PORTAAL: a new tool to assess evidence-based teaching practices

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**Why develop a tool to characterize teaching in large classrooms?**

- Changing a class to include opportunities for active learning increases student achievement.⁴,⁵,⁶
- But, the magnitude of this effect varies drastically between classrooms (and sometimes no effect is seen).⁴,⁵,⁶

**Hypothesis:** The variation in the implementation of active learning influences student learning gains.⁴,⁵,⁶

**Project Goal:** Develop a tool that can effectively document the variation in how active learning is implemented in large classes and validate this tool using student achievement.

**Development of observational tool:**

1. Reviewed primary literature on active learning in large lectures to identify elements of active learning classrooms linked to:
   a. Improved performance on formative/summative assessments.⁴,⁵,⁶
   b. Improved conversations between students in class.²,³

2. Identified 4 elements correlated with changes in student achievement/engagement:
   - **Practice** – How much practice are students getting and how aligned is practice with exams?
   - **Logic Development** – How are students encouraged to think like scientists?
   - **Accountability** – How are students encouraged to participate in class?
   - **Apprehension Reduction** – Do students feel safe engaging with the material in class?

3. Developed a tool that can be:
   - used by observers with minimal background
   - Requires minimal training time.
   - Is reliable across wide range of observers.

**PORTAAL**

- **Introduction:**
  1. Start of introductory talk
  2. Start of student discussion of [Active Learning Exercise/Task/Question]
  3. Introduction of introductory problem/skill tutorial
  4. Tutorial (30–45 min)
  5. Expected exchange activity 1 [L2]
  6. Expected exchange activity 2 [L1]
  7. Expected exchange activity 3 [L3]
  8. Expected exchange activity 4 [L4]

- **Question Evaluation:**
  1. Question Evaluation (modified)
  2. Question Evaluation (modified)
  3. Question Evaluation (modified)

- **Summary:**
  1. Questions (L1, L2, L3, L4)

- **Control for confounding sources of variation.**
  - Determined Bloom level of exam questions
  - Calculated a Weighted Bloom Score for each exam³⁷
  - Predicted difficulty of each exam question. (Predicted Exam Score)³⁷

**Variation in Amount of Practice**

- Obtained course recordings of 25 instructors teaching intro biology
- 2 observers scored 3 classes per instructor independently with tool
- and then came to consensus on any discrepancies in their scores.
- Rubric scores averaged across all 3 classes per instructor.
- Two faculty have documented increases in exam performance and drops in failure rates – These are REFERENCE FACULTY
- RED Reference Faculty dropped fail rates from 20% to 6%
- Blue Reference Faculty dropped fail rates less dramatically

**Variation in Extent of Focus on Logic Development**

- Number instructors: 7
- L1: Percent activities students explain answers to their peers
- L2: Percent activities students explain answers to their group
- L3: Percent activities students explain answers to one peer
- L4/RA: Percent activities students explain answers to their peers

**Variation in Degree of Accountability**

- Number instructors: 7
- A3/R1: Percent activities with cold/hold/call/monitor

**Next Steps: Do PORTAAL elements correlate with student exam performance?**

**Step 1:** Control for confounding sources of variation.

- Differences in Exam Academic Challenge:
  - Determined Bloom level of exam questions
  - Calculated a Weighted Bloom Score for each exam³⁷
  - Predicted difficulty of each exam question. (Predicted Exam Score)³⁷

- Differences in Student Academic Ability:
  - Student Cumulative College GPA at start of Bio series³⁷ and SAT Verbal

**Step 2:** Develop a Model.

- PORTAAL elements + Exam Challenge + Student Ability + Course + Student = Exam Points Earned

**Preliminary conclusions:**

PORTAAL profiles indicate that:
- Active learning is implemented in vastly different ways across the intro bio series at one university.
- Faculty cluster into four groups based on:
  - number of 18 elements used
  - how often each element implemented
- Logic Development consistently had the lowest scores

Reference Faculty provide insight:
- which elements may be most critical
- how much of each element is critical

The large variation between classrooms provides an opportunity to identify relationships between the frequency of certain elements and student exam performance.

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**References:**

2. S. Freeman, unpublished data.
4. M. Smith, J. S. Freeman, unpublished data.