Intro to POGIL: Process-Orientated Guided Inquiry Learning

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The Plan

- Brief Intro
- Run Part I of a POGIL
- Discuss how and why POGIL
- Run Part II of a POGIL
- Wrap-up
About me

- Assistant Professor
  Neuroscience and Biology (year 2)

- Interested in active learning (colleagues, pedagogy research)

- Attended 3-day POGIL workshop (July 2014)
Colleges Reinvent Classes to Keep More Students in Science

By RICHARD PÉREZ-PÉÑA DECEMBER 26, 2014

DAVIS, Calif. — Hundreds of students fill the seats, but the lecture hall stays quiet enough for everyone to hear each cough and crumpling piece of paper. The instructor speaks from a podium for nearly the entire 80 minutes. Most students take notes. Some scan the Internet. A few doze.

In a nearby hall, an instructor, Catherine Uvarov, peppers students with questions and presses them to explain and expand on their answers. Every few minutes, she has them solve

Catherine Uvarov, a chemistry instructor at the University of California, Davis, has adopted an experimental approach to teaching an introductory course. Max Whittaker for The New York Times
Active learning increases student performance in science, engineering, and mathematics

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To test the hypothesis that lecturing maximizes learning and course performance, we metaanalyzed 225 studies that reported data on examination scores or failure rates when comparing student performance in undergraduate science, technology, engineering, and mathematics (STEM) courses under traditional lecturing versus active learning. The effect sizes indicate that on average, student performance on examinations and concept inventories increased by 0.47 SDs under active learning ($n = 158$ studies), and that the odds ratio for failing was 1.95 under traditional lecturing ($n = 67$ studies). These results indicate that average examination scores improved by about 6% in active learning sections, and that students in classes with traditional lecturing were 1.5 times more likely to fail than were students in classes with active learning. Heterogeneity analyses indicated that both results hold across the STEM disciplines, that active learning increases scores on concept inventories more than on course examinations, and that active learning appears effective across all class sizes—although the greatest effects are in small ($n \leq 50$) classes. Trim and fill analyses indicated that the effect sizes are similar in magnitude to those from 225 studies in the published and unpublished literature. The active learning interventions varied widely in intensity and implementation, and included approaches as diverse as occasional group problem-solving, worksheets or tutorials completed during class, use of personal response systems with or without peer instruction, and studio or workshop course designs. We followed guidelines for best practice in quantitative reviews (SI Materials and Methods), and evaluated student performance using two outcome variables: (i) scores on identical or formally equivalent examinations, concept inventories, or other assessments; or (ii) failure rates, usually measured as the percentage of students receiving a D or F grade or withdrawing from the course in question (DFW rate).

The analysis, then, focused on two related questions. Does active learning boost examination scores? Does it lower failure rates?

Results

The overall mean effect size for performance on identical or equivalent examinations, concept inventories, and other assess-
Active (Guided) Learning

**Student-centered**
most of class time is spent by student solving problems

**Professor facilitates**
assigns readings, writes questions, activities, delivers “mini lectures”, gives quizzes, exams, introduces and sequences topics, wraps up/ties together classes
Active Learning

Examples:

student-driven research projects in various formats: instructional videos, websites, grant proposals, manuscripts

class response systems: “clicker” questions

in-class problem solving (ask a neighbor)

“1 minute papers” (summarize key points in class in 1 minute)

online discussion boards

flipped classes: video recorded lectures followed by in class discussion

POGIL
POGIL is defined by

- In-class problem solving done by students working in small groups
- Activities to follow a 3 step learning cycle: exploration, concept invention, application
- Activities that simultaneously develop “process” skills: time management, information retrieval, managing resources, oral and written communication
POGIL provides institutional support

- NSF funded non-profit organization
- Runs training workshops
- Provides standardized feedback on instructor-designed activities

pogil.org
Activity 1
Assign roles

- Manager: keeps an eye on the clock, makes sure group is progressing on-time

- Scribe: records answer; provides notes for the whole group

- Spokesperson: orally presents the group’s answer

- Process Analyst: takes notes on how well the group is working together - strengths and areas for improvement
In 10 minutes

- Answer questions about Model 1 in the Membrane Potential activity.

- Please have the Spokesperson ready to answer the question to 7.
Analysis and Significance
The Learning Cycle

process skills: data analysis

exploration

term introduction

concept invention

application

test questions
Schools and employers want good process skills

American Association of Medical Colleges
POGIL improves performance for more students

![Bar chart showing final course scores for lecture only and lecture+POGIL](chart.png)

**Fig. 1.** Mean final scores in the Anatomy and Physiology 2 (A&P 2) course from spring 2008 (SP08), fall 2008 (FA08), spring 2009 (SP09), and fall 2009 (FA09). Values are means ± SD. NS, not significant ($P \geq 0.05$). *$P < 0.01$ as measured using a two-tailed Student’s t-test.

![Percentage of students distribution](chart2.png)

**Fig. 3.** Final course grade distributions in A&P 2 from SP08, FA08, SP09, and FA09.

Brown, 2010
Implementing POGIL

• POGIL suggests a regular schedule (weekly, biweekly)

• Others use POGIL to complement lectures that cover particularly difficult material

• Some go all-in and run their entire class lecture-free

• Colleagues share POGILs, published POGIL texts

• Writing your own takes 3-5 hours and can be adapted from pre-existing lecture preps, problem sets, quizzes, exam questions.

• Recommend workshop to learn more about effective POGIL design and facilitation
Activity 2
Meta analysis activity

In 10 minutes Label each question in Model 2:

**Exploratory (E):** directed questions designed to engage the model: list, describe, define

**Concept Invention (CI):** questions that require comparison/contrast, analysis

**Application (A):** questions that require synthesis, evaluation