(How much) can we reasonably expect research to improve teaching and learning?

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What counts as the best research?
What are our default knowledge goals?

• How people learn, in a generalizable way, that allows reasonable predictions
• Known-good techniques for teaching and ways to respond to learners
• What works among a menu of interventions
Common Guidelines for Educational Research (ED, NSF)
Common Guidelines taxonomy of research types in education

1. Foundational research (methodological and pure research)
2. Early-stage or exploratory research (correlational studies)
3. Design and development research (formative evaluation and iterative refinement)
4. Efficacy research (outcomes under ideal circumstances)
5. Effectiveness research (outcomes under typical circumstances)
6. Scale-up research (outcomes across real world circumstances)
What is our default action model?

- Research on educational psychology
- Design interventions
- Evaluate interventions
- Disseminate
- Repeat

Another framing:
- Causal research on theories of learning
- Evaluation research on instructional designs (constrained by theories of learning) “What works”
What are our assumptions underlying the WWC criteria?

- Universality
- Replicability
- Severability (often implemented through linear modelling, although not always)
- Causal claims are the ones that matter
Medical research model

• Basic Research
• Treatment development
• Randomized, blinded clinical trials
• Efficacy data
• Adoption and dissemination
Challenges in the medical model

- Interaction effects
- Individual differences
- Treatment replicability
- Blinding
- Efficacy without understanding can be dangerous
Additional educational challenges

• Individual differences, and interaction effects with individual differences (Cronbach, 1972)
• Culture as a core covariate, and product
  – Problems with ‘controlling for culture’
  – Replicability
  – Lack of universality
• Enactment
  – A curriculum is not a pill
  – Enactment is both contingent and requires judgment
• Technology exacerbates rather than solves these problems
Does multimedia help learning?

- 1998: 35 studies
- 1999: 46 studies
- 2005: 43 studies
- 2002: $10m, 10k students, 130 schools
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Answer: It Depends!
The Problem of Studying What’s Possible

• How do we study what’s best when we don’t even know what’s best looks like?
• How do we study things we don’t know how to make happen reliably?
• Invention vs. discovery
Simple Positivism vs. Interpretivism

• Dual challenge to traditional conception of research
• “Bias” (perspective) is not undesirable, it is inevitable, and must be incorporated into the work
• Some phenomena worth studying are not objectively in the world
What can we do about this?

• Understand what we are willing to trade off
  – Control for causal vs. correlational claims?
  – Global vs. local sciences?
  – Generalizability for applicability?
  – Replicability vs. contextualization?
  – Completeness vs Co-creation of change (Engestromm)?

• Understand what we really want vs. what we think we want
  – True rather than simple
  – Useful rather than all-encompassing
  – Embracing rather than ‘controlling’ the role of culture and perspective
  – Contested terrains vs top-down interventions (Engestromm)
Metrics of contribution?

• Can I claim to have produced more knowledge if my article is 1/10 as good but read by 10x as many people?

• Does writing a textbook that transforms the teaching of the discipline count as ‘knowledge production’?

• If I learn amazing things, synthesize them as nobody has done before, and use them to do stuff, does that count as a contribution to knowledge?
Metrics of contribution?

• Can I claim to have produced more knowledge if my article is 1/10 as good but read by 10x as many people?
  – Should a class count more if it’s larger? What about a MOOC?

• Does writing a textbook that transforms the teaching of the discipline count as ‘knowledge production’?
  – What if you transform the teaching without a textbook, like Itten?

• If I learn amazing things, synthesize them as nobody has done before, and use them to do stuff, does that count as a contribution to knowledge?
  – What if it’s dance performance? Architecture? Journalism?
Pasteur’s Quadrant (Stokes)

To what extent does basic understanding compete with application? Or reinforce it?

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<tr>
<th>Pure research (goal of understanding)</th>
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Neils Bohr
Louis Pasteur
Thomas Edison

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Low Applicability
High Applicability
Making Social Science Matter (Flyvbjerg, after Socrates)

- Episteme ἐπιστήμη
  - logicodeductive
- Techne τέχνη
  - craft, praxis
- Phronesis φρόνησις
  - values, what is proper and right, good judgment
Contingency

• “Finally, I thought I began to see in the problem of artificiality an explanation of the difficulty that has been experienced in filling engineering and other professions with empirical and theoretical substance distinct from the substance of their supporting sciences. Engineering, medicine, business, architecture, and painting are concerned not with the necessary but with the contingent—not with how things are but with how they might be—in short, with design. The possibility of creating a science or sciences of design is exactly as great as the possibility of creating any science of the artificial. The two possibilities stand or fall together.”

—Herb Simon
Sciences of Design

• “The contingency of artificial phenomena has always created doubts as to whether they fall properly within the compass of science. Sometimes these doubts are directed at the... difficulty of disentangling prescription from description. This seems to me not to be the real difficulty. The genuine problem is to show how empirical propositions can be made at all about systems that, given different circumstances, might be quite other than they are.” — Herb Simon

• “The conjunction of problematic and determinate characters in nature renders every existence, as well as every idea and human act, an experiment in fact, even though not in design. To be intelligently experimental is but to be conscious of this intersection of natural conditions so as to profit by it instead of being at its mercy.” — John Dewey
Knowing as truth vs. knowing how to do
Design-based research

• Doing research (and making strong claims) through iterative design

• NOT
  – Doing research on designers (design studies)
  – Doing research on a design (evaluation, formative or summative)
  – Doing design through research (research-based design)
Canonical DBR method

• Identify initial draft of problem and context
• Map conjectures based on a design proposition
• Collect wide-ranging baseline data in context
• Work with partners in context to create and tailor design(s) for context
• Implement iteratively and collect data to test conjectures, understand context, and understand design. Continuously document designed intent, enacted design, and outcomes.
• As data comes in, adapt the design and the conjectures. (Retrospective analysis as appropriate)
• Begin process of tentative generalization
Conjecture mapping (Sandoval, 2013)

- Design propositions are of the form "Intervention of type X should have impact of type Y"
- DBR should test an "embodied conjecture"
- That conjecture has at least two degrees of freedom
  - Designed features ("embodiments") are intended to influence learning processes, which represents a "design conjecture"
  - Learning processes are intended to influence learning outcomes, which represents a "theoretical conjecture"
  - You can NEVER test these separately unless you believe embodiments deterministically influence outcomes
Implementing iteratively

• Sometimes iterations involve 'mid-course corrections'
• Usually, you treat each iteration as a quasi-experiment against baseline or against prior iterations
• Sometimes iteration takes place across contexts
• Much information is gathered; it is used opportunistically both to advance the research and the design assumptions
  – Data can serve as an 'early warning system' to orient the design activity
  – Data can ensure conceptions of context and design match reality
  – Implementation fidelity is a duty not to prior decisions, but to the spirit of the design (c.f., Brown 1992 "lethal mutations")
Evaluating Design Conjectures Against Data

• Improve understanding of how the design functions in context.
  – Use planned comparisons to test design conjectures
  – Check that intended and enacted design align
  – Use induction and post-hoc iteration analysis to disconfirm alternate explanations of what happened and why
Evaluating Design Conjectures Against Data

• The design is suspect
  – "We believe, but are not sure, that embodiment x represents the class of interventions X"

• The mediating processes are contingent
  – on context ("your mileage may vary")
  – on implementation (we were trying to make X and we did so through intervention x, x', x"...)

• Agency and perspective are acknowledged
  – the designer, and design partners in context, help ensure implementation fidelity at the cost of blinding and arms-length objectivity, so design assumptions, revisions, and rationale need to be documented and inspectable
What it means to do design research vs. design-based research

• Design itself is a knowledge producing activity (e.g., Simon, Argyris & Schön)
• Design research generally produce a refined conception of the problem, the design moves available to address the problem, and an idea of if and how something works in a particular context
• "The design" is an outcome
• Knowledge for designers is an outcome (tactics, strategies, tacit knowledge)
• Design research does not attempt to make generalized claims about the natural world or human psychology
• DBR is design in service of research
DBR is odd to many

- Things that make positivists nervous
  - Weaker objectivity of researchers
  - Changing protocols mid-experiment
  - Weaker claims about causation
  - Less generalized claims

- Things that make interpretivists nervous
  - Agency in context is not minimized but maximized
  - Researchers often try to make quasi-positivistic (more generalized) claims

- Things that make designers nervous
  - The designs may be deliberately suboptimal (to gain info)
  - Evaluation isn't always informing the design itself
DBR has important advantages

- Not just "if it works" but "how it works" findings
- Greater theoretical alignment (treatment validity, not just fidelity)
- Built-in applicability (action-oriented, and relevant to at least some contexts)
- May produce design achievements in addition to research achievements
- Can be shared by demonstration as well as explanation
- Really sensitive to unforeseen, but critical, variables ("dealbreaker" detection)
- Tends to build capacity for future work
Producing "your mileage may vary" research
(Kali & Hoadley forthcoming, after Nelson and Stolterman)
Challenges to traditional research stance

• Action vs understanding
• Predictive vs prescriptive theory
• Generalized vs localized sciences, contextual contingency
• Careful vs timely
• Esoteric vs exoteric
Reasonable ways to use educational research

• Understand that most of what traditionalists call rigorous educational research focuses on the limited portion that is universal, replicable, etc.
• Beware researchers bearing low effect size RCTs
• Interpretivist work is needed for questions that surround human experience or meaning
• "Usable knowledge" or professional judgment are another way to think about research outcomes
• Design sciences are an alternative to natural science models when exploring the prospective or contingent