Interpreting
the Impact
of Research**

London, J., Cox, M. (2015). The Beginning of a Scholarly Conversation on Impact in Engineering Education: A Synthesis of the Three Major Difficulties Associated with Studying Research Impact. *Proceedings of the Australasian Association for Engineering Education Annual Conference, Victoria, Australia*. [Best Overall Paper Award]

Defining Research Impact

Impact is a **time-sensitive** interpretation of the **extent to which change** has happened **in and beyond** the context in which the change originated.



Scientific Impact: Advances in reliable knowledge (theories, methods, facts, models) that primarily influence academic communities

(Bornmann & Marx, 2014; Donovan, 2011; Godin & Doré, 2005)

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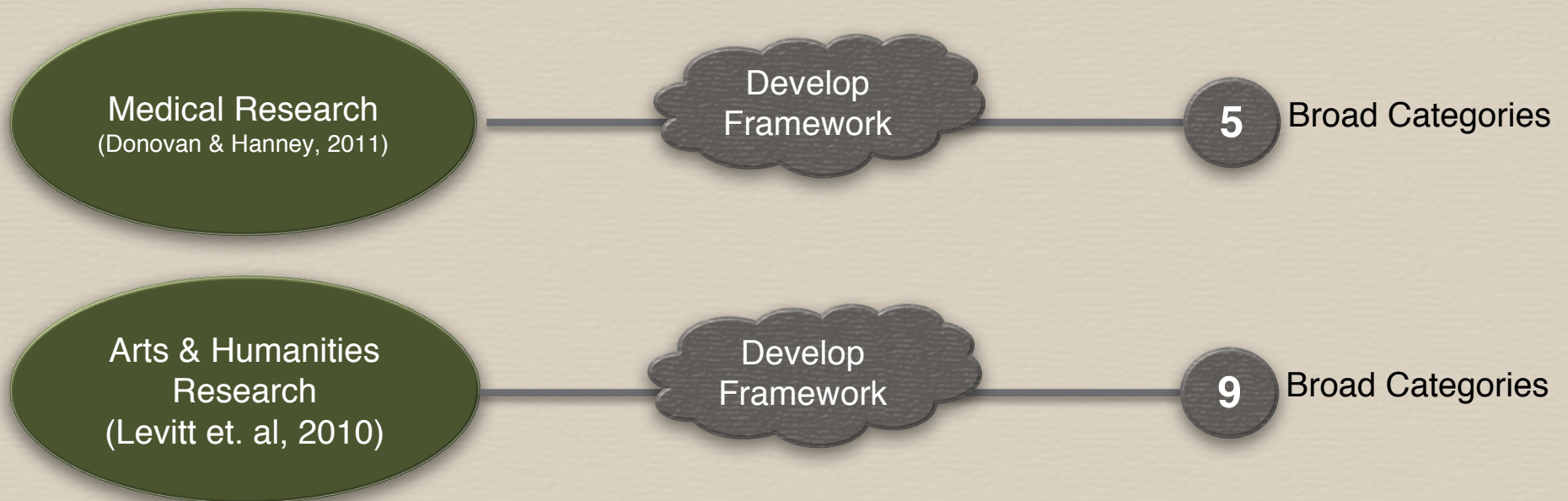
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Disciplinary Perspectives on Impact

Framework: “exposition of a set of assumptions, concepts, values, and practices that constitutes a way of understanding the research within a body of knowledge”



Disciplinary Perspectives on Impact

Informal STEM
Education &
Outreach R&D
Framework
(Allen et al., 2008)

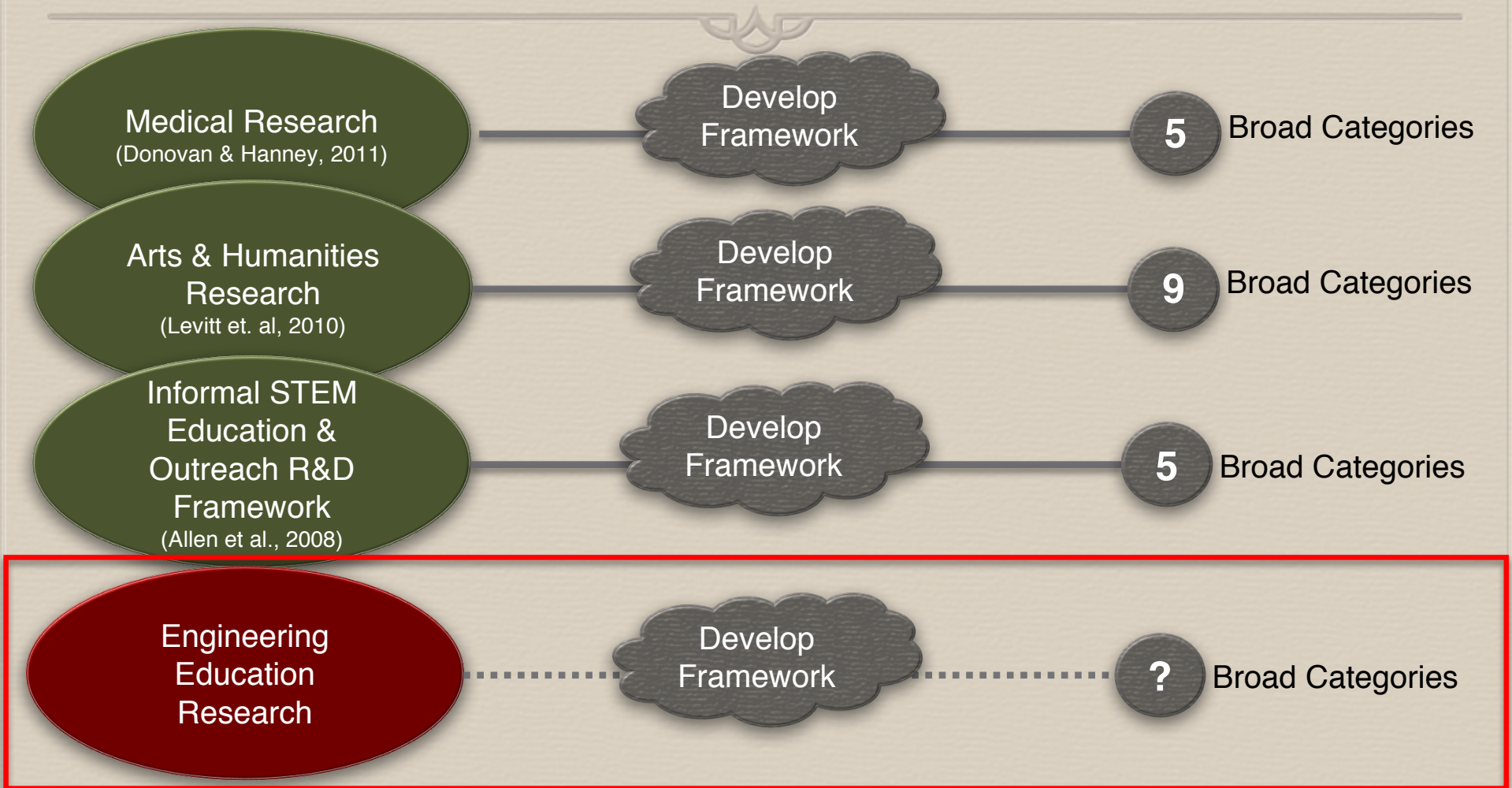
Develop
Framework

5

Broad Categories

- 1) Awareness, knowledge, or understanding of STEM concepts, processes, or careers
- 2) Engagement or interest in STEM concepts, processes, or careers
- 3) Attitudes towards STEM-related topics or capabilities
- 4) Behaviors related to STEM concepts, processes, or careers
- 5) Skills based on STEM concepts, processes or careers

Disciplinary Perspectives on Impact





Q2: How can we collectively characterize the impact of engineering education research?

Acknowledgements

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Any opinions, findings, conclusions, recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the National Science Foundation.

∞ Collaborator: Dr. Maura Borrego (UT-Austin)



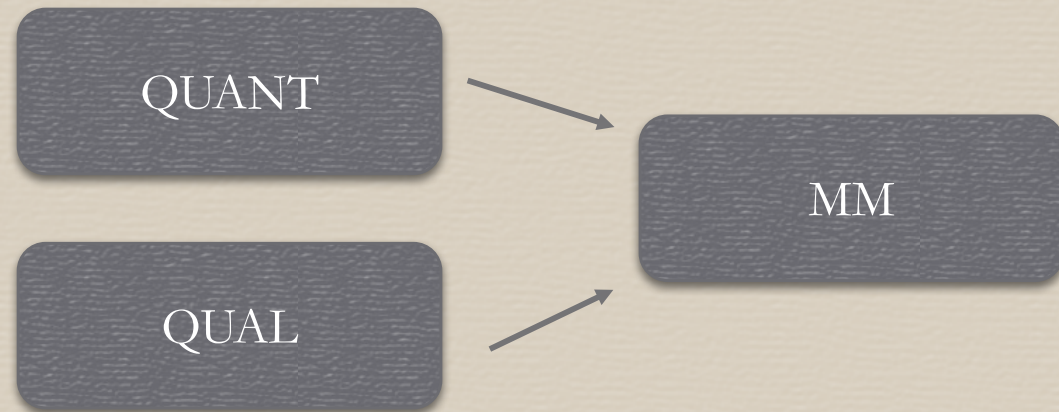
Project Overview



- ❧ Develop an engineering education research impact framework that is informed by the community and internationally inclusive
- ❧ Describe researchers', administrators, and practitioners' insights on the role of research in engineering education practice

Research Design & Questions

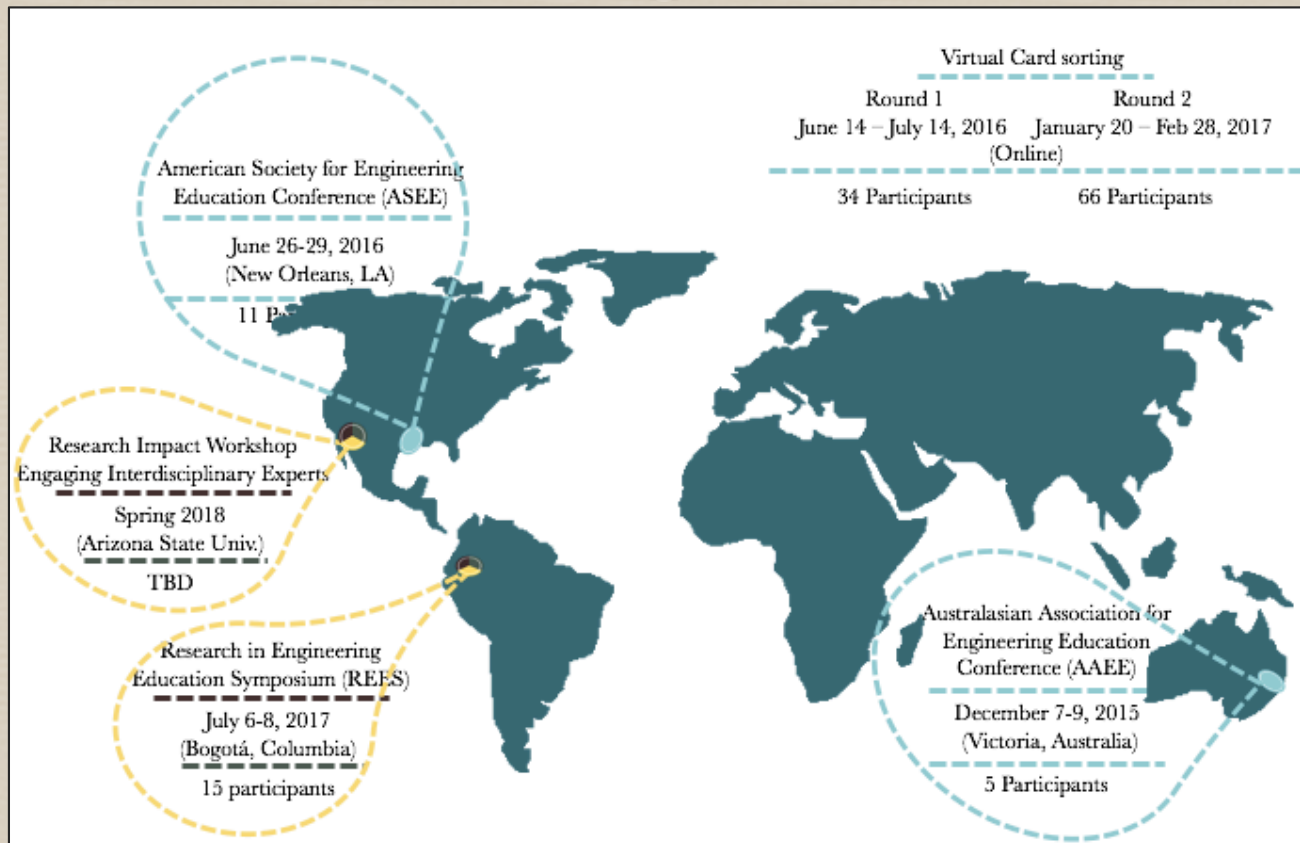
Convergent Parallel Mixed Methods Design (Creswell, Plano-Clark, 2011)



RQs:

- ❧ **What is a meaningful and shared description of the impact of engineering education research, according to engineering education researchers? (QUANT)**
- ❧ How do different engineering education practitioners –including non/tenure-track faculty, department chairs, co-curricular support personnel, engineering deans and engineering staff advisors— perceive the impact of engineering education research? (QUAL)
- ❧ To what extent does the interview findings with practitioners agree with and expand the data used to develop a framework characterizing the impact of engineering education research? (MM)

EER Impact Community-Informed Framework



Messick's Theory of Instrument Development (Messick, 1995, 1996; Purzer, Cardella, n.d.)

Card Sorting Activity

29

Increase in the number of publications authored or coauthored by translational researchers

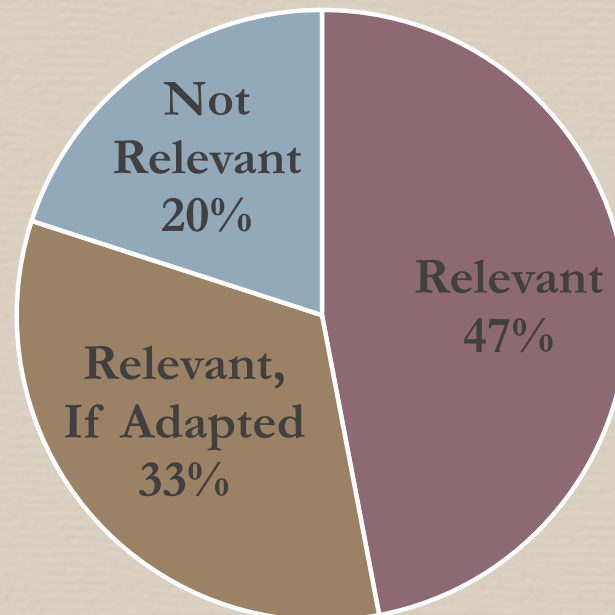
39

Increase in media coverage for articles or projects involving the unit's researcher(s)

**Impact
Framework**

Preliminary Results

Overall Categorical Distribution (n = 125 cards)



London, J., Patel, P., Borrego, M. (2017). Toward a Shared Meaning of the “Impact” of Engineering Education Research: Initial Findings of a Convergent Parallel Mixed Methods Study. *Paper presented at the 2017 American Society for Engineering Education Annual Conference*, Columbus, OH.

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Preliminary Results

Relevant to Engineering Education

Increase in the stock of scholarly resources that advance knowledge and understanding

Development of educational resources (e.g., curricula, pedagogical tools, training materials, teaching instruments)

Creation of an intellectual climate that influences decision making, policy development, and programs around a variety of issues that affect citizens (e.g., education, national security).

Barriers to efficiencies in the research process are identified and strategies for overcoming those barriers are developed (e.g., shortening the time to IRB approval, ease of completion of required documents)

Not Relevant to Engineering Education

Findings and discoveries from bench science are incorporated into studies involving animals or humans

Relevant, if Adapted

Medical practice becomes more evidence based

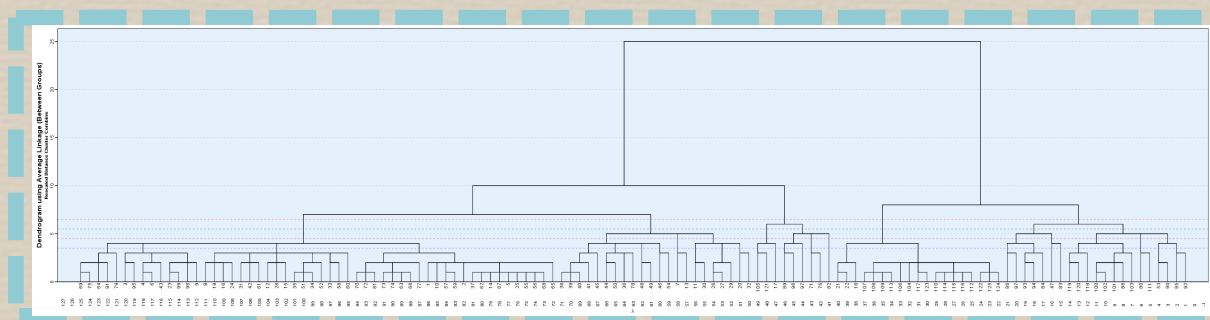
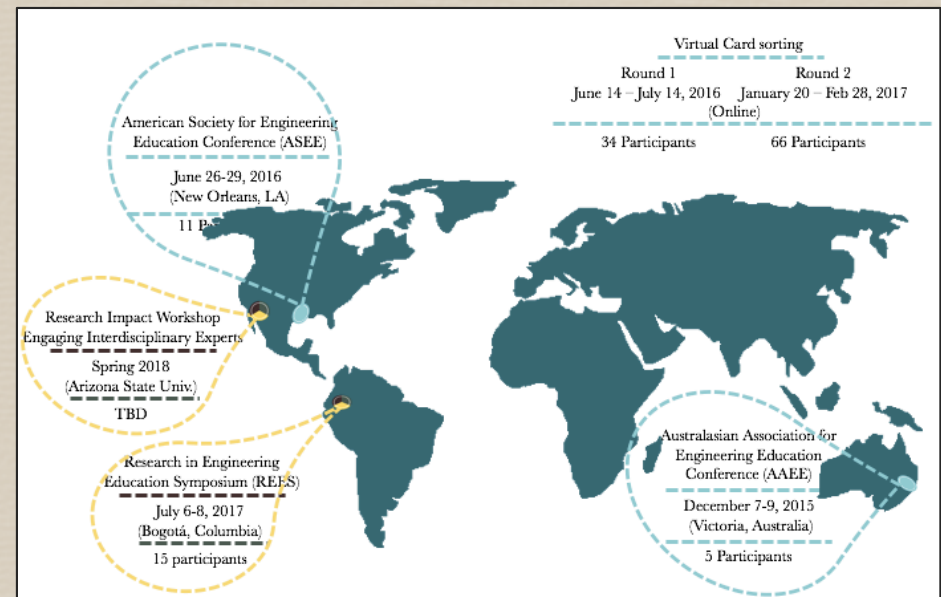
Self-efficacy and empowerment among health care consumers increases

Improvements in the delivery of effective and efficient health care services are made

EER Impact Community-Informed Framework

To Recommend Workshop Participants:
<http://tinyurl.com/yc6pgmcz>

To Stay Informed about Findings:
www.Impactfulresearch.com



Preliminary Hierarchical Cluster Analysis Results

Anticipated Impact



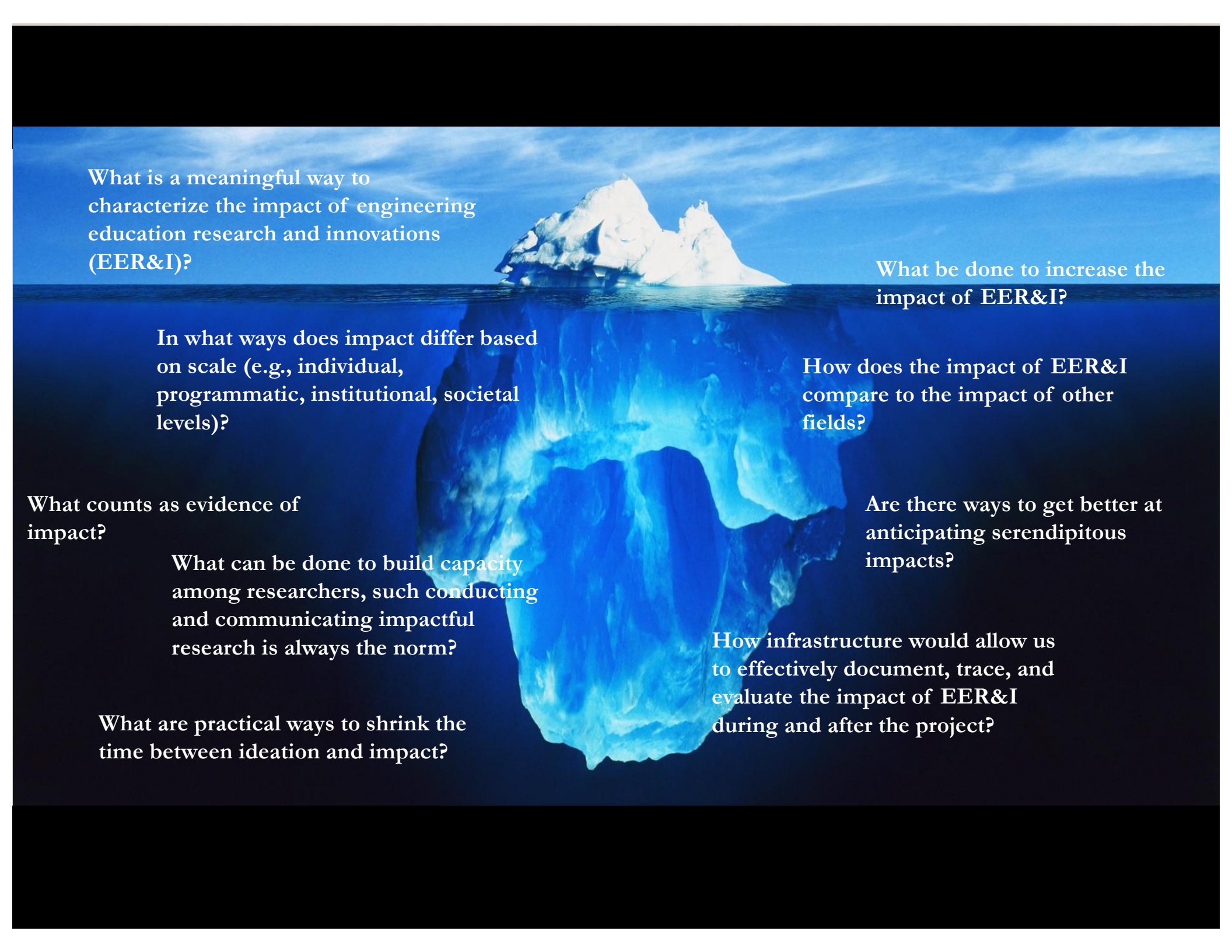
Scientific Impact: Advance the scholarship of impact by developing a framework that is robustly relevant to a wide range of engineering education research and innovations (EER&I).



Contextual Impact: Facilitate the use of shared language among engineering education stakeholders around the world, and clarity about what the impact of EER&I looks like. Provide a strong basis for discussions on how research *should* influence practice.



Societal Impact: Engaging the global engineering education research community in the framework development positively impacts awareness, quality, robustness of usability/applicability, dissemination and buy in. This should lead to more realized impacts of EER&I.



What is a meaningful way to characterize the impact of engineering education research and innovations (EER&I)?

What be done to increase the impact of EER&I?

In what ways does impact differ based on scale (e.g., individual, programmatic, institutional, societal levels)?

How does the impact of EER&I compare to the impact of other fields?

What counts as evidence of impact?

Are there ways to get better at anticipating serendipitous impacts?

What can be done to build capacity among researchers, such conducting and communicating impactful research is always the norm?

How infrastructure would allow us to effectively document, trace, and evaluate the impact of EER&I during and after the project?

What are practical ways to shrink the time between ideation and impact?



Q3: How can I use this awareness to engage in activities that lead to greater impact?

From Research to Impact...



SP '16: EGR 280



SP '17: EGR 280

FA '16: KEEN
Professorship Mini-grant

THE
KERN FAMILY
FOUNDATION

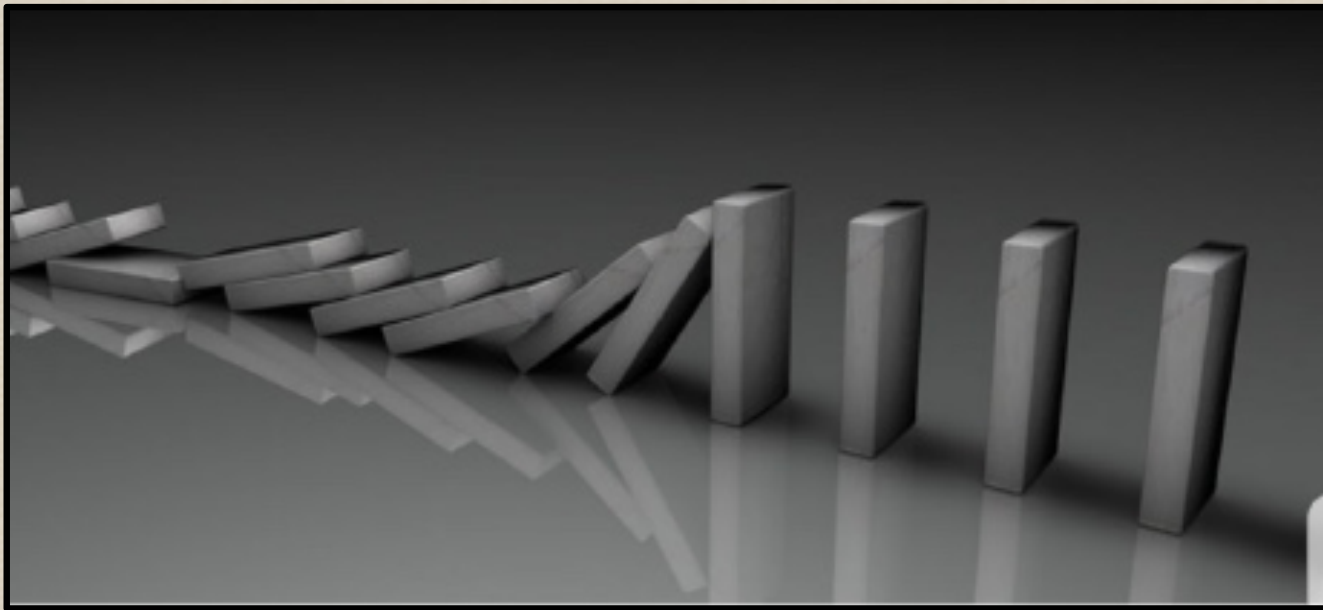
FA '17: Teaching Award
& FIE Proceeding




Work in Progress-- Cultivating an Entrepreneurial Mindset in an Undergraduate Engineering Statistics Course Using Project-based Learning




How will you make an impact?





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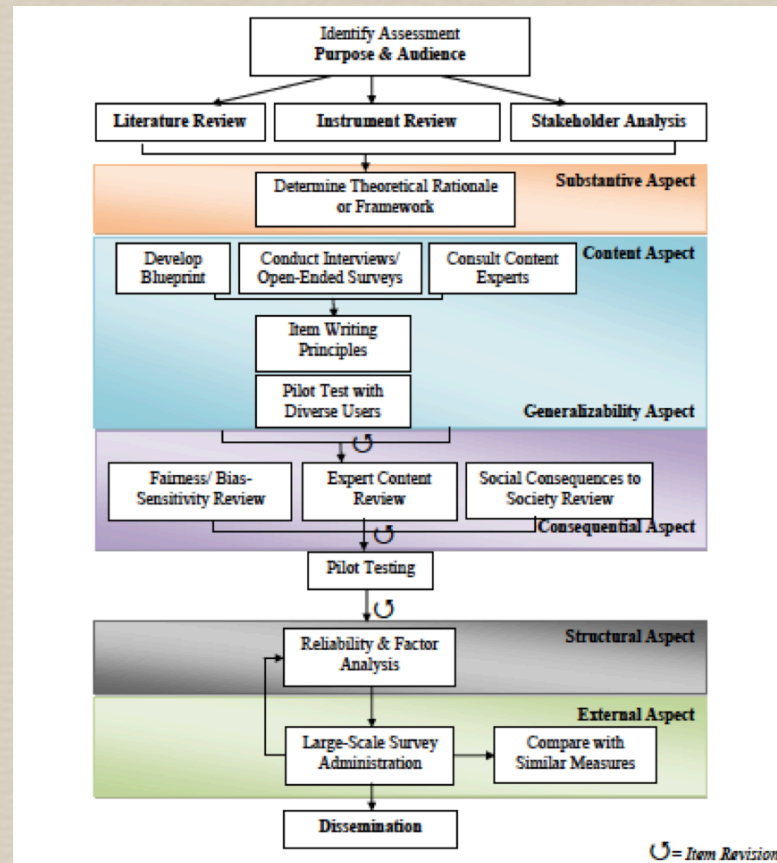
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FYI - Theoretical Lens

Messick's Unified Theory of Instrument Development



(Purzer, Cardella, n.d.)