Lessons Learned:

Teaching strategies I wish I had known from the start

Andy Holland
ISU Great Ideas in Teaching Series
October 19, 2018

Keys to Good Teaching

1) Organize content and activities clearly.

2) Communicate ideas carefully.

3) Treat students like people.

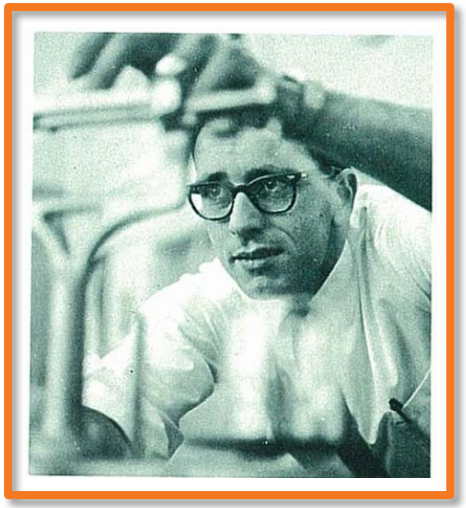
4) Look for ways to do (1), (2), and (3) better.

The End

How did I learn to teach chemistry?

- 16 hours of formal training.
- By watching great teachers:

  Dave Poulsen (BHS)
  Jim Mayer (UW)
  Karen Goldberg (UW)
  Carolyn Bertozzi (UCB)
  Bob Bergman (UCB)



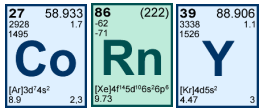
- By watching not-so-great teachers:

[redacted]

Hallmarks of good teaching?

Dave Poulsen
Bellevue High School

Dramatic Presentation ✓



Jokes ✓

Open book exams ✓

"Think like a molecule" ✓

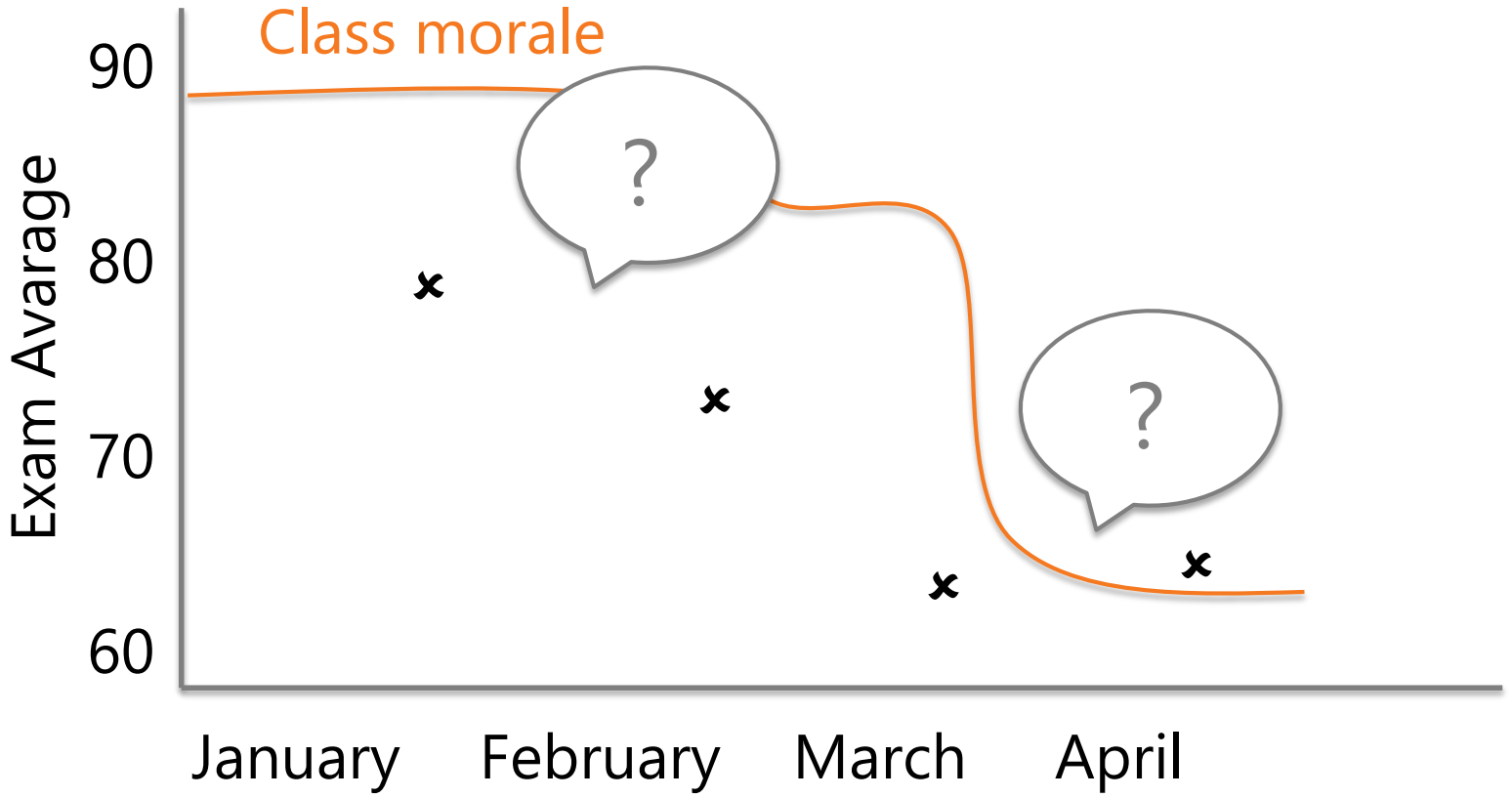
Colorful demos ✓

Context: What am I teaching?

CHEM 1111, 1112, **3301, 3302**: Core courses for primarily for chemistry majors, pre-pharm, and pre-med students.

- 50-70 motivated, academically successful students.
- Well-deserved reputation for difficulty.
- Natural emphasis on critical problem solving.

Spring 2005, CHEM 112 8:00 MWF



Even in a big lecture, maintaining a positive class atmosphere is part of my job.

Students struggle to learn if they are:

- Angry
- Disengaged
- Terrified
- Crushed

Trust

Compassion

Stability

Hope

Idaho State
UNIVERSITY

zoom

Pocatello | Idaho Falls | Meridian | Twin Falls

Idaho State
UNIVERSITY

Building morale without compromise

Questionable ways to win student good will:

constant jokes
easy tests
lots of days off
chumminess

Productive ways to win student good will:

useful lectures
fair tests
well-spent time
mutual respect

Maintaining a healthy class atmosphere doesn't mean ingratiating yourself or pandering to students.

Making compassion obvious

Everyone who teaches cares about students, but students don't know this unless you show them (especially in challenging classes).

- Respond to emails and grade tests quickly.
- Learn names and use them.
- Avoid adversarial interactions when possible.

Avoiding unnecessary conflict

How can we respond to cheating?

1) Bust Cheaters (justice, but at what cost?)

2) Prevent Cheating (avoids adversarial situation)

- Give exams that resist copying and notes.
- Minimize points for activities outside of class.
- Explicitly permit collaboration when it's unavoidable.

Emphasizing growth over evaluation

Common view of the course:

> *"Watch lectures, do work, take tests to demonstrate that I am smart enough to go on to the next step toward the career I want."*

Healthier view of the course:

> *"Do work to build skills for the next steps toward the career I want."*

Lessons from convention centers

What is a good lecture?

"Ideals" for professional (chemistry) presentations:

- Keep a brisk pace to include more research content.
- Err on the side of overestimating the audience's knowledge.
- Make sure you appear smart and capable.

Ideals for lecturing to students:

- Absolutely none of those things.

The most polished lectures are rarely the most useful lectures.

- An eloquent presentation can produce the sensation of learning without actually delivering that outcome.
- Smooth delivery elides gaps in understanding rather than exposing and correcting them.
- What have you really *learned* from TED talks?

Goals for better lectures

Clearly present key information in useful context, but also:

- Confront students with limits of their understanding.
- Seek student feedback.

These are characteristics of popular innovations such as flipped classrooms and clickers, but can also be accomplished by interrupting lecture with questions.

Repetition works better than it sounds

- Repetition feels awkward to the speaker, but can be critical for the listener.
- When a student asks a question that I literally just answered, it usually means they were busy processing something else and I'm going too fast.
- Polish is not the same as usefulness.

Lessons from committee service

General Education Requirements Committee

NWCCU in 2014: “The evaluation committee recommends that the institution develop and implement a process of ongoing assessment of learning outcomes for its General Education Program [Standard 4.A].”

Hmmm, we take for granted that evaluation aligns with assessment, but that need not be the case.

Mapping purposes to activities

Learning
(drawing connections, drilling skills)

Outcome assessment
(measuring achievement of course objectives)

Evaluation
(assigning grade)

Homework and Worksheets

Quizzes and Exams

Exams as learning experiences

- Students taking exams are at their most prepared and focused, helping them make new connections.

> "This tool that you just learned is closely related to a key concept from a chemistry course you took last semester. Apply both approaches to this problem, and show that the results are the same."

> "Group theory tells us that chiral molecules are those without an S_n symmetry element. Apply this to the examples below, and show how this is consistent with more common definitions of chirality."

- Fair implementation requires long exams, generous grading rubric.

Exam questions as messages

"Briefly explain a concept that you learned in CHEM 3301 during the past three weeks, but had no opportunity to use or describe elsewhere on this exam."

Not useful for outcome assessment or evaluation, but:

- Reinforces that things not on the exam still matter.
- Recognizes personal growth.
- Good indicator of what students absorb and/or value.

Activities can be useful outside traditional purposes.

- Low stakes homework/worksheet activities can yield high quality assessment data.
- Activities with no value to assessment or evaluation can still be great for learning.
- Careful deliberation leads to better alignment of purpose, format, and weighting.

Lessons from consulting

ALEKS is an online platform for outcomes-oriented math and chemistry education.

Emphasizes assessment of discrete skills to personalize instruction.

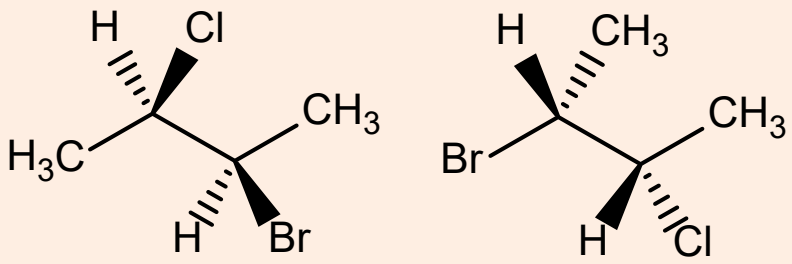
Hmmm, aligning questions with small, narrowly defined outcomes is really useful.

Rethinking question design

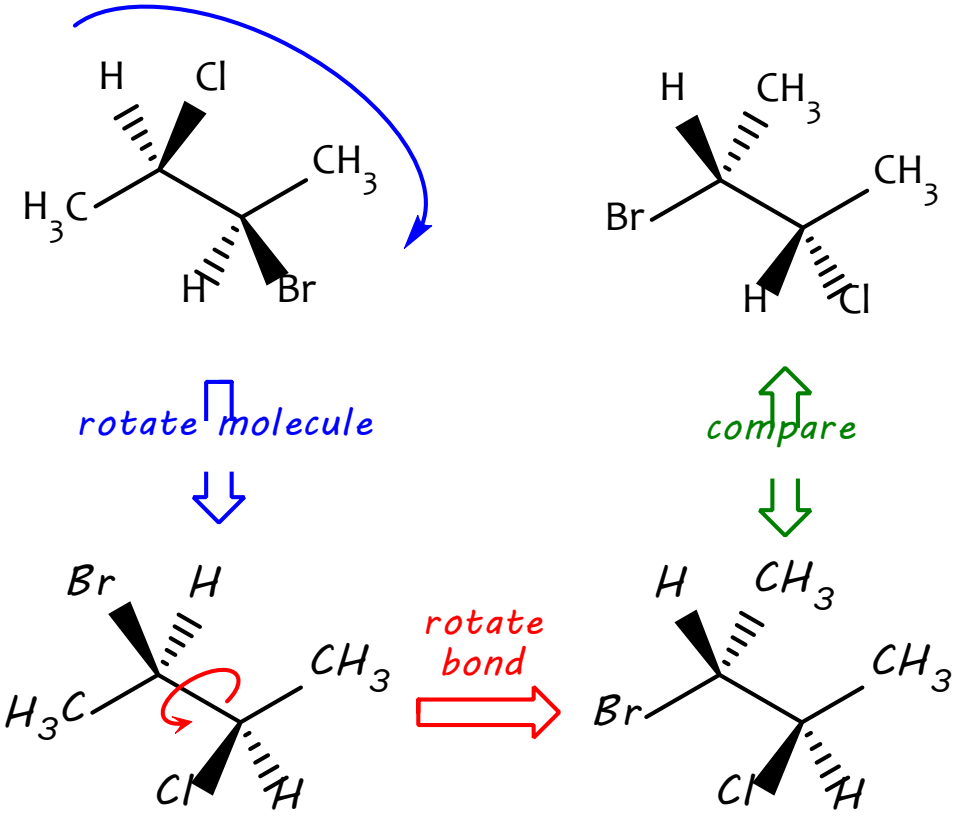
Classic test questions often roll many tasks into one:

What is the structural relationship between the two structures pictured?

a) Identical structures
b) Conformations
c) Enantiomers
d) Diastereomers
e) Constitutitonal isomers



Rethinking question design



Solution requires student to:

- rotate molecule
- rotate bonds
- apply terms

Simpler questions

Draw the result of rotating this molecule 180° in the plane of the page.

Draw the result of rotating the C2-C3 bond to move the Br atom into the plane of the page.

Draw the enantiomer of the pictured structure.

Capstone questions where students put ideas together are still important but need not be default.

Breaking a complex question into several parts is sometimes better for everyone.

Simpler questions offer:

- More precise assessment feedback.
- More confidence for students.
- Easier grading (sometimes).

Elegant questions are fun for me, but not necessarily useful to students.

Teaching ideas can come from unexpected places.

The expected places:

- Education literature
- Colleagues
- Research
- Course evaluations

Hearing student feedback

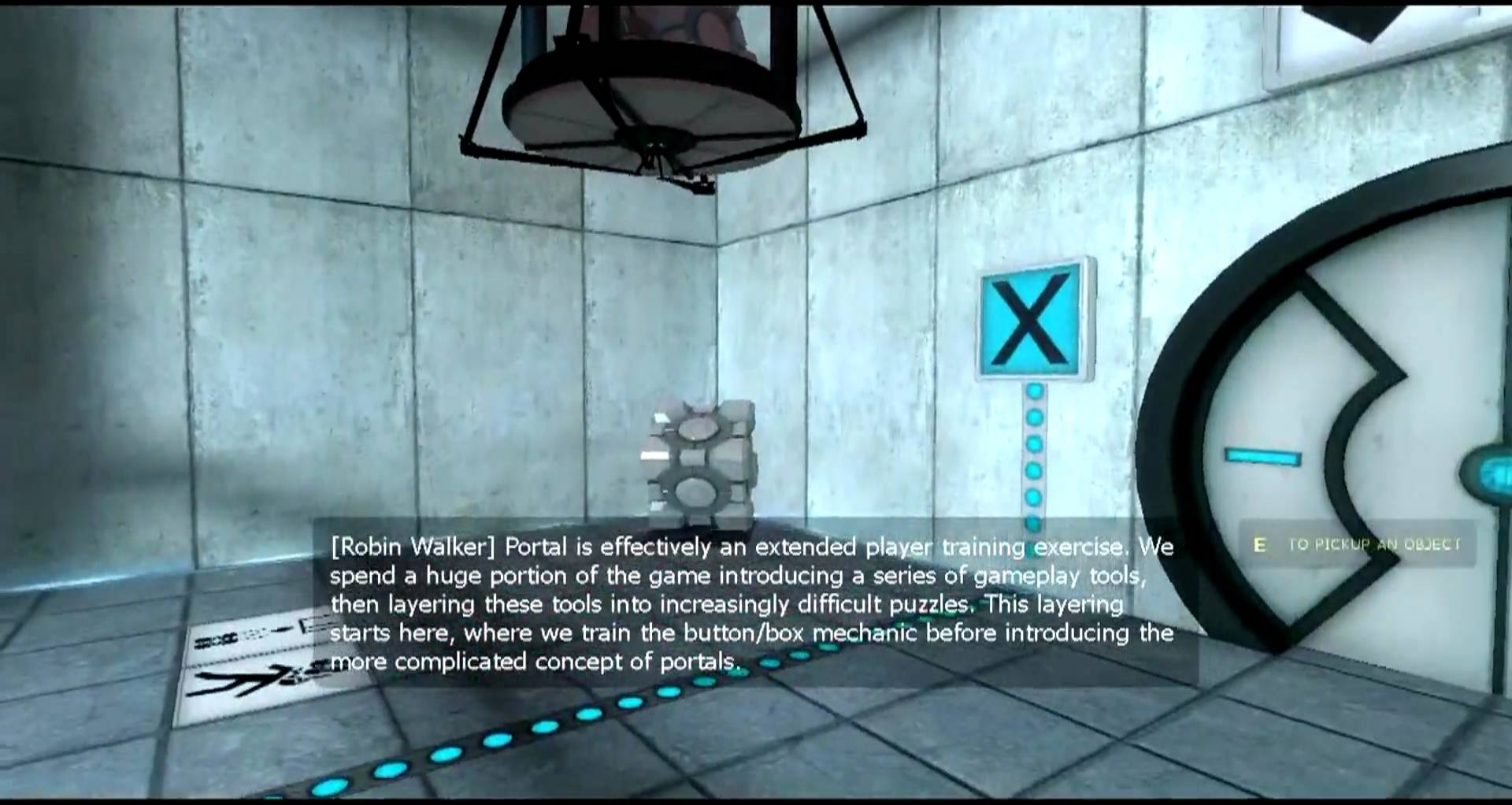
"Too many 'bad examples' that contradict what we are supposed to learn. How are we supposed to keep track of what the right answer is?"

"But the whole point is to think critically about these ideas rather than just parroting them. If I just ask you to memorize stuff that TOTALLY defeats the whole…"

"You've misunderstood the purpose of discussing those exceptions, so I should probably make it more clear."

Lessons from… video games?

Lessons from… video games?


[Robin Walker] Portal is effectively an extended player training exercise. We spend a huge portion of the game introducing a series of gameplay tools, then layering these tools into increasingly difficult puzzles. This layering starts here, where we train the button/box mechanic before introducing the more complicated concept of portals.
E TO PICKUP AN OBJECT

Course design = game design?

- A key goal is to encourage ~~players~~ students to spend their time and effort in productive ways.

- How do you make activities open-ended while still directing ~~players~~ students in a productive direction?

- When should you use subtle tips to suggest a certain problem solving strategy?

- If my class is this much like a game, is that actually an indictment of the class?

Closing thoughts

- Every instructor carries a set of preconceptions and assumptions that warrant deliberate inspection.
- Activities both in and outside the classroom provide useful new perspectives and ideas.
- Every class is unique and is best served by a unique approach.