Learning Gain and Confidence Gain as Metrics for Pedagogical Effectiveness

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SEDA – May 2017
YOUR PRESENTER

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School of Economics – University of East Anglia

Research fields
• Higher Education policy and practice (widen. access, satisfaction)
• Technology Enhanced Learning
• Self-Assessment and Academic Self-Efficacy
ACKNOWLEDGEMENTS

UEA Students, Alumni, and Research Assistants

HEFCE Piloting and Evaluating Measures of Learning Gain

HEA – Teaching Development Grant Scheme
INTRODUCTION

Valuing What We Can Measure or Measuring What We Value?

• A topical question for those evaluating recent changes in the British education systems (not just HE).

• Very often the reaction is dismissing metrics altogether: they cannot work!

• I believe metrics are important, but we should measure what we value.

• I value student confidence.
CONFIDENCE GAIN: the theoretical approach

Academic Self-Efficacy = confidence at performing academic tasks and/or attaining academic goals.

Bandura (1977)

1. Mastery of experiences
2. Vicarious experiences
3. Verbal persuasion
4. Environment and settings

See also: Pajares (1996) and Ritchie (2015).

Idea: Students should develop their self-efficacy to master their learning experience. Measure learning gain along with increased self-efficacy: ‘confidence gain’.
ACTIVE LEARNING ENVIRONMENT

Introductory Economics (2015-16)

- year-long module (compulsory 1st year)
- 250 students (range 140-250 over past 3 years)
- 22 lectures (1hr per week)
- 8 seminars (every second week)
- 8 workshops (every second week)

Students endowed with individual Audience Response Systems (clickers) → continuous data collection facilitated by technology.
WORKSHOPS – two pedagogies at work

Round 1
- formative question
- 4 choices
- no information
- no answer

Self-Assessment 1
- confidence question
- 4 level Likert-scale
- information shared

Peer-Instruction
- students talk
- compare answers
- explain each other

Self-Assessment 2
- confidence question
- 4 level Likert-scale
- information shared

Round 2
- formative question
- Identical to R1
- information shared
- correct answer
After the Brexit Referendum the British Pound (GBP) has significantly depreciated (GBP lost value). This implies:

A. that British exports could increase, because the pound is cheaper.

B. that Britain is exposed to risk of higher inflation, as imports of raw materials are more expensive.

C. both (A) and (B) are correct.

D. none of the above is correct.
How confident do you feel about having given the right answer?

A. Very confident.
B. Confident.
C. Not confident.
D. Not at all confident.
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D. none of the above is correct.
How confident do you feel about responding to a similar question in future?

A. Very confident.

B. Confident.

C. Not confident.

D. Not at all confident.
After the Brexit Referendum the British Pound (GBP) has significantly depreciated (GBP lost value). This implies:

- Both (A) and (B)
- None of the above

First Slide  Second Slide
How confident do you feel about responding to a similar question in future?

- Very confident: 100%
- Confident: 100%
- Not confident: 100%
- Not at all confident: 100%
WORKSHOPS – two pedagogies at work

Round 1
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Self-Assessment 2
- confidence question
- 4 level Likert-scale
- information shared
## DATASETS AND CODING

<table>
<thead>
<tr>
<th>Student</th>
<th>Q1</th>
<th>Q2</th>
<th>Q3</th>
<th>...</th>
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### Formative questions
1 = correct  
0 = incorrect

### Confidence questions
1 = strongly/agree  
0 = strongly/disagree
SUMMARY of PREVIOUS FINDINGS

• Positive association between attainment and confidence in performance → this formative assessment design elicits good self-assessment outcomes

• Negative association between entropy and confidence levels → objective and subjective measures of confidence align

• Negative association between classroom learning gain and % correct R1 → Peer-Instruction supports low-performers – ‘catching up effect’

• No association between learning gains and confidence → confidence levels do not influence the effectiveness of Peer-Instruction

• Students seem to recognise the power of Peer-Instruction → consistent opinions across different sources of feedback.
OPERATIONALISING GAINS

For each 1st and 2nd response to formative assessment questions:

Learning Gain (LG) = % correct R2 − % correct R1

For each 1st and 2nd response to self-assessment questions:

Confidence Gain (CG) = % confident R2 − % confident R1

These can be measured at student-level or at class-level.
LEARNING AND CONFIDENCE GAIN

Learning / Confidence Gain at student-level

- For each session (8 in total): compute LG and CG for each student
- Cross-tabulate students’ LG & CG above/below average
- Fisher’s Exact Test of association between LG & CG.

<table>
<thead>
<tr>
<th></th>
<th>Above Average LG</th>
<th>Below Average LG</th>
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<tbody>
<tr>
<td>Above Average CG</td>
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<tr>
<td>Below Average CG</td>
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</table>
LEARNING AND CONFIDENCE GAIN

Learning / Confidence Gain at student-level
- For each session (8 in total): compute LG and CG for each student
- Cross-tabulate students’ LG & CG above/below average
- Fisher’s Exact Test of association between LG & CG.

Results:
- For each session (8 in total): significant positive association between LG and CG (P<0.01 for 7 sessions)
- Student who learn the most also develop stronger confidence.
LEARNING AND CONFIDENCE GAIN

Learning / Confidence Gain at class-level
- Measure LG & CG for each question asked within the year
- Regression analysis of the relationship between LG & CG
- Control for different sessions
- Verify whether there is a time trend: CG getting wider over time.

Results:
- Confirmed positive association of LG & CG at class-level
- Identified positive trend, but fear of self-selection bias.
LEARNING AND CONFIDENCE GAIN

Confidence Gain = f ( Learning Gain ) + Week Number

<table>
<thead>
<tr>
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<th>Coeff</th>
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<table>
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<td>Significance F</td>
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<td>R Square</td>
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<td>Observations</td>
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Week = 1, 2,...8 = time trend
SUMMARY of NEW RESULTS

• Consistent positive association between learning and confidence gain tested using different methods.
  → peer-instruction and self-assessment foster student self-efficacy
  → we are accounting for both mastery and vicarious experiences

• Weak evidence hints that confidence gain increases over time
  → is there a long-run positive effect on student self-efficacy?
  → or is there just a self-selection bias?

• Evidence shows that lower attendance associates with higher confidence gain
  → low-attendance students are the less confident; the more resilient students remain engaged, hence confidence gain appears to increase, but we need to think of how to re-engage the less resilient.
FURTHER RESEARCH

• We are pioneering new metrics for learning gain
  → open to criticism, but lots of potential to be explored

• Break down data at student level and investigate student typologies
  → characterise gain according to demographics and student engagement

• Alter the teaching algorithm: ask self-assessment question for the second time before teaching to the right answer
  → measures the net effect of the peer-instruction pedagogy, and the mastery of experience (without vicarious experience effect).
  → we have preliminary results: teacher helps, but not indispensable.
STAY IN TOUCH!

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SEDA – May 2017
Confidence Gain = f ( Learning Gain ) + weekly dummies

<table>
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<th>P-value</th>
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**Regression Statistics**

- Significance F: 0.0000
- R Square: 0.3215
- Adjusted R Square: 0.2745
- Standard Error: 0.1191
- Observations: 140