Semi-Flipped Classroom in an Energy Balances Course

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AIChE Annual Meeting; November 17, 2014

Rowan University

Rowan ChE Curriculum

Freshman Year

Calculus	Physics	Chemistry	Freshman Clinic	General Education

Sophomore Fall

Math	Chemistry	Biology	Sophomore Clinic	Principles of Chemical Processes I

Sophomore Spring

Math	Chemistry	Sophomore Clinic	Principles of Chemical Processes II	Fluid Mechanics

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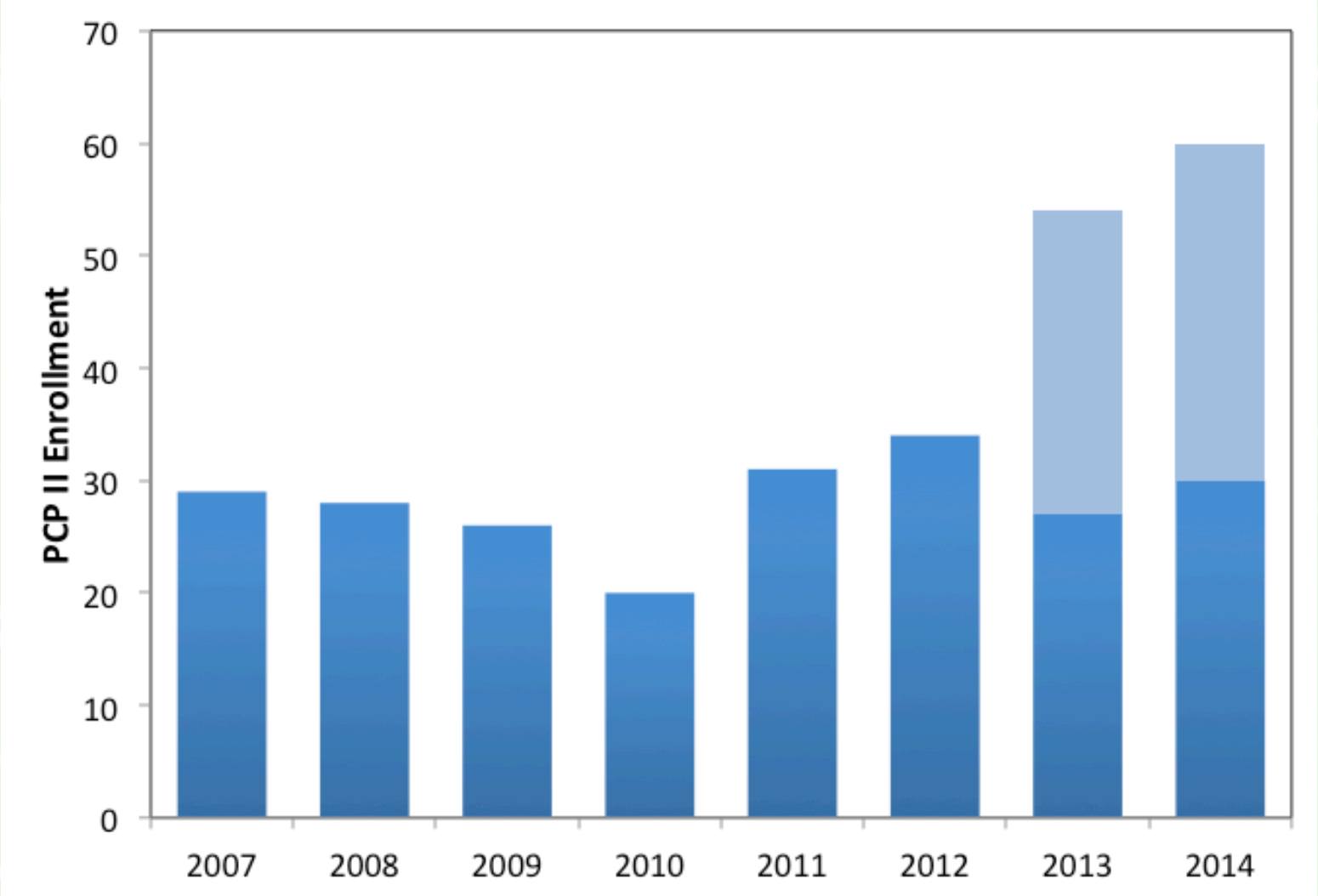
Course Objectives

1. Introduce the fundamentals of the energy balances and their role in chemical processes.
2. Expand the understanding of the engineering approach to open-ended problems.
3. Develop the capacity to employ engineering judgment to assess the validity of answers.
4. Use modern computer tools to solve process problems.
5. Continue to develop an understanding of the importance of safety and environmental issues.

Principles of Chemical Processes II



PCP II at Rowan University

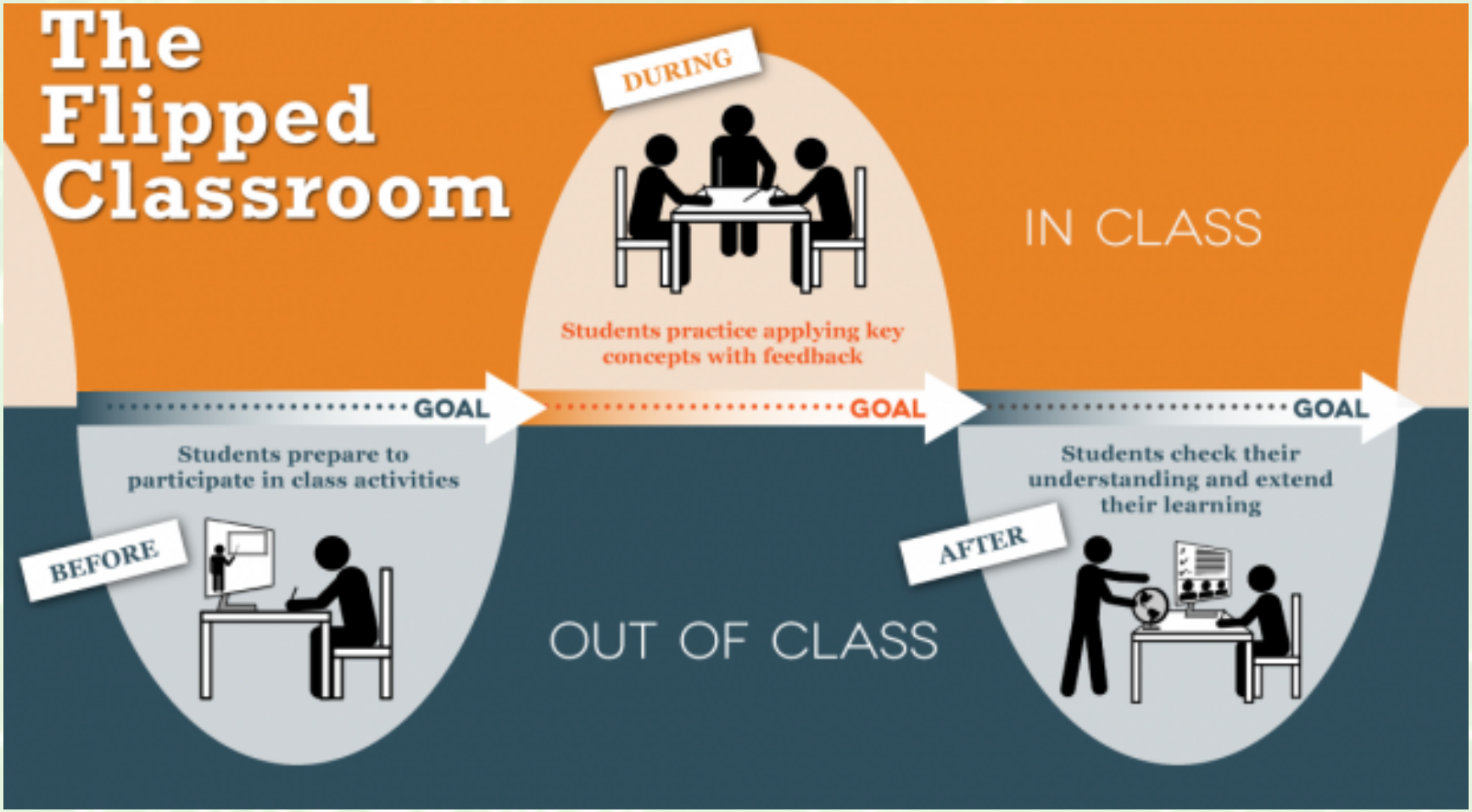
- Split into two sections for the first time in Spring 2013, which corresponded to an instructor change as well.
- Two classes a week (one 75-minute and one 105-minute class/lab).
- Common exams, graded homeworks, semester-long group project
- Course-specific tutoring session once a week

Observations of PCP II – 1st round

- Students did not read the textbook.
- Students were not seeking help when they needed it.
- Students did not know how to study or how to learn (after all, this is not the 14th grade).
- As a general rule, abstract thinking skills were poor.
- Providing different in-class examples in the two sections led to heterogeneity in exam preparation and performance.

Flipping the Classroom

- We decided to partially "flip the classroom" in order to
  - Provide additional in-class problem solving time
  - Encourage students to take responsibility and ownership for their own learning
  - Expose students to different teaching styles
  - Ensure homogeneity in the students' preparation for upper-level Chemical Engineering courses



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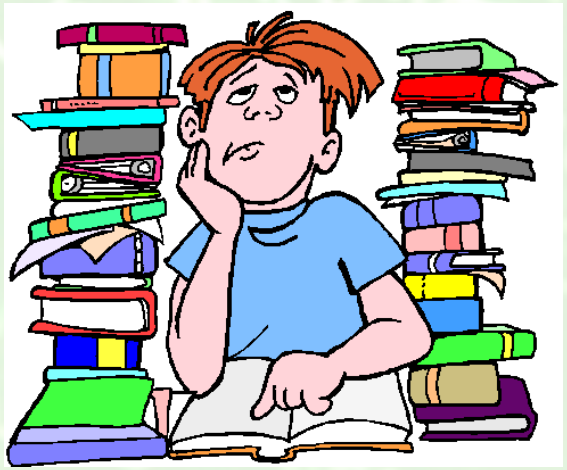
Implementation of a Semi-Flipped Classroom

- Split the classroom time:
  - One 75-minute class period: traditional lecture, active learning, problem solving, solution strategies (*1 Instructor*)
  - One 145-minute class/lab/exam period (*+ 40min*): **flipped**, collaborative learning, problem solving (*Both Instructors*)
  - One 120-minute course-specific tutoring session – Optional (*Two Seniors*)

A Semi-Flipped Classroom

- Reading Assignments
  - Conceptual/Abstract Thinking Required



- Readiness Assessment Quiz (10% of final grade)

Readiness Assessment Quizzes

- Taken verbatim from the reading assignment
  – Or –
- Multiple choice questions requiring comprehension of abstract concepts
  – Or –
- Short problem solving exercises
  – Or –
- Assessment of chart-reading abilities

- Completed independently, submitted, then discussed in pairs, answered via PollEverywhere, class-wide discussion

The heat of vaporization

Respond at **PollEv.com/rowanpcp**
Text a **CODE** to **37607**

Depends on the entropy of the universe	**141426**
May vary with T and P	**141427**
May vary considerably with P	**141429**
May vary considerably with T	**141436**
None of the above	**141437**

Total Results: 34

The heat of vaporization

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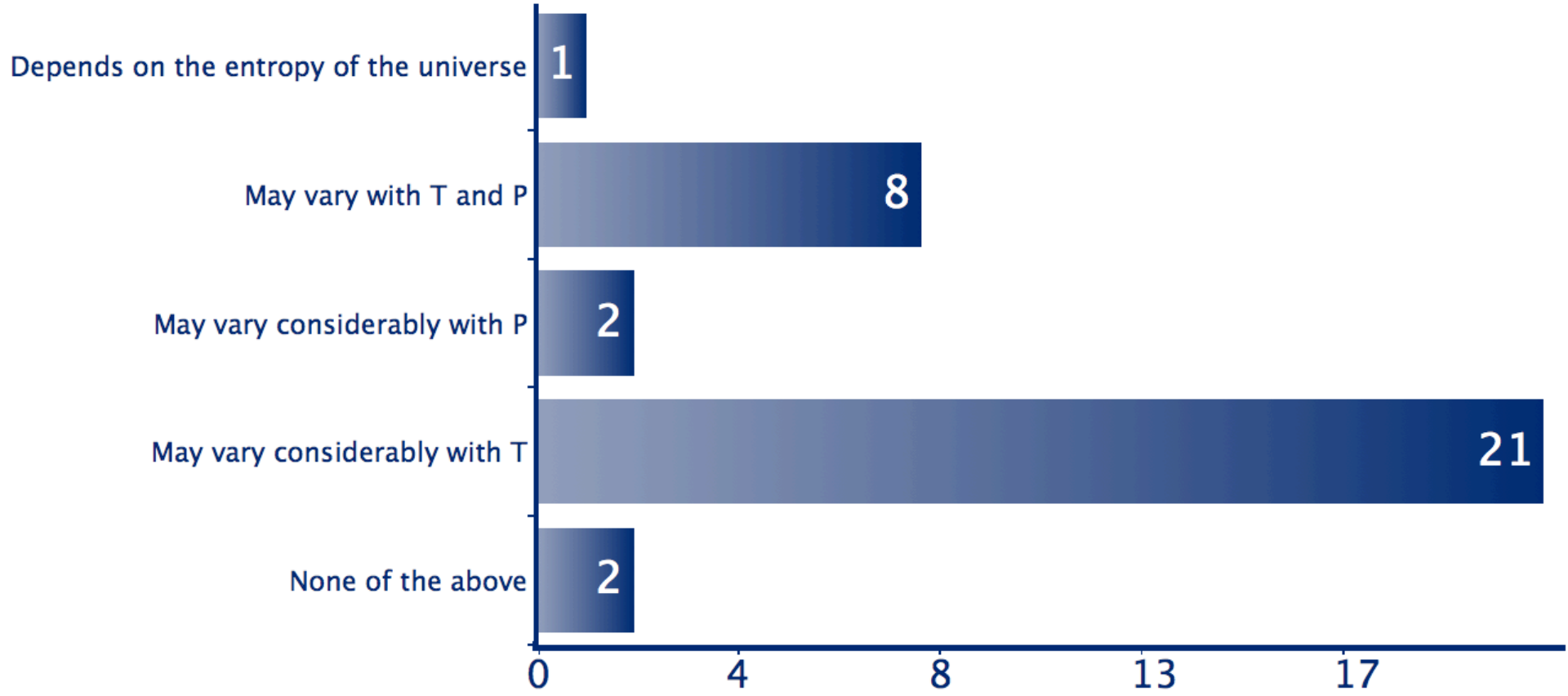
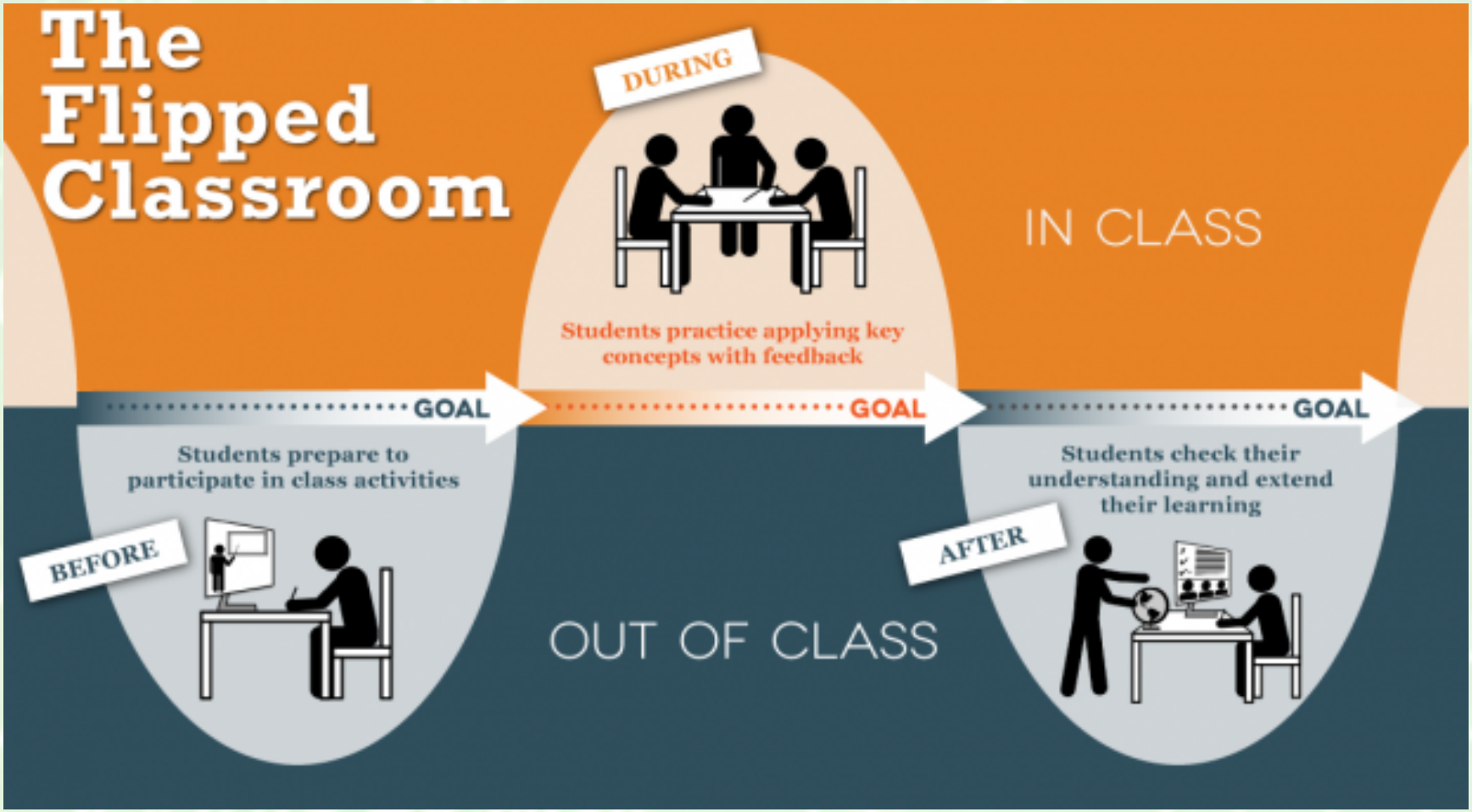
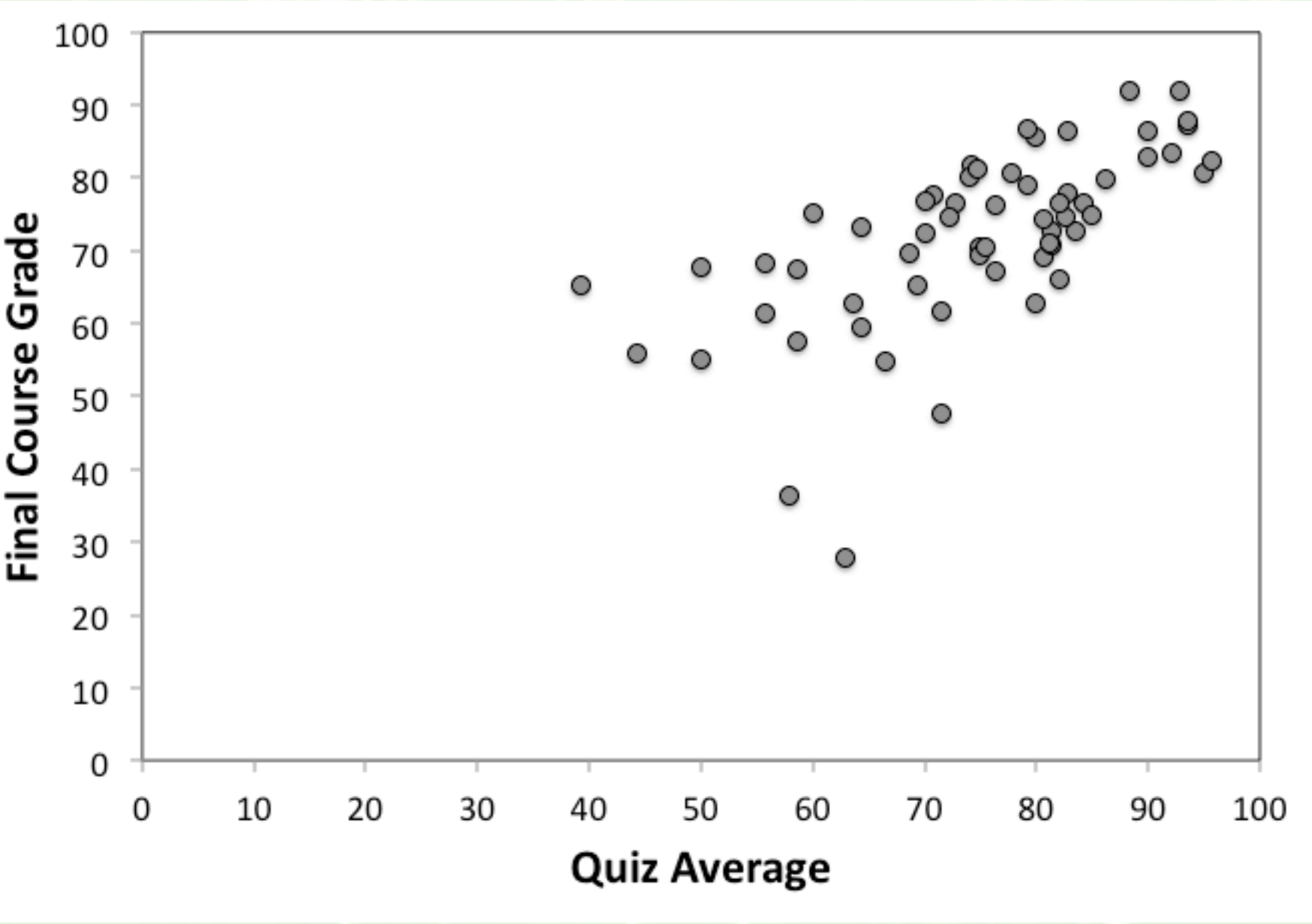
Start this poll to accept responses




The Flipped Classroom
DURING
IN CLASS
Students practice applying key concepts with feedback
GOAL
GOAL
GOAL
Students prepare to participate in class activities
BEFORE
Students check their understanding and extend their learning
AFTER
OUT OF CLASS


Final Course Grade
100
90
80
70
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50
40
30
20
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0
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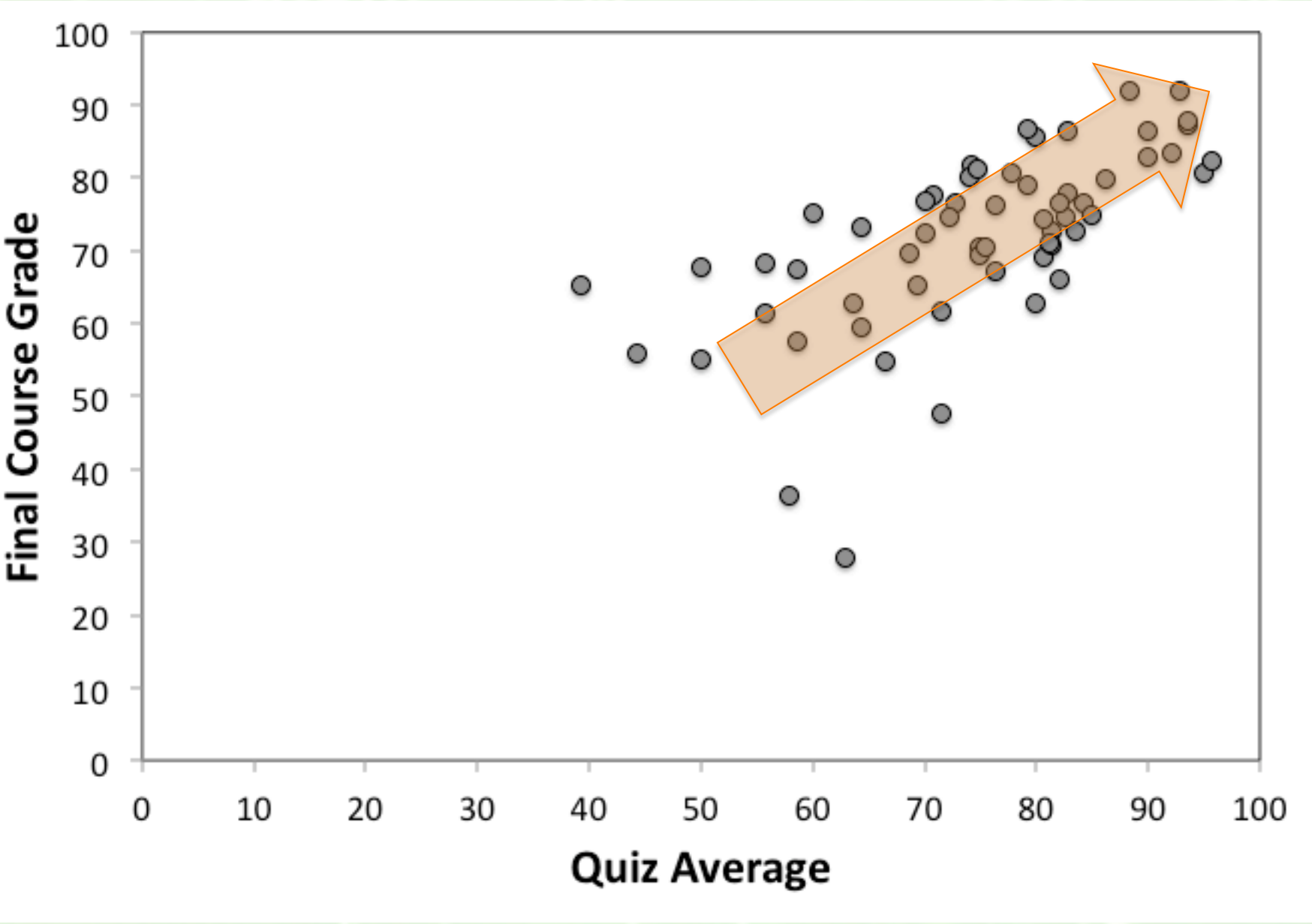
20
30
40
50
60
70
80
90
100
Quiz Average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80
90
100
Quiz Average

Effectiveness of the Semi-Flipped Classroom

- Students provided mixed reviews (as expected)
- Instructors teaching Thermodynamics I this semester have noted anecdotally that the students are more engaged.
- Performance improved on the first Thermodynamics exam* (77.7 to 81.3, p=0.12)

* The first exam includes a question using the entropy balance, which is not covered in PCP II.

Semi-Flipped Classroom

- Seems to improve student engagement, learning, and lifelong-learning skills.
- Standardized the “foundation” across two sections.
- Introduced lower-level students to varied teaching styles in the same course.
- Easy to implement

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