
Scaffolding Student Activities Outside of Class

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Overview

- **Goals**

- Student audience: Introductory GE Statistics courses for non-majors

- **Proposed Strategies**

- Reading quizzes, Practice problems, Investigation assignments, Pre-labs

- **Principles for design, Cautions**

- **Discussion**

Possible class period?

- Review previous material
 - Students take notes but often not processing or self-evaluating or questioning
- Lecture on new material
 - Students take notes but often not processing or self-evaluating or questioning
- Run out of time, “Finish this example outside of class”
 - Students won’t unless you are going to grade it
 - Difficult to provide timely feedback before next class

Possible Office Hour Visit?

S: I can't do this problem

I: Have you looked back through your notes?

S: No...

I: The text?

S: I looked in the text but I couldn't find a similar problem ...

S: I understood when you went over it in class but once I got home I couldn't get started...

Current Issues

- “Estimate the amount of time you spent *per week* on this class outside of the lecture time”
 - 2-4 hrs out for every one hour in, 4 unit course?
 - How spend that time?
- Infrequent office hour visits
 - Don't know where to start to ask questions
- Difficulty linking between class examples and homework problems

Our Goals

- Want to shift how we spend time in class to more of a “learn-by-doing” environment where we can provide proactive support
- Where do students most need our help?
 - Reinforcing the difficult concepts
 - Making connections
 - Communication skills
 - Discussion/Debate/Exploration/Feedback
 - Technology help

Our Goals

- Need to increase and better structure how students spend time outside of class
 - Meaningful activities, practice, exploration
 - Sufficient support, guidelines, motivation
- Assessment *for* learning
 - Just-in-time learning (e.g., Novak, 1999):
Immediate feedback to student and teacher on what was and was not understood that day

Strategies we are exploring

1. Reading quizzes – preparing for class (Karen)
2. Practice problems – reinforcing class material (Beth)
3. Investigation tasks – putting the pieces together (Allan)
4. Pre-labs – preparing for labs (Beth)

Strategy 1: Reading Quizzes

- Purpose
 - Encourage students to read the text for concept level understanding
- What they are
 - 3-4 multiple choice or T/F questions over each section in the text.
 - Require little, if any, computation

Strategy 1: Reading Quizzes

- Why implement reading quizzes?
 - Lack of participation in class
 - “Any questions?”
 - “Do you understand?”
 - Overwhelming amount of information to cover
 - Desire to focus student attention on big ideas
 - Students are most often concerned with the nuts & bolts:
 - “Do I have to know this for the test?”
 - “How will this help me do the assigned homework?”

Strategy 1: Reading Quizzes

- Why concept level questions?
 - Students are lacking in true understanding of concepts
 - Force Concept Inventory (FCI) in Physics
 - Results: 80% could state Newton's Law, fewer than 15% had full understanding which allowed application in different settings/contexts (Hestenes, *The Physics Teacher*, 1995)
 - Master the nuts & bolts – (class lecture)
 - What about application to new contexts that are not like the examples in class or the text?
 - Development of statistical thinking
 - Want to students to move beyond what's presented in the course to be able to question and find solutions to new questions independently (Chance, B., *Journal of Statistics Education*, 2002)
 - Lay the foundation for conceptual understanding/thinking

Strategy 1: Reading Quizzes

- Why multiple choice and/or True/False?
 - Graded automatically – next slide
 - Feedback is important component
 - Answer choices are offered that address ‘typical’ misconceptions
 - Students are given instant feedback on why their answer choice is right or wrong.
 - Begin to correct misconceptions before they come to lecture.

Strategy 1: Reading Quizzes

■ How

□ Test Manager in Blackboard

- Available by Friday the week before the sections are covered in class.
- Due by class time on the day the section is covered.
 - Become unavailable after this time
- Graded automatically – includes instant feedback
- Worth about 4.5% (~25 points) of the final course grade
 - Begin the quarter with this 4.5%
 - Lose points for not doing the quizzes or for doing them incorrectly
- Not requiring every student to do the quizzes every week.
 - Email notification with sections and due dates

Strategy 1: Reading Quizzes

■ Issues

- One attempt only
 - Can be done over multiple sessions
- Confusion on due dates & times
 - Cleared up by Week 3

■ Benefits

- Instant feedback on understanding
 - Begin to correct misconceptions before lecture
- Students come to class more prepared
 - Often come with questions already formulated
- Lecture can be more directed

Strategy 1: Reading Quizzes

Exam 1 Results

Section	Median	Mean	Standard Deviation	Max	Min	25 th percentile	75 th percentile
4 (Required Reading Quizzes)	78.6	77.5	8.4	90	60	72.75	87.25
5	75.1	73	11.5	95	53	67	86

- ❑ Section 4 mean is 4.5 points greater than Section 5 (not statistically significant)
- ❑ Section 4 standard deviation is 3.1 points less than Section 5 (not statistically significant)
- ❑ In Section 5 the lowest 25% of scores were below 67, while in Section 4 they were below 73.

Strategy 1: Reading Quizzes

Survey Results ($n=31$)

Question 1: The reading quizzes aided my understanding and helped me learn the material.

Strongly Disagree	Disagree	No Opinion	Agree	Strongly Agree
10%	13%	7%	67%	3%

Question 2: The Reading Quizzes added interest and motivated my learning.

Strongly Disagree	Disagree	No Opinion	Agree	Strongly Agree
5%	24%	14%	52%	5%

*Completion Rate: All students have completed at least 75% of assigned quizzes.

Strategy 1: Reading Quizzes

- Conclusions (at this early stage)
 - 70% of students agree that reading the text aids learning and understanding
 - 57% of students agree that the reading quizzes add interest and motivate learning
 - Results of Exam 1 indicate the reading quizzes *may* improve student understanding
 - At the very least they do not appear to hurt student understanding
 - The reading quizzes may help the lower performing students the most.
 - Increased 25th percentile
 - Reduced standard deviation

Strategy 2: Practice Problems

- Angelo and Cross (1993): Minute Paper
 - What did you find to be the muddiest point?
- Extended to spending last 10 minutes of class on an application of what they learned, with partner
 - Read overnight and returned next class period, begin next class with summary of main points
- Next step: Move outside of class
 - Allows students to respond more thoughtfully, processing material between classes but maintain “low stakes”

Strategy 2: Practice Problems

- Electronically submitted daily practice problems
 - Goal: Fairly short questions on material covered that day, either highlighting key concept, common misconception or practice calculation, prelude to HW question
 - Method: Submitted via email or Blackboard before next class period
 - Feedback: Instructor reviews that morning, adjusts lecture if needed, can provide individual comments back to students

Strategy 2: Practice Problems

- Example 1: Applying terminology to new scenario (often data collected on them)
 - Sample feedback given in Blackboard Discussion Board
- Example 2: Conceptual understanding of surprisingly difficult topic

Strategy 2: Practice Problems

6) How useful did you find the following learning aids in helping you understand statistics?

Earlier implementations:

	1-not helpful	2	3	4	5- most helpful
End of class		5	6	11	3
Practice Problems	4	7	15	7	5

*credit/no credit, 5% of overall grade

Strategy 2: Practice Problems

■ Student Comments

- “The practice problems, I felt were a necessity because otherwise I think I would have not taken the time to actually do the problems in the book and been completely lost on what was going on.”
- “I liked the format of the practice problems that we had this semester.... It was helpful that they were not graded because there wasn’t as much pressure. But since they were part of the participation grade, we still had to spend time on them and spending time on the practice problems made the discussions much more helpful.”
- “I like the fact that practice problems are required but not graded, it takes the pressure off of something if you don’t understand it at first.”



Strategy 2: Practice Problems

- Student comments:
 - ❑ Make PP smaller to take less time, or make them multiple choice. If it took more than 10 mins, I usually didn't do it.
 - ❑ Not assigned everyday, only once or twice a week
 - ❑ Make more of them concept-based, less calculation
 - ❑ At least two days for each not a few hours



Strategy 2: Practice Problems

■ Reflections

- Students need some time to get used to the idea
- Delicate balance on getting students to take seriously and to review individual comments as well as frequency/stress level
 - Can't be optional
 - Between daily and weekly, but consistent
 - Allow some free misses, but keep them in the habit

Strategy 3: Investigation assignments

- Students work on an extended, multi-step problem concerning real study/data
 - Applying what they have learned in class
 - Exploring new property of method studied in class
 - Synthesizing multiple aspects of analysis
- Generally involve use of technology
- Require word-processed report
- Students encouraged to work with partner

Strategy 3: Investigation assignments

- As compared to more routine textbook problems
 - More “real”
 - Often involve data collected on students themselves
 - Cannot mimic examples from text
 - Call for extending, synthesizing knowledge
 - Require written communication, presentation skills

Strategy 3: Investigation assignments

■ Example 1

- Analyze data on weights of backpacks carried by Cal Poly students
- Examine ratio of backpack weight to body weight
 - Compare to recommended max ratio of .10
- Perform descriptive analysis for both quantitative and categorical variables
- Conduct significance tests, create confidence intervals for both kinds of variables
- Write report summarizing findings

Strategy 3: Investigation assignments

■ Example 2

- Collect class data from “which tire was flat?” activity
- Conduct test of significance
 - Report, interpret, explain findings
- Analyze data from another class
 - Investigate role of sample size on statistical significance
 - Formulate, explain general result about impact of sample size

Strategy 3: Investigation assignments

■ Reflections

- Roughly 1-1.5 assigned per week
- Become focus of students' out-of-class efforts
- Help students to
 - Apply statistical knowledge
 - Extend statistical knowledge
 - Recognize what is valued
 - Develop computing skills
 - Develop writing skills

Strategy 4: Pre-labs

- Weekly lab assignments, with time expectation outside of class to complete with partner
 - Often some “set up” time
 - Students often struggle with technology, concepts outside of class
- New goal: Finish first pass of lab within 50 minutes where instructor/TA present, common technology platform

Strategy 4: Pre-labs

- Short tasks submitted electronically before come to lab period to work on longer technology-enhanced investigation
 - Watch a video/read article to motivate research study
 - Practice basic terminology, “readiness”
 - Make predictions that will then be tested, hopefully establishing cognitive dissonance (e.g., Posner et al)
- Feedback before lab

Strategy 4: Pre-labs

Survey Results (n=33):

Question: Did you find the pre-lab process reasonable?

Yes, they were reasonably short and a good way to start thinking about the labs in advance.	76%
They weren't too bad but it was tough having to do them right before the other lab was due.	12%
They were reasonable but I near really learned anything from answering the questions or reading the instructor's feedback	12%

Strategy 4: Pre-labs

■ Student Comments

- ❑ “I thought they were helpful for focusing”
- ❑ “Keep on reminding us about them, I always forgot...”
- ❑ “They were easy, short, to the point, and gave a great preview of what the lab was going to be like!”
- ❑ “Maybe posting the pre-labs sooner”
- ❑ “Sometimes I felt as though the pre-labs introduced topics that I didn’t quite understand yet, but my confusion was always clarified when I started the lab and the concepts were explained.”

Strategy 4: Pre-labs

■ Reflections

- Can be a powerful way to get the pump primed
- Must watch that does not get overwhelming

Summary: Principles of design

- Learning occurs through struggling and wrestling with ideas (Resnick, 1987)
- Integrate assessment into learning process, provide continual feedback loop
- Challenge students to apply the tools and think beyond rote repetition
 - Focus on what you ask students to *do*
- Provide immediate and constructive feedback
 - To student and instructor

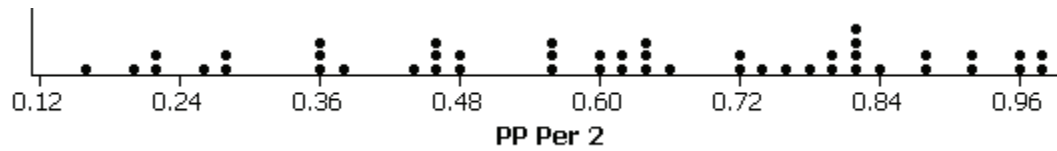
Summary: Decisions/Cautions

- Tailor to student audience
 - “Priming the pump” vs. immediate practice and reflection
 - Optional vs. required (student views of “assessment”)
 - Multiple choice with (more immediate) feedback but not all questions amenable (communication practice)
- Don’t try to do too much
 - Keep integrated with course
 - Keep manageable for student and instructor
 - Prepare, motivate, support
- Some technologies expedite the evaluation process, others lengthen it

Questions/Feedback?

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■ Stat 301



Self-Tests

- I took the self-tests and I found them helpful to reinforce the concepts: 27%
- I took the self-tests, but I wish that the solutions would give more details: 27%
- I took the self-tests, but did not feel like they helped me understand the concepts: 12%
- I never used the self-tests: 30%
- I tried to take the self-tests, but had trouble with the technology: 3%