Igniting Evidence-based Instructional Change…
One Classroom-based Evaluation at a Time

VITAL Workshop
December 5, 2013

Michael A. Posner
Associate Professor of Statistics
http://homepage.villanova.edu/michael.posner

Outline

• Scholarship of Teaching and Learning (SoTL)
• Guidelines for classroom-based assessment
  – Defining a goal
  – Measurements
  – Comparison/control groups
  – Statistical analysis
  – Qualitative analysis
  – Next steps
  – Dissemination of results
• Your teaching innovation / enhancement

My Background in SoTL

• We rely on evidence for our research, but not our teaching
  – Dale Berger, SMER Report, CAUSEmos Clusters
  – What if we trained airline pilots like we trained teachers? (Laboy-Rush, 2012)
• Integrate research, teaching, and service
  – Valued for tenure/promotion/evaluation?

Have you done classroom-bas

Text a CODE to 37607

| Yes, I have published in a DBER/ERJ | 786755 |
| Yes, but I have not published | 786756 |
| Yes, casually but not formally | 786757 |
| Nothing...yet! | 786758 |

What is Not Evidence-based Education Research (SoTL)?

• I gave students a video to watch
  – …and two of them told me they loved it!
  – “The plural of anecdotle is not data”
• I tried a new active learning technique
  – …and students scores on a post-test were higher than
  their scores on a pre-test
  – Thisi hopefully happened anyway!
  – How is it different than with another technique?

What is SoTL?

• SoTL is an evidence-based way…of creating a “sustained culture of inquiry about teaching and learning” (Maki)…Teaching can always become more effective and learning more significant and enduring. Growth in students and their learning is the life-juice of being a teacher. SoTL can stimulate those juices to flow in innovative, effective, and reflective ways.
• SoTL is not only the engagement by individuals in vigorous research on teaching and making that research public in building a body of knowledge, but also an attitude and a way of thinking about teaching. SoTL emphasizes that teaching is serious intellectual activity that can be both deeply personal and highly collegial. SoTL, as understood in an expansive sense, is perhaps the best way to improve teaching for student understanding. That is a lofty claim, yet one not only possible, but when done well, probable.

SoTL Commons: http://academics.georgiasouthern.edu/soctlconference/2013/
### The Pyramid of Classroom-based Research

- Collaborators?
- Funding?
- Refinements

- Individual researcher, classroom-based studies

### A Guiding Example - PARLO

- Attended workshop on Formative Assessment (2005)
- Young Women’s Leadership Charter School
  - Shared a set of learning outcomes with students (about 12 per semester course)
  - Assigned proficiency-based grades (HP, P, NYP)
  - Allowed students to resubmit (for full credit)
  - Great outcomes
- I was inspired!
- We named it PARLO (Proficiency-based Assessment and Reassessment of Learning Outcomes) and I tried it in my classes
- SERJ article in 2011 and $2.4m NSF grant

### Defining a Goal

- **Goal**
  - What are you attempting to achieve?
  - What problem are you trying to solve?
  - Go back and refine your goal!
  - Develop a theoretical framework that links how the variables relate and interact
  - Refine goal further through collaboration and peer feedback, literature overview
  - Reiterate this throughout the process and make decisions based on this goal
  - “How does making this choice help achieve the goal?”

### Defining a Goal - PARLO

- What is the impact on student attitudes and performance by allowing assignment resubmission?
- Based on Cognitive Learning Theory
  - Depth of Knowledge (Webb)
  - Successful international math ed (Stigler & Hiebert)
    - Time on task, making connections, struggle
    - Applying Cognitive Theory to Statistics Instruction (Greenhouse & Lovett)
  - Time on task, real-time feedback, knowledge is context-specific and learning must integrate new knowledge with existing beliefs, learning decreases as mental load increases

### Defining a Goal – You!

- The PARLO System
- Learning Outcomes
- Data Collection Methods
- Assessment & Procedures
- Reflection & Discussion

- Student Study Outcomes
  - Increased understanding of student learning
  - Increased engagement in student learning

- Parent Study Outcomes
  - Increased understanding of student learning
  - Increased engagement in student learning

- Teacher Study Outcomes
  - Increased understanding of student learning
  - Increased engagement in student learning

- Non-PARLO Factors
  - Poverty
  - Demographics
  - Previous performance

- Administrative Factors
  - Teacher beliefs?

### Model for Educational Transformation

**LEGEND:**
- Quantitative
- Qualitative
- Unmeasured

**Measurement Tool**
- Should we include “papers” as well?

**DRAFT** Proficiency-based Assessment and Reassessment of Learning Outcomes (PARLO) Model for Educational Transformation
Are we gathering data on this?

Michael A. Posner, 1/27/2012
Measurements

- Measurements
  - Valid: meaningful, relevant, useful
  - Reliable: consistent, free of random error
  - Fair: doesn’t provide benefit or detriment to one or more subgroups
  - Do not reinvent the wheel! Find existing instruments.

- Measuring success
  - What is your dependent variable?
  - What are factors that might affect it? Measure them!

- Measuring the Innovation
  - Fidelity of Implementation (self-report, external, etc.)

Measurement Instruments

- Concept inventories are typically multiple choice surveys that don’t require explicit subject expertise
  - Ex: Force Concept Inventory (Eric Mazur)

- Concept Inventories in Higher Education Science.

- Developing Measurement Instruments for Science Education Research.
  [Link](http://link.springer.com/chapter/10.1007%2F978-1-4020-9041-7_43#page-1)

- Google “Concept Inventory” and your field

Measurements - PARLO

- PARLO Measurements
  - Attitudes – Survey of Attitudes Towards Statistics, both pre and post
  - Performance – Common Final Exam and Comprehensive Assessment of Outcomes in Statistics
  - Percent resubmitted and delayed proficiency
  - Student demographics obtained via survey and through the registrar

Measurements – You!

- Feel free to search online for validated instruments

Comparison/Control Groups

- Ex: Monotone vs. Animated Teaching
- No controls -> Misattribution of effects
- External vs. internal controls
  - External controls
    - Last year’s students
    - Other classes (randomly assigned?)
  - Internal controls
    - Pre/post measurements
    - Modular crossover design
- Randomized, controlled trials are hard in education

Control Group - PARLO

- Two of the same classes - one using traditional methods and one using PARLO system
- Pre/post Attitude Scores
Control Group – You!

Statistical Analysis
• Start with (and possibly end with) descriptive statistics and graphical displays
• Examine potential confounders
  – Make sure to gather them!
  – Stratification or controlling
  – Bonjour Paris L’ecole

Statistical Analysis II
• Identify Bias
  – Response bias (wording, question order, etc.)
  – Non-response bias (Favor gay marriage)
  – Differential vs non-differential bias
  – Loss to followup - Why did they drop? Is it related to other variables?

Statistical Analysis - Advanced
• Multiple linear/logistic regression to control for potential confounders
• Consider gain scores carefully
  – See Bonate and SMER
• Unit of randomization vs. unit of analysis (multilevel model)
• Causal inference
  – Propensity score quasi-randomization methods

PARLO at Villanova: Resubmissions
CAOS = 17.7 + 6.2 proportion (p-value=0.014) p>0.1, controlling for Math SAT

PARLO AT VILLANOVA: ATTITUDES
Var(Gain) = Var(X2-X1) = Var(X2) + Var(X1) – 2 Cov (X2,X1)
Cov determined through interval Vars and external Cor
PARLO AT VILLANOVA: DELAYED PROFICIENCY

Statistical Analysis – You!
- Plan what analyses would be appropriate
- Create the tables that you will (may) use to report the final findings

Qualitative Analysis
- Open-ended questions or observations
- Surveys, interviews, focus groups
  - What is their perception on how it worked?
  - Why did it or didn’t it work?
  - Add questions to CATS (not linked)
- Measure fidelity of implementation
  - Was there cross-contamination of groups?
  - Did students use external resources?

Qualitative Analysis - PARLO
- Focus Groups (not well attended)
- Comments
  - You know what to expect each class
  - I really liked his method of grading
  - The ability to resubmit work was an outstanding system
  - I had no idea where I stood on my grade

VPS - One More Result...
- The following did NOT occur...

Qualitative Analysis – You!
- What deeper questions/explorations do you have?
- What aspects of your intervention do you want to know more about?
- What mid-course improvements can be made?
**Next Steps**

- Logistics and feasibility
  - Am I compromising fairness? Ethical issues?
  - Can I really accomplish what I set out to do?
- Peer review and feedback
- Presenting it to your students
  - Initial presentation, advanced warning?
- Mid-course changes
- Refine your design/methods & try it again
- Generate new research questions

**Next Steps**

- This was 2nd year of the study. In year 1…
  - SATS was not discovered - designed survey
  - CAOS not given
  - Discovered pattern in enrollment (athletes)
  - Refined LOs
  - Midcourse problems – midterm grades
  - Presented it differently to students
- SERJ Paper (2011)
- National Science Foundation PARLO Study
  - $2.4mil, 4-year randomized control trial in 32 schools in Greater Philadelphia

**Next Steps – You!**

- Logistics and feasibility
- How will you present it to your students?

**Dissemination of Results**

- Optional…but encouraged
- IRB Approval
- Confidentiality
- Look for DBER journal
- Describe context and student demographics
- Address time, training, and support needed
- Provide instrument characteristics (inter-rater reliability, internal validity, previous validity)

**Other Examples of My SoTL**

- Attitudes research
  - Instructor characteristics that impact student attitudes (SERJ, R&R)
  - The impact of the first day of class on student attitudes (SERJ, in progress)
  - How attitudes are related to content mastery
  - The relation of attitudes and content mastery to long-term retention
- Motivations and hesitations for using FUN (JSE 2012)
- Leveraging the power of choice (AMLE, 2011)
- Understanding prerequisite knowledge to sampling distributions (ICOTS, 2010 presentation)
- The effectiveness of flipped/inverted classroom
- Appropriate analysis of gain scores

**VITAL Faculty Associate**

- VITAL Faculty Associate, 2013-14
  - This workshop
  - Consult with faculty on classroom-based research
  - michael.posner@villanova.edu
  - Continue to be inspired by my colleagues
If you would attain to what you are not yet, you must always be displeased by what you are. For where you are pleased with yourself there you have remained. Keep adding, keep walking, keep advancing.

~Saint Augustine

Change is Hard!

No one would think of getting to the Moon or of wiping out a disease without research. Likewise, one cannot expect reform efforts in education to have significant effects without research-based knowledge to guide them.

~National Research Council, 2002

References

- Change is Hard!
- Towar...
The central idea of evidence-based education – that education policy and practice ought to be fashioned based on what is known from rigorous research – offers a compelling way to approach reform efforts.

— National Research Council, 2005

...while a man is an insoluble puzzle, in the aggregate he becomes a mathematical certainty. You can, for example, never foretell what any one man will do, but you can say with precision what an average number will be up to. Individuals vary, but percentages remain constant. So says the statistician.

— Sherlock Holmes

If you would attain to what you are not yet, you must always be displeased by what you are. For where you are pleased with yourself there you have remained. Keep adding, keep walking, keep advancing.

~ Saint Augustine

I am a deep believer in the power of data to drive our decisions. Data gives us the roadmap to reform. It tells us where we are, where we need to go, and who is most at risk.”

— Arne Duncan, 4th Annual IES Research Conference, June 8, 2009
The government are very keen on amassing statistics. They collect them, add them, raise them to the n-th power, take the cube root and prepare wonderful diagrams. But you must never forget that every one of these figures comes in the first instance from the village watchman, who just puts down what he damn pleases.

--Comment of an English judge on the subject of Indian statistics; Quoted in Sir Josiah Stamp in _Some Economic Matters in Modern Life_

Confucious says…

If your plan is for one year, plant rice.
If your plan is for ten years, plant trees.
If your plan is for one hundred years, educate children.