

Icebreaker questions

- Why do you want to flip your classroom?
- What is your biggest concern about flipped classroom?



To Flip, Perchance to Dream

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18 October 2024



Caveat

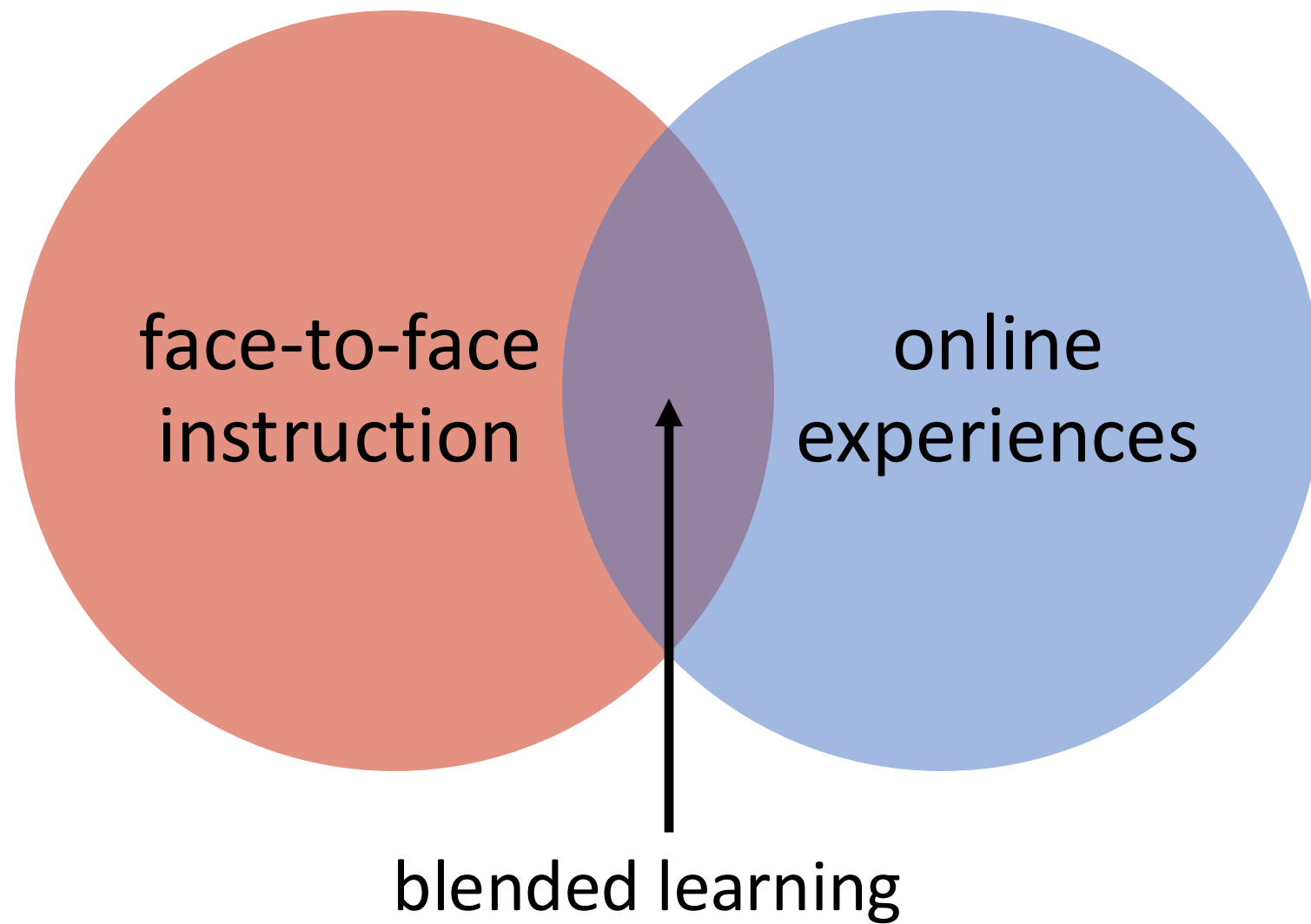
*“evidence shows that it is not the technology per se that changes learning and teaching but the **pedagogical advantage** we make of its use”*

Price and Kirkwood (2008)

Blended learning is...

*“a combination of on-site (i.e. face-to-face) with online experiences to produce **effective, efficient** and **flexible** learning”*

Stein and Graham (2016)



Why blended learning?

Improved instructional design

- Blended courses are arguably more intentionally designed than face-to-face courses

Increased guidance and triggers

- Students in face-to-face classes receive guidance from the teacher, and explicit guidance online

Easier access to learning activities

- With materials and activities online, the class can engage according to their own schedule

Individualised learning opportunities

- Digital materials can be accessed according to students' needs allowing students to self-direct their learning

Increased engagement through social interaction

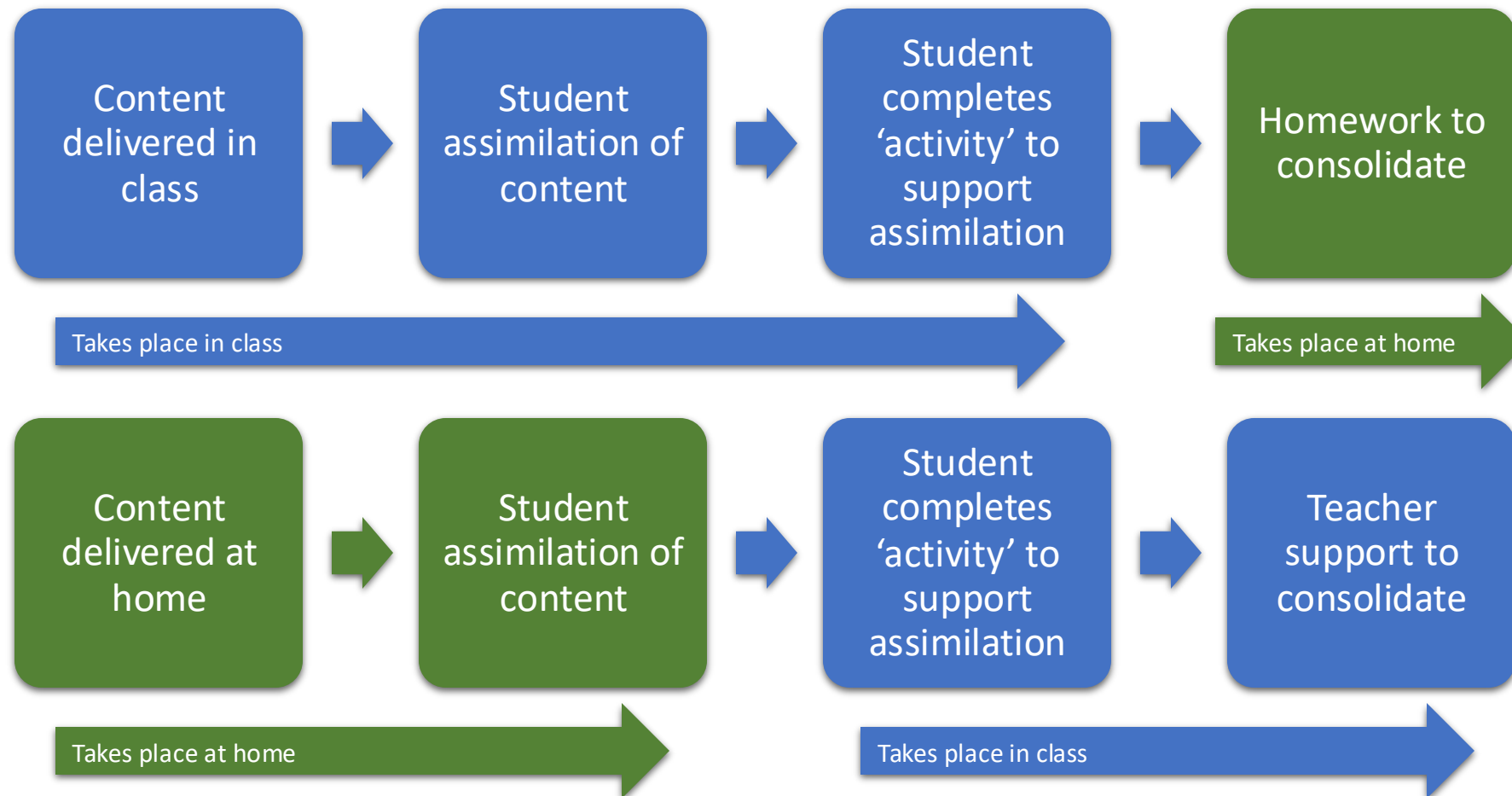
- Face-to-face time can be repurposed for more interactive engagement

Time on task

- Blended courses tend to intensify student focus on more relevant work

The flipped classroom approach

Traditional vs flipped



Based on a graphic taken from Steed, A. (2012) The Flipped Classroom, *Teaching Business & Economics*, **16**, 9–11.

Traditional vs flipped

Traditional:
Lessons in class, homework at home

Flipped:
Lessons at home, homework in class

Theoretical basis

*“To develop competence in an area of inquiry, students must: a) **have a deep foundation of factual knowledge,** b) **understand facts and ideas in the context of a conceptual framework,** and c) **organize knowledge in ways that facilitate retrieval and application**”*

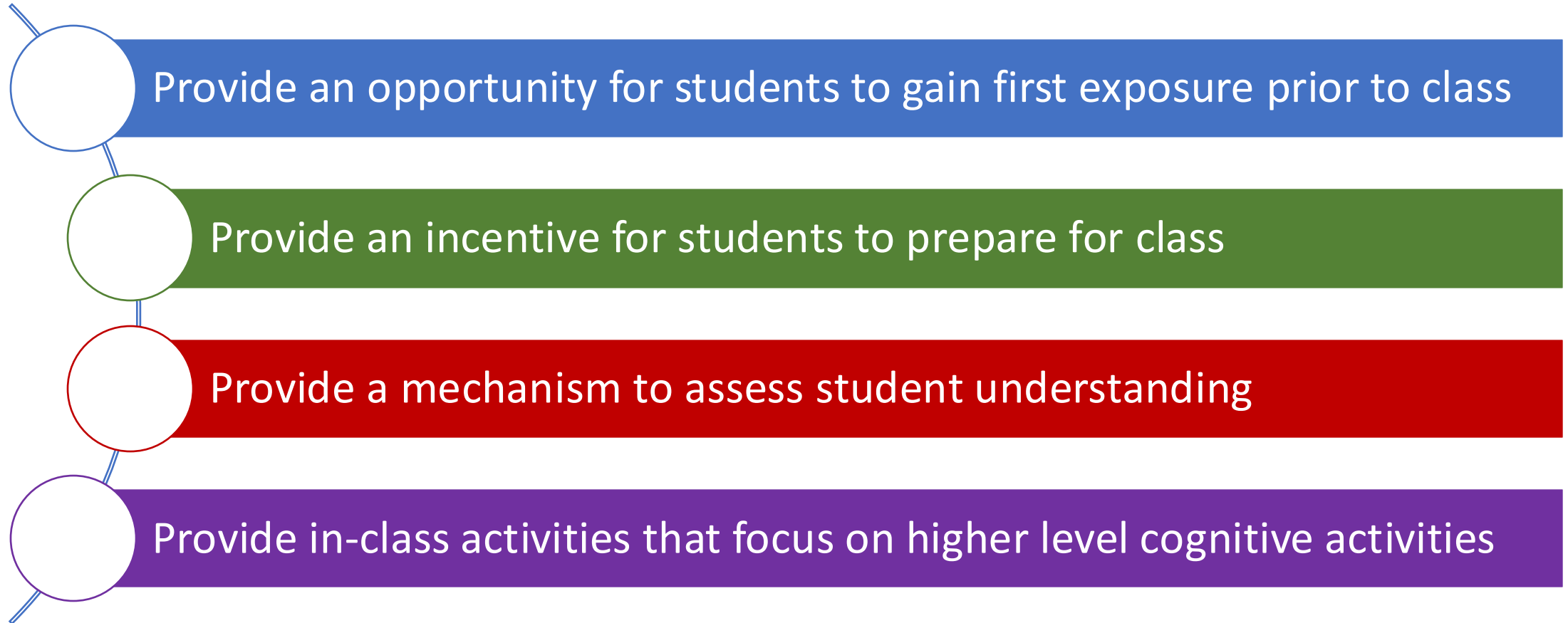
Bransford *et al.* (2000, p. 16)

Theoretical basis

*“A ‘**metacognitive**’ approach to instruction can help students learn to take control of their own learning by defining learning goals and monitoring their progress in achieving them”*

Bransford *et al.* (2000, p. 18)

What are the key elements?



Brame, C., (2013) *Flipping the classroom*, Vanderbilt University Center for Teaching [<http://cft.vanderbilt.edu/guides-sub-pages/flipping-the-classroom/>].

Breakout activity

Chat about the class you want to flip. How do you intend to implement the four key elements?

- How will students gain basic knowledge prior to class?
- How will you incentivise students to be prepared for class?
- How will you assess whether students are prepared?
- What kind of higher-order cognitive learning activities do you intend to use?

My flipped classroom

Week before
class



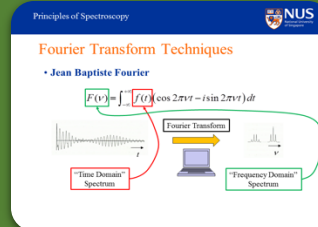
One day before
class



In class

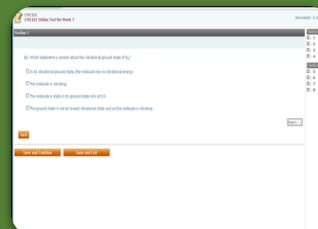


Following
week



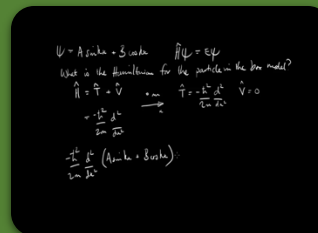
Online Lectures

- Playlists of short (10–15 minute), narrated presentations



Weekly Online Quizzes

- Identification of student misconceptions



Large Class Review Session

- Review of online material
- Learner response system

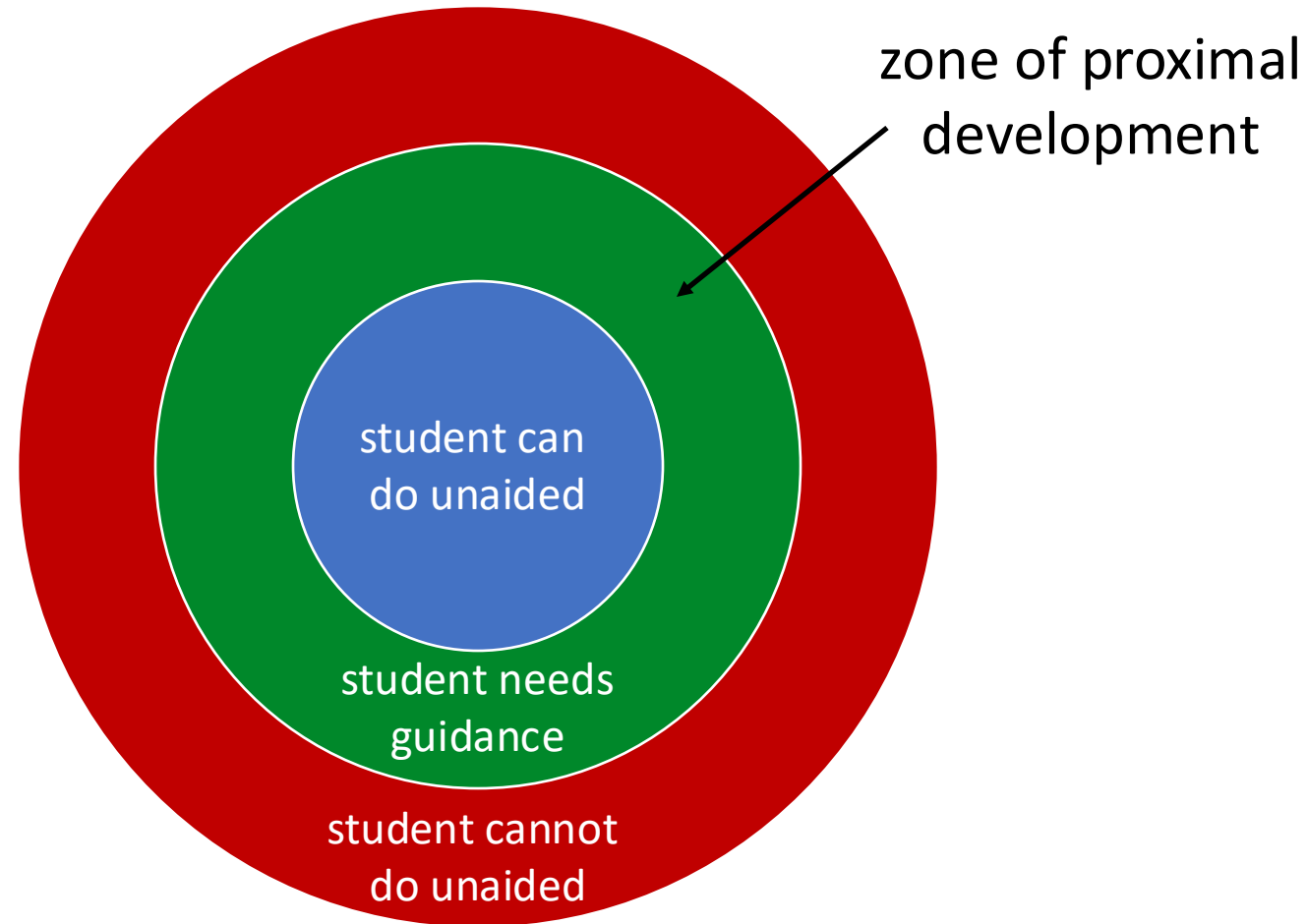


Small Group Active Learning

- Work in groups of 3–5 students
- Active problem solving
- Peer learning

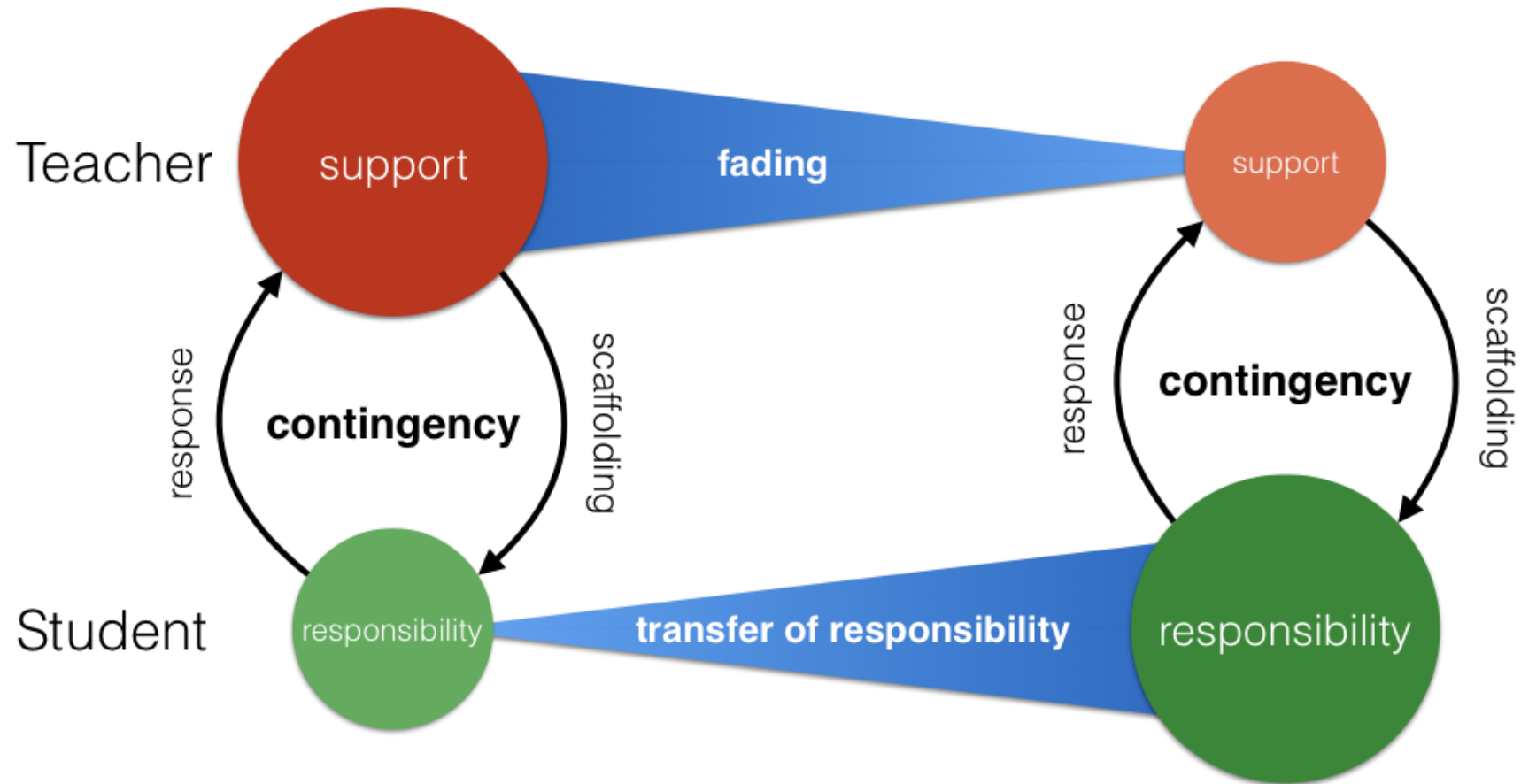
Important pedagogical components

Zone of proximal development



Vygotsky, L.S. (1978) *Mind in Society: Development of Higher Psychological Processes*, Cambridge, MA: Harvard University Press, pp. 86-87.

Model of scaffolding

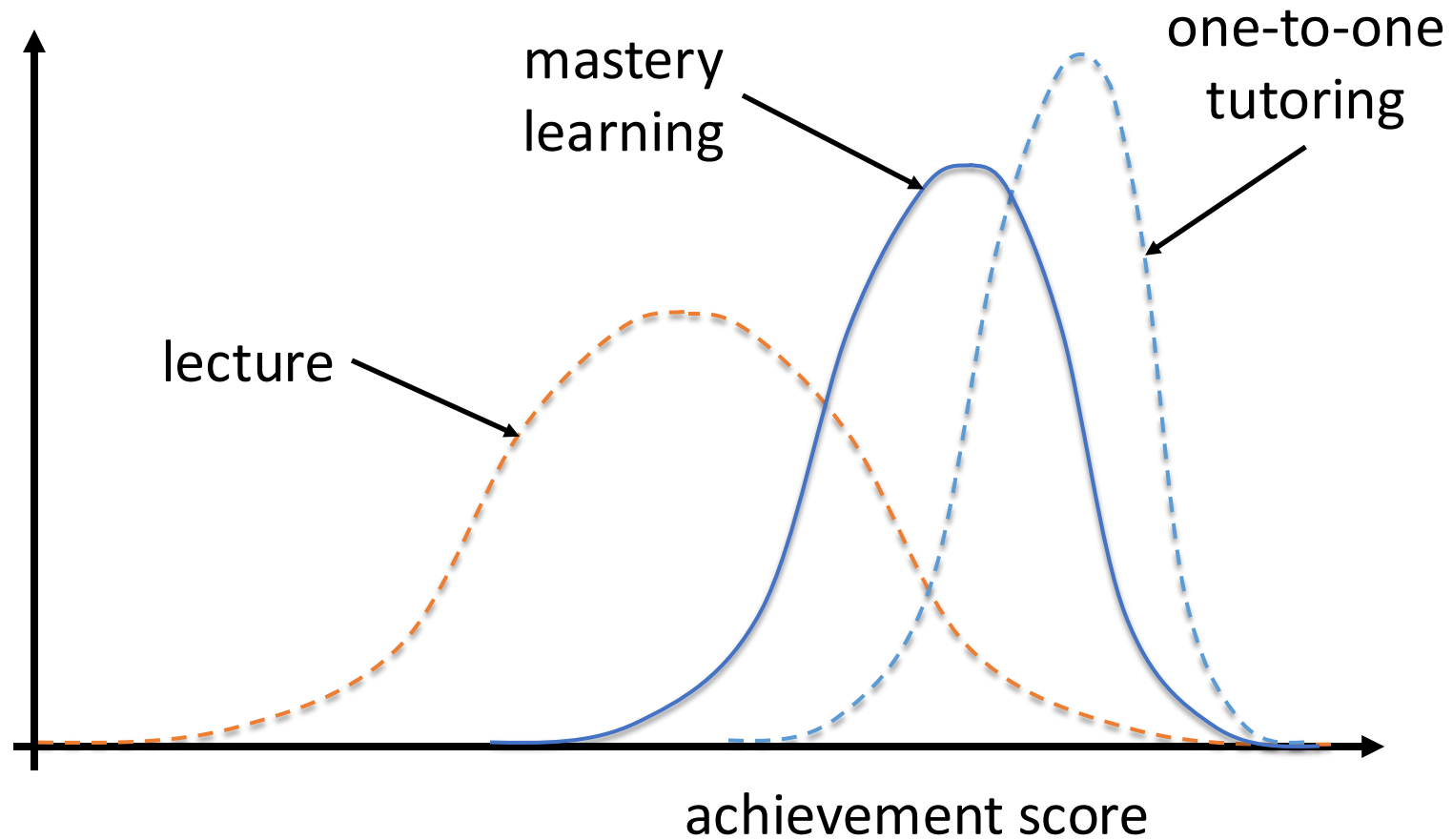


Just-in-time teaching

*“The most important single factor influencing learning is **what the learner already knows**. Ascertain this and teach [them] accordingly.”*

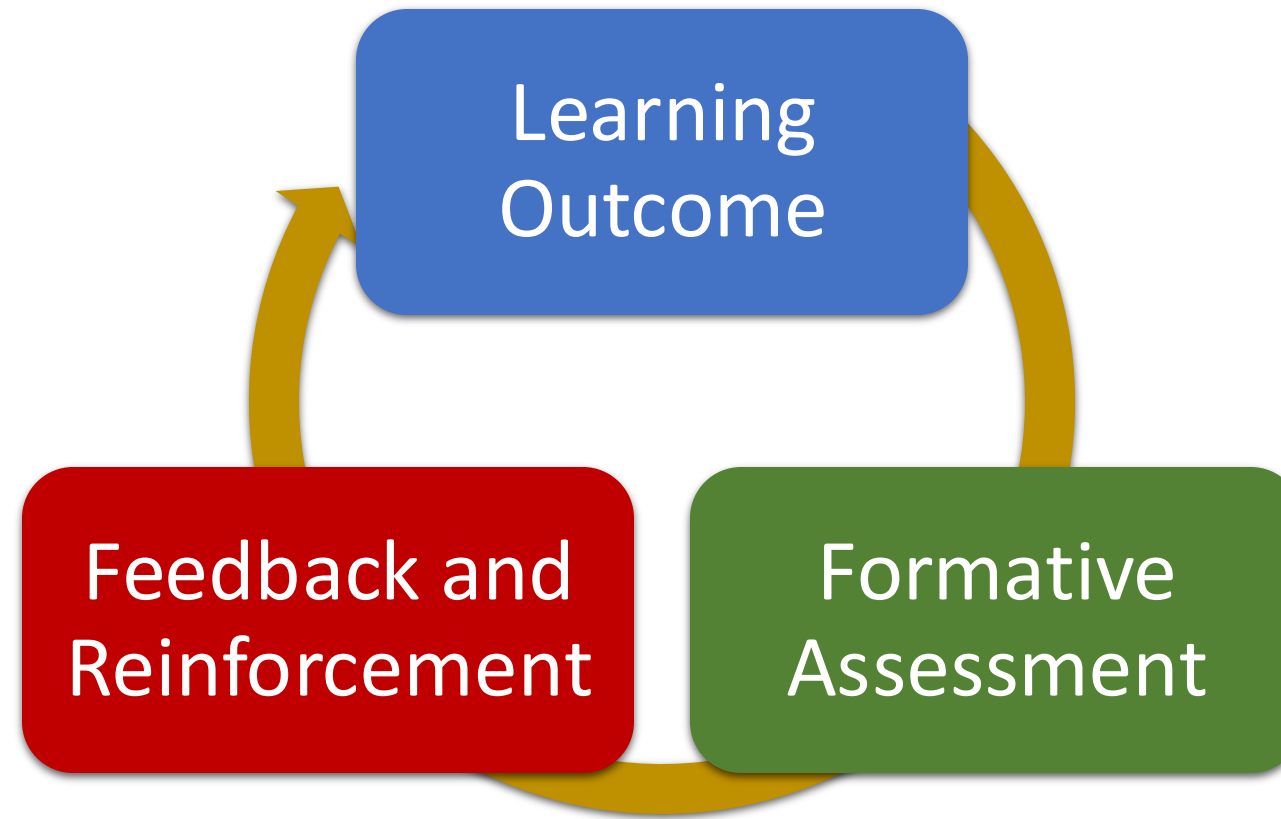
Ausubel (1968)

Mastery learning



Bloom, B. (1984) The 2 Sigma Problem: The Search for Methods of Group Instruction as Effective as One-to-One Tutoring, *Educational Researcher*, **13**(6), 4–16.

Mastery learning



Bloom, B. S., and J. B. Carroll. (1971) *Mastery learning: Theory and practice*, New York: Holt, Rinehart and Winston.

Weekly online quiz

CM2101 Online Quiz: Topic 4a CLOSE Print

Assessment Title : Online Quiz: Topic 4a
Student Name : ADRIAN MICHAEL LEE
Start Date and Time : 09-Apr-2014 09:57 AM
Number of Attempts : 1 out of 5
Duration : 6m 50s
Total Marks : 5 out of 10

You can always view your assessment feedback by clicking on Usage/My Usage in the horizontal menu from the IVLE Workspace.

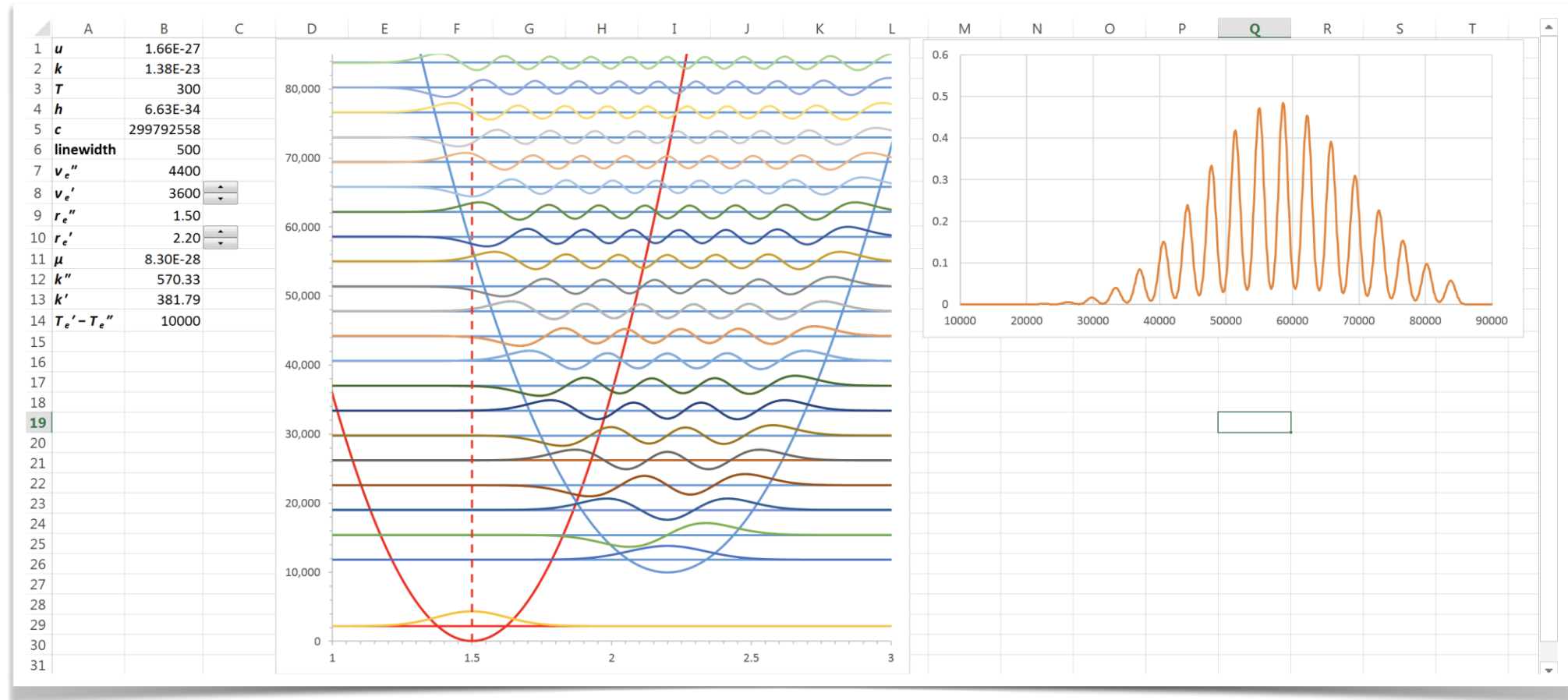
Section 1
For your first attempt, please provide a brief rationale for your answer. (If you forgot to provide a rationale first time through, you can provide the rationale on a later attempt.)

1) What is the degeneracy of the rotational energy level with $J = 4$ for a heteronuclear diatomic molecule?

☐ 2
☒ 9
☐ 1
☐ 4

Your Answer :	9
Solution :	Degeneracy arises from the fact that the different spatial orientations have the same energy. For a given value of J , there are a number of possible M_J values.
Your Marks :	1 out of 1

Interactive visualisations



Peer instruction

EDUCATION

Farewell, Lecture?

Eric Mazur

Discussions of education are generally predicated on the assumption that we know what education is. I hope to convince you otherwise by recounting some of my own experiences. When I started teaching introductory physics to undergraduates at Harvard University, I never asked myself how I would educate my students. I did what my teachers had done—I lectured. I thought that was how one learns. Look around anywhere in the world and you'll find lecture halls filled with students and, at the front, an instructor. This approach to education has not changed since before the Renaissance and the birth of scientific inquiry. Early in my career I received the first hints that something was wrong with teaching in this manner, but I had ignored it. Sometimes it's hard to face reality.

When I started teaching, I prepared lecture notes and then taught from them. Because my lectures deviated from the textbook, I provided students with copies of these lecture notes. The infuriating result was that on my end-of-semester evaluations—which were quite good otherwise—a number of students complained that I was “lecturing straight from (his) lecture notes.” What was I supposed to do? Develop a set of lecture notes different



Click here. Students continually discuss concepts among themselves and with the instructor during class. Discussions are spurred by multiple-choice conceptual questions that students answer using a clicker device. See supporting online text for examples of such “clicker questions.”

from the ones I handed out? I decided to ignore the students' complaints.

A few years later, I discovered that the students were right. My lecturing was ineffective, despite the high evaluations. Early on in the physics curriculum—in week 2 of a typical introductory physics course—the Laws of Newton are presented. Every student in such a course can recite Newton's third law of motion, which states that the force of object A on object B in an interaction between two objects is equal in magnitude to the force of B on A—it sometimes is known as “action is reaction.” One day, when the course had progressed to more complicated material, I decided to test my students' understanding of this concept not by doing traditional problems, but by asking them a set of basic conceptual questions (1, 2). One of the questions, for example, requires students to compare the forces that a heavy truck and a light car exert on one another when they collide. I expected that the students would have no trouble tackling such questions, but much to my surprise, hardly a minute after the test began, one student asked, “How should I answer these questions? According to what you taught me or according to the way I usually think about these things?” To my dismay, students had great difficulty with the conceptual questions. That was when it began to dawn on me that something was amiss.

In hindsight, the reason for my students' poor performance is simple. The traditional approach to teaching reduces education to a transfer of information. Before the industrial revolution, when books were not yet mass commodities, the lecture method was the only way to transfer information from one generation to the next. However, education is so

A physics professor describes his evolution from lecturing to dynamically engaging students during class and improving how they learn.

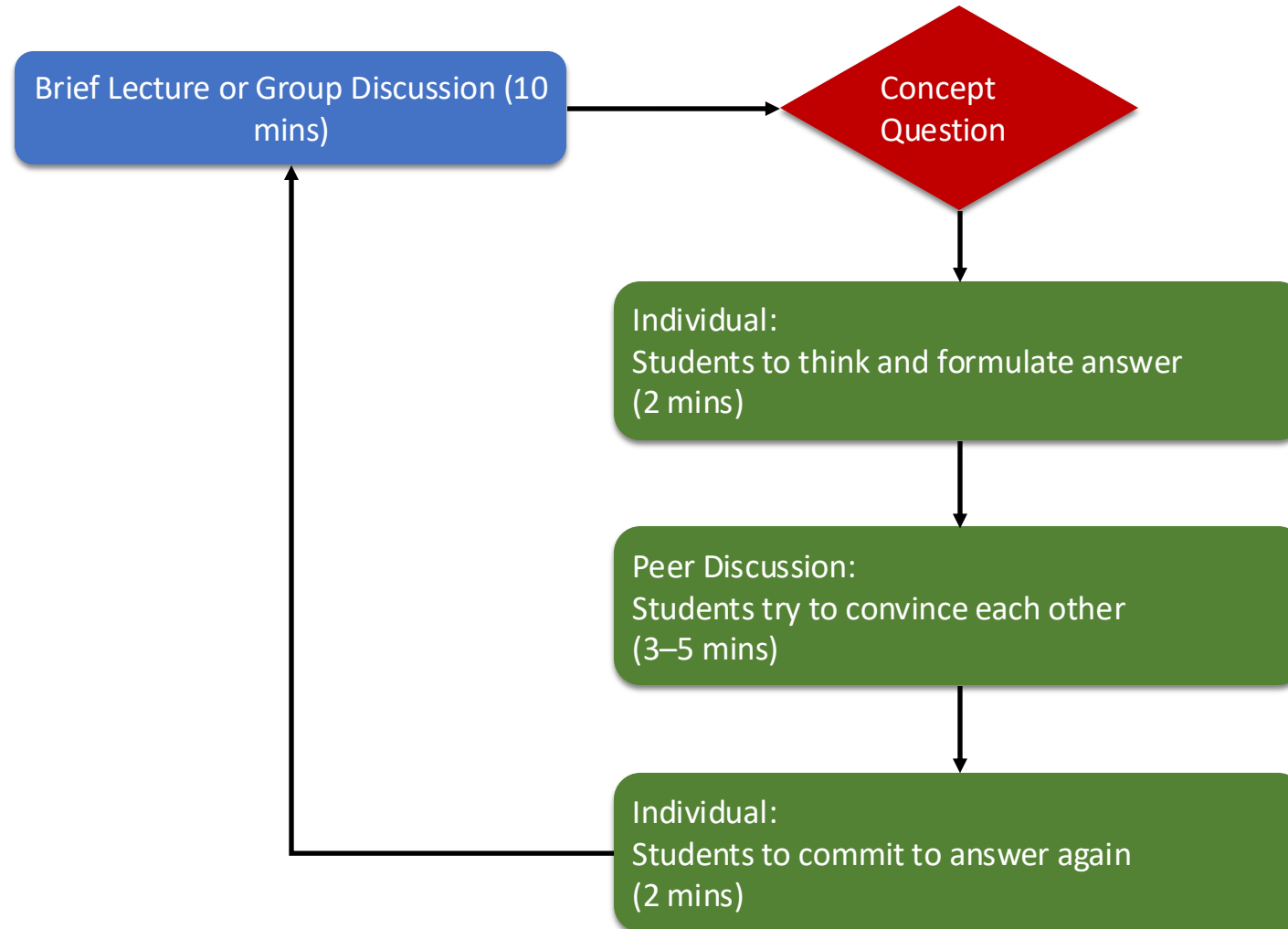
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CREDIT (BOTTOM): JON CHASE/HARVARD UNIVERSITY

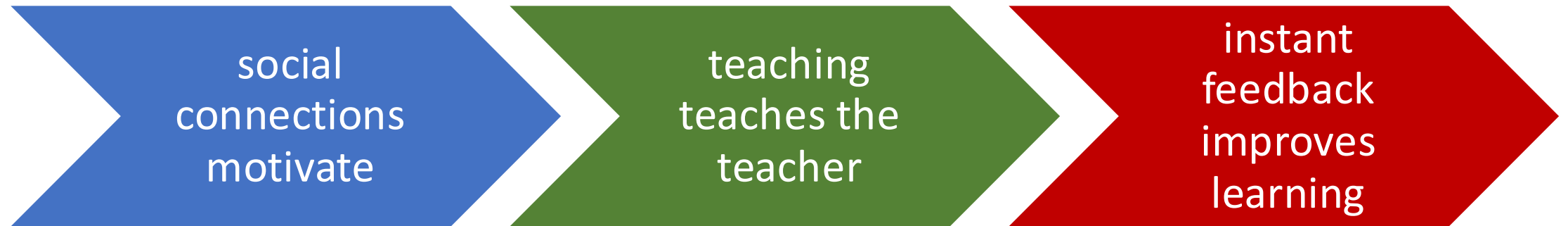
Mazur, E. (2009) Farewell, Lecture?, *Science*, **323**, 50–51.

Large class review sessions



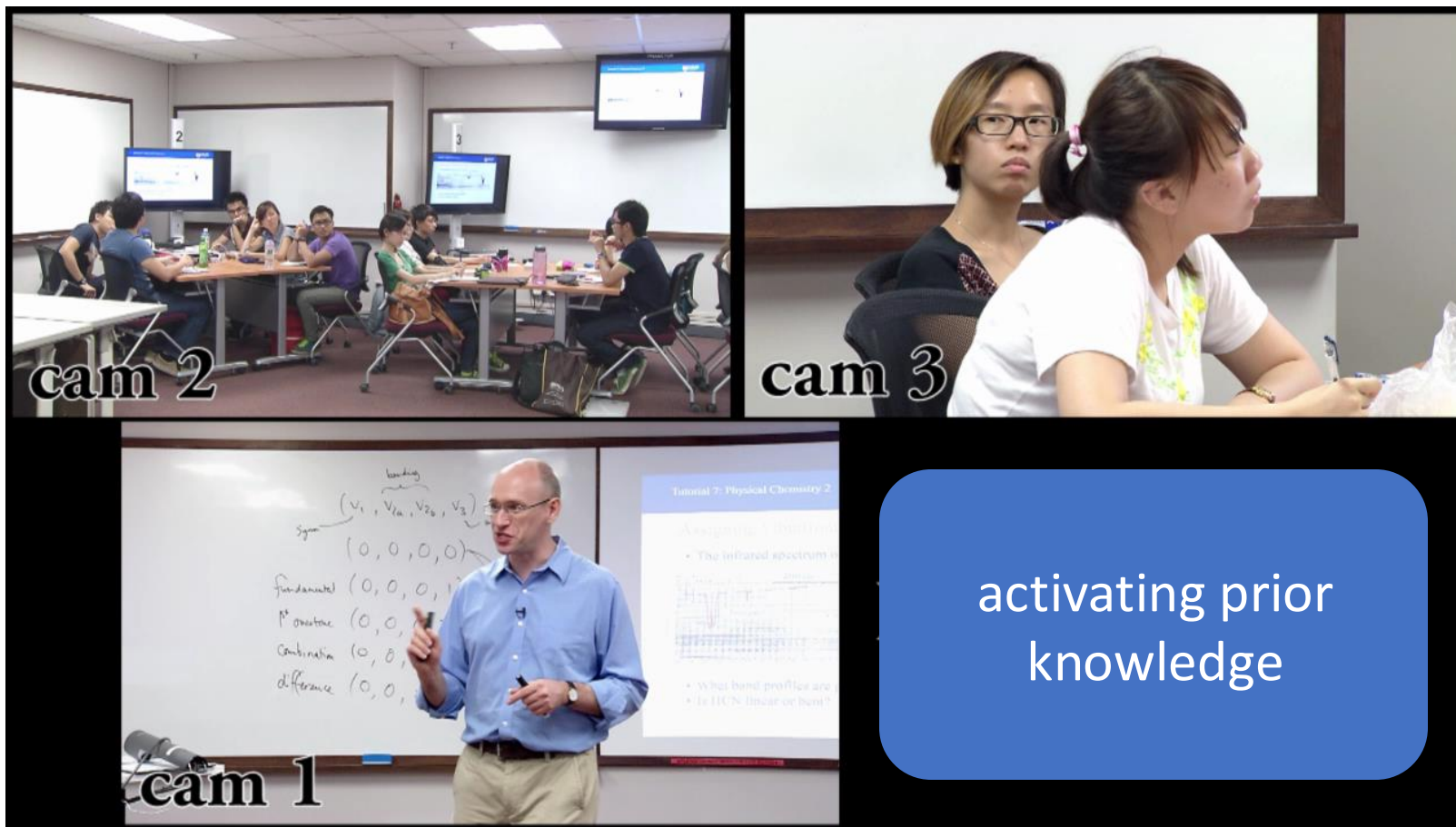
Mazur, E. (1998) *Peer Instruction: A User's Manual*, Englewood Cliffs: Prentice Hall.

Three social science generalisations



King, G., and M. Sen (2013) How social science research can improve teaching, *PS: Political Science and Politics*, **46**, 621–629.

Active learning tutorial: activating prior knowledge



Active learning tutorial: peer learning



Active learning tutorial: facilitation



Teaching in an active learning classroom

<https://youtu.be/ea6q4Ah3JPc>

Does it work?

Improved Learning in a Large-Enrollment Physics Class

Louis Deslauriers,^{1,2} Ellen Schelew,² Carl Wieman^{1†‡}

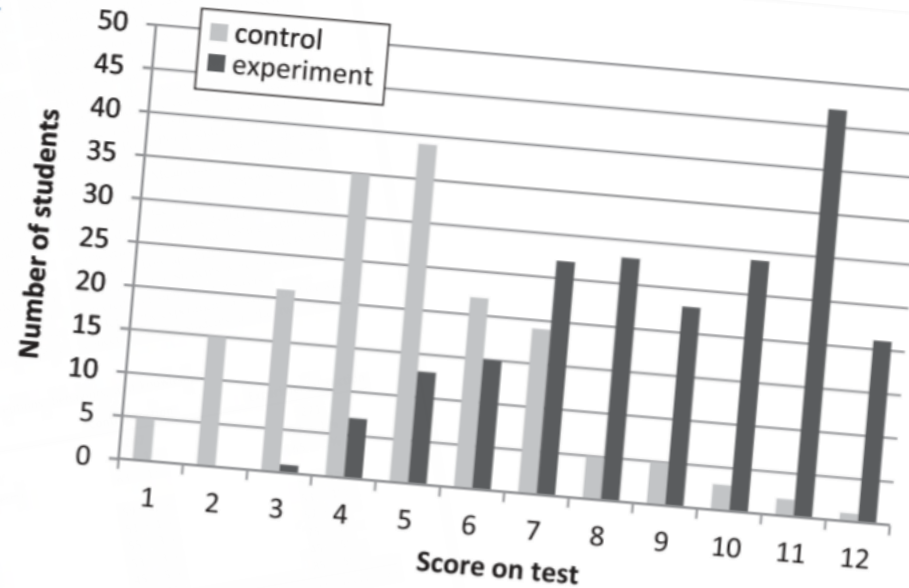
We compared the amounts of learning achieved using two different instructional approaches under controlled conditions. The experimental group received a specific set of topics and objectives when taught by an experienced highly rated instructor based on research in learning science. The control group received the same instruction based on traditional lecture given by an experienced highly rated but inexperienced instructor using traditional lecture. The comparison was made between two sections of the same physics course. We found that the experimental group achieved twice the learning in the same amount of time as the control group.

Fig. 1. Histogram of student scores for the two sections.

from any particular practice but rather from the integration into the overall deliberate practice framework.

This study was carried out in the second term of the first-year physics sequence taken by all of the first-year physics students at the University of British Columbia. This calculus-based course covers various standard topics in electricity and magnetism. The course enrollment was 850 students, who were divided among three sections. Each section had 3 hours of lecture per week. The lectures were held in a large theater-style lecture hall with fixed chairs behind benches grouping up to five students. The students also had weekly homework assignments, instructional laboratory experiments, and recitations where they received feedback on their work. All course sections were graded. All course sections were graded.

The traditional prevailing view of the postsecondary education system is that students are a growing number of other instructional approaches (1–8). A typical demonstration of this is the change in the standard concept inventory. In our study, we found that the quantum mechanics section in the first term showed a significant improvement in the later part of the year by the large number of students who took the course.



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†To whom correspondence should be addressed. E-mail: gilbert@wieman.com.
‡This work does not necessarily represent the views of the Office of Science and Technology Policy or the United States government.

Measurements of student learning were taken during the experiment. Attendance during experiment, Attendance before experiment, Engagement during experiment, Engagement before experiment.

*Average value of multiple measurements carried out in a 2-week interval before the location in the classroom; numbers given are spatial and temporal averages.

13 MAY 2011 VOL 332 SCIENCE www.sciencemag.org

Active learning increases student performance in science, engineering, and mathematics

Scott Freeman^{a,1}, Sarah L. Eddy^a, Miles McDonough^a, M. K. Smith^a, N. Okoroafor^a, H. Jordt^a and Mary Pat Wenderoth^a

^aDepartment of Biology, University of Washington

Edited* by Bruce Alberts, University of California

To test the hypothesis that lecturing impacts course performance, we metaanalyzed 225 data on examination scores or failure rates in performance in undergraduate science, engineering, and mathematics (STEM) courses versus active learning. The effect sizes increased by 0.47 SDs under active learning that the odds ratio for failing was 1.95 (n = 67 studies). These results indicate that scores improved by about 6% in active students in classes with traditional lecturing. Heterogeneity analyses indicated that the STEM disciplines, that active learning concept inventories more than on concept inventories appears effective across the greatest effects are in small (n ≤ 5) and fail-safe n calculations suggest publication bias. The results also suggest methodological rigor of the inclusion of controls over student quality, largest and most comprehensive STEM education published to date. The continued use of traditional lecturing as a preferred, empirically supported active learning as the preferred, empirically validated teaching practice in regular classrooms.

constructivism | undergraduate education | evidence-based teaching | scientific teaching



Student performance in

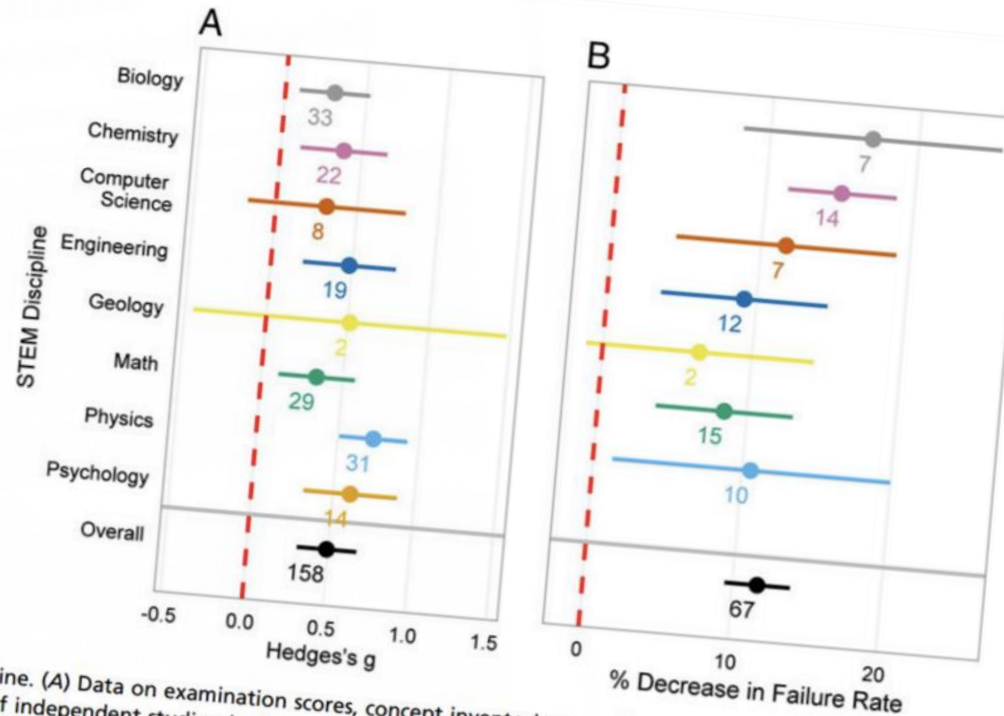


Fig. 2. Effect sizes by discipline. (A) Data on examination scores, concept inventories, or other assessments. (B) Data on failure rates. Numbers below data points indicate the number of independent studies; horizontal lines are 95% confidence intervals.

Freeman, S., S. L. Eddy, M. McDonough, M. K. Smith, N. Okoroafor, H. Jordt and M. P. Wenderoth. (2014) Active learning increases student performance in science, engineering, and mathematics. *Proceedings of the National Academy of Sciences*. **111**, 8410–8415.

Peer Instruction: Ten years of experience and results

Catherine H. Crouch and Eric Mazur^{a)}
Department of Physics, Harvard University, Cambridge, Massachusetts 02138

(Received 21 April 2000; accepted 15 March 2001)

We report data from ten years of teaching with Peer Instruction in algebra-based introductory physics courses for nonmajors; our results show mastery of both conceptual reasoning and quantitative problem solving. We also discuss ways we have improved our implementation of PI since 1990. Notably, we have replaced in-class reading quizzes with pre-class video and introduced a research-based mechanics textbook for portions of the course. We have also introduced cooperative learning into the discussion sections as well as the laboratory. These changes are intended to help students learn more from pre-class reading and to improve the discussion sections, and are accompanied by further increases in student performance.

American Association of Physics Teachers.

[DOI: 10.1119/1.1374249]

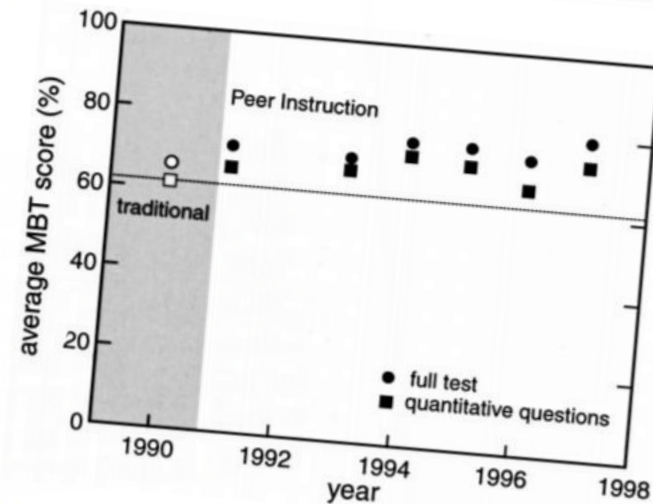
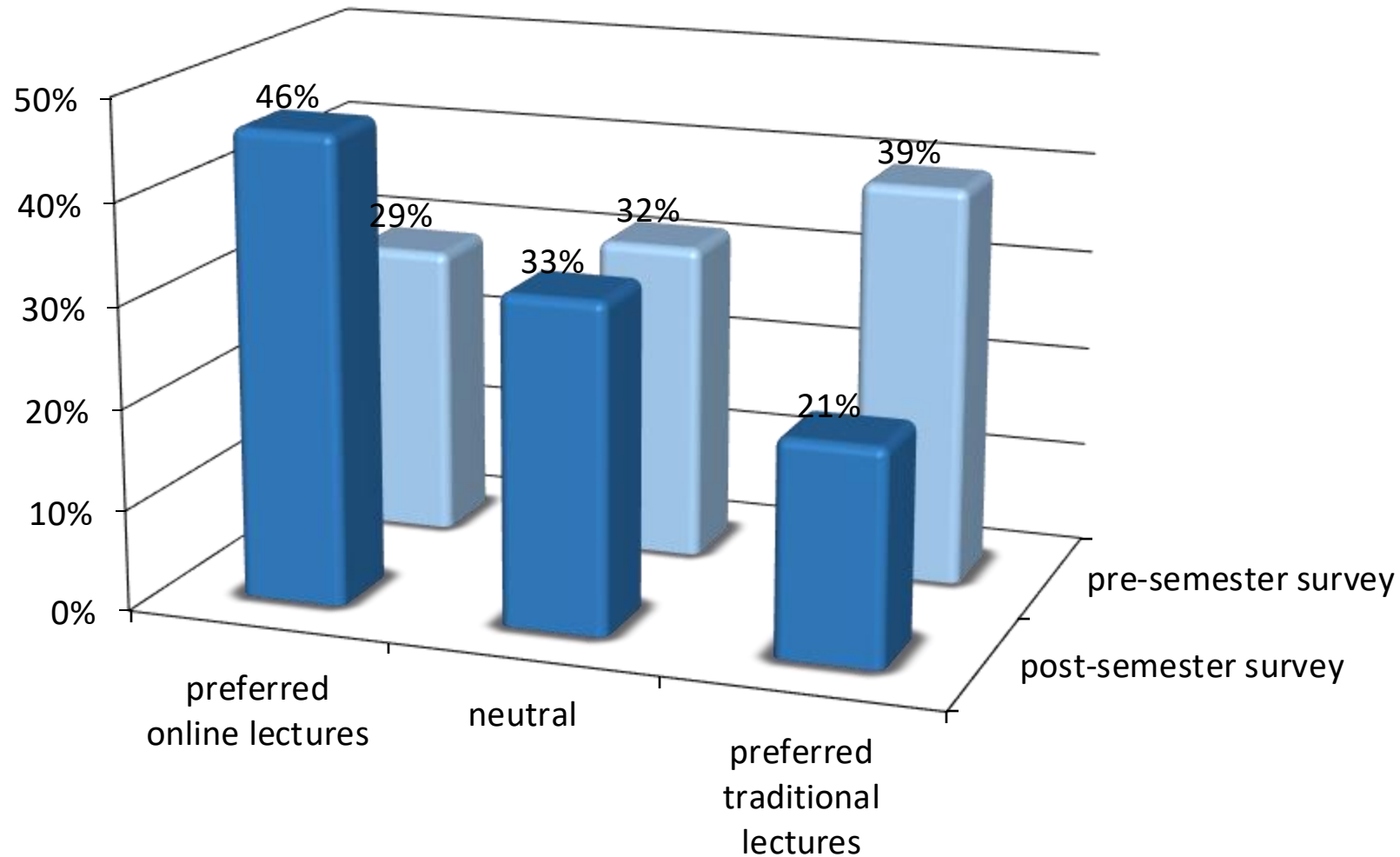
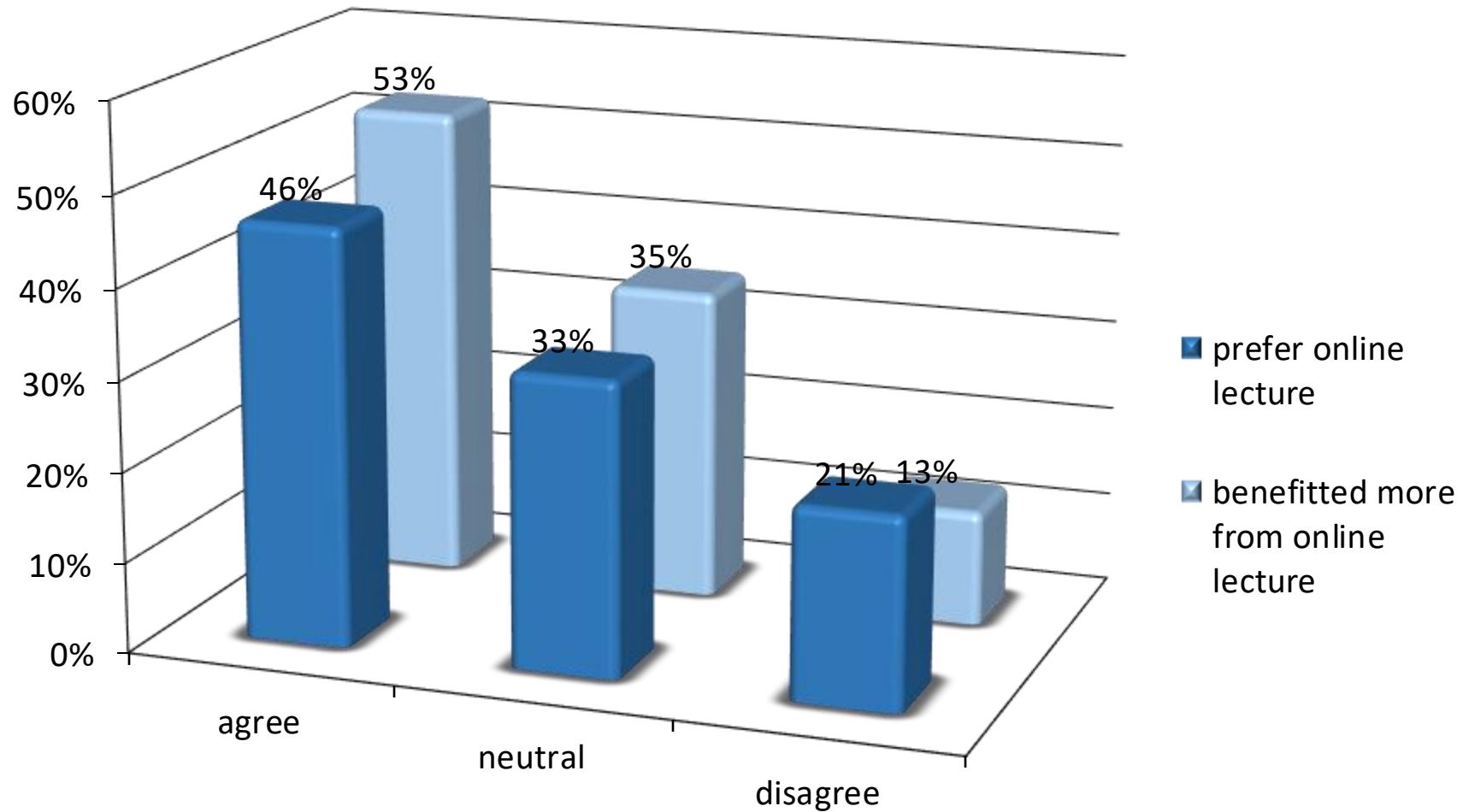


Fig. 3. Mechanics Baseline Test (Ref. 13) scores for introductory calculus-based physics, Harvard University, Fall 1990–Fall 1997. Average score on entire test (circles) and on quantitative questions (Ref. 17) only (squares) vs year are shown. Open symbols indicate traditionally taught courses and filled symbols indicate courses taught with PI. The dotted line indicates performance on quantitative questions with traditional pedagogy (1990).

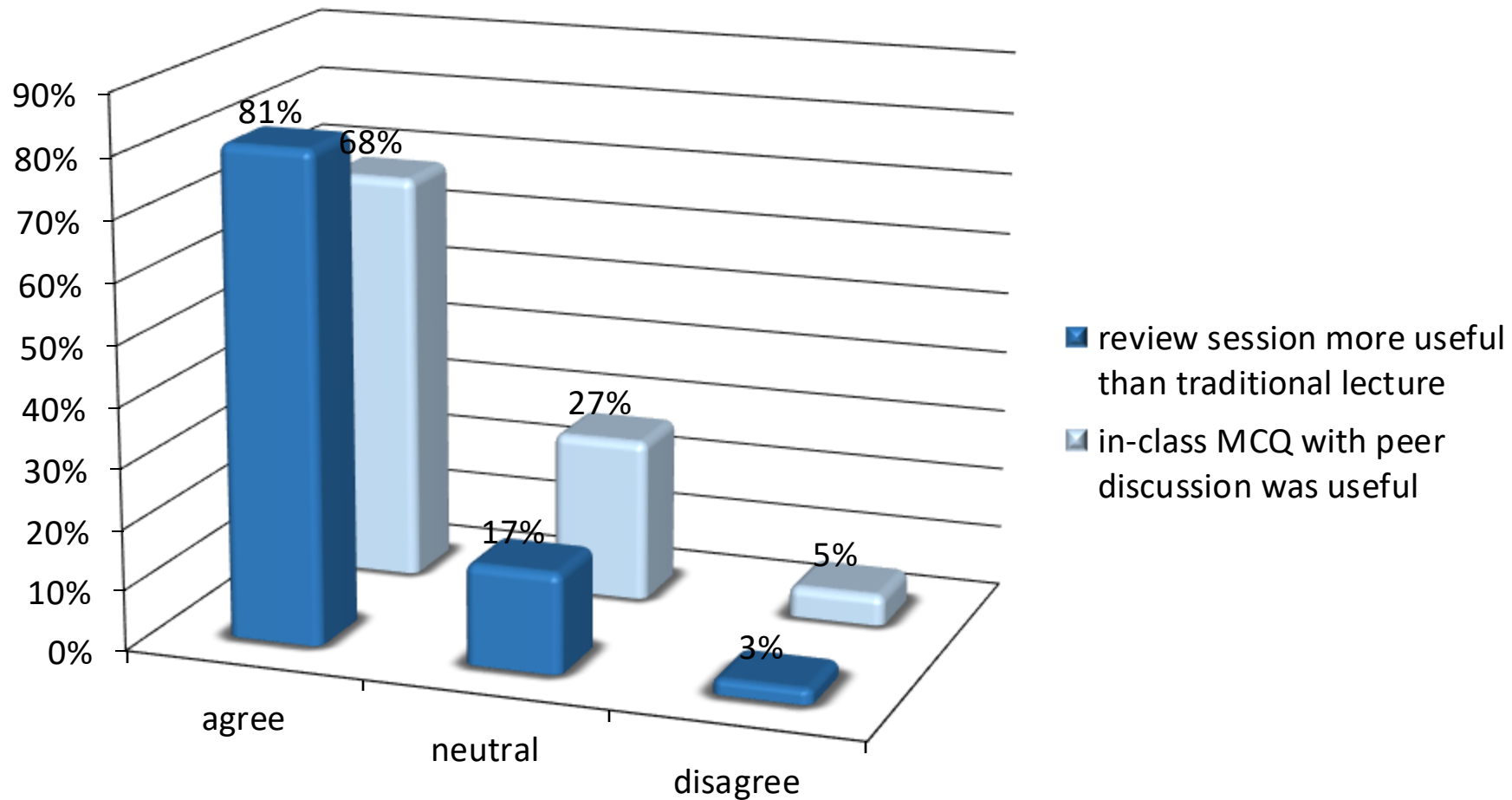
Student feedback: online lectures



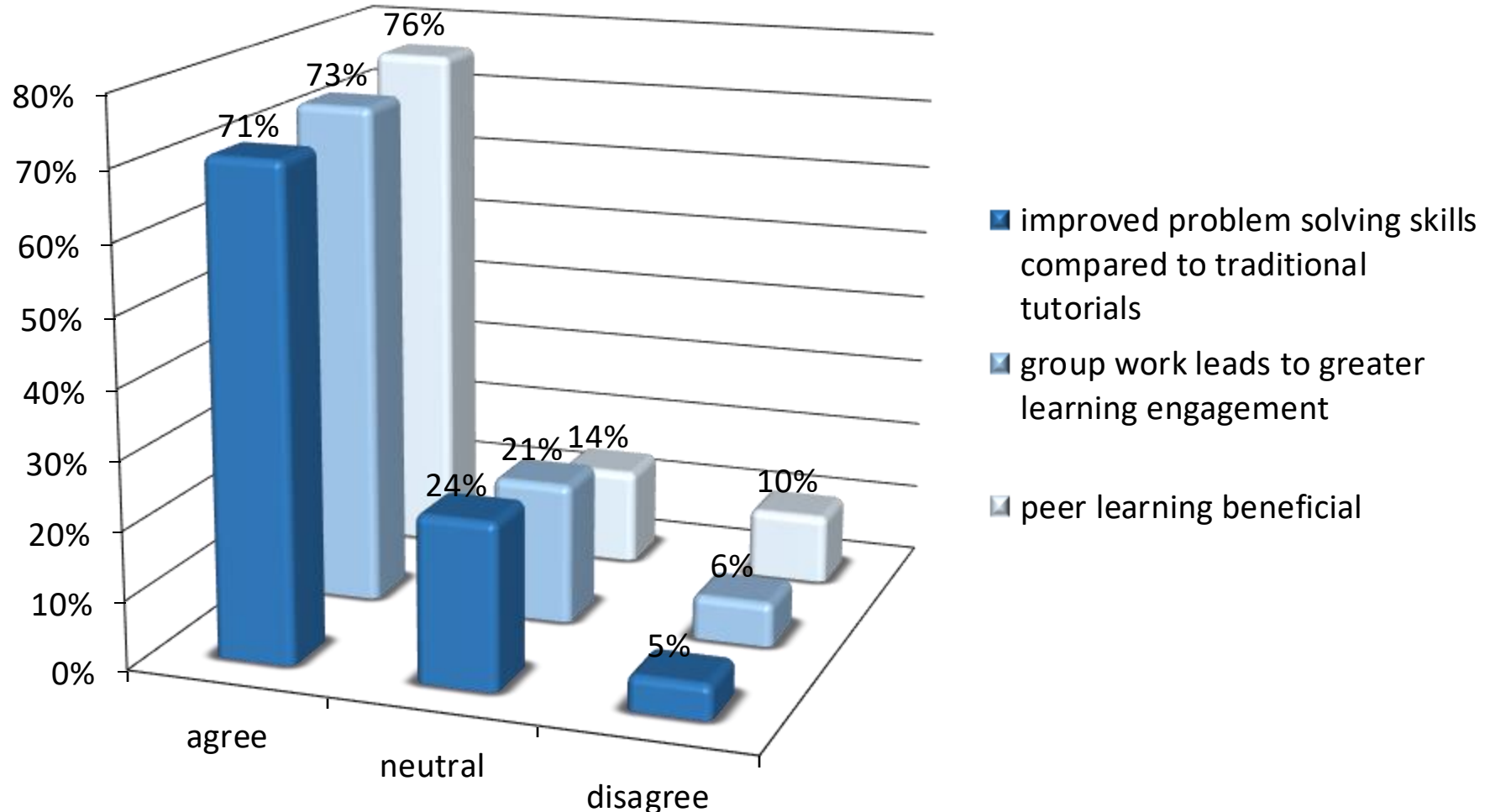
Student feedback: online lectures



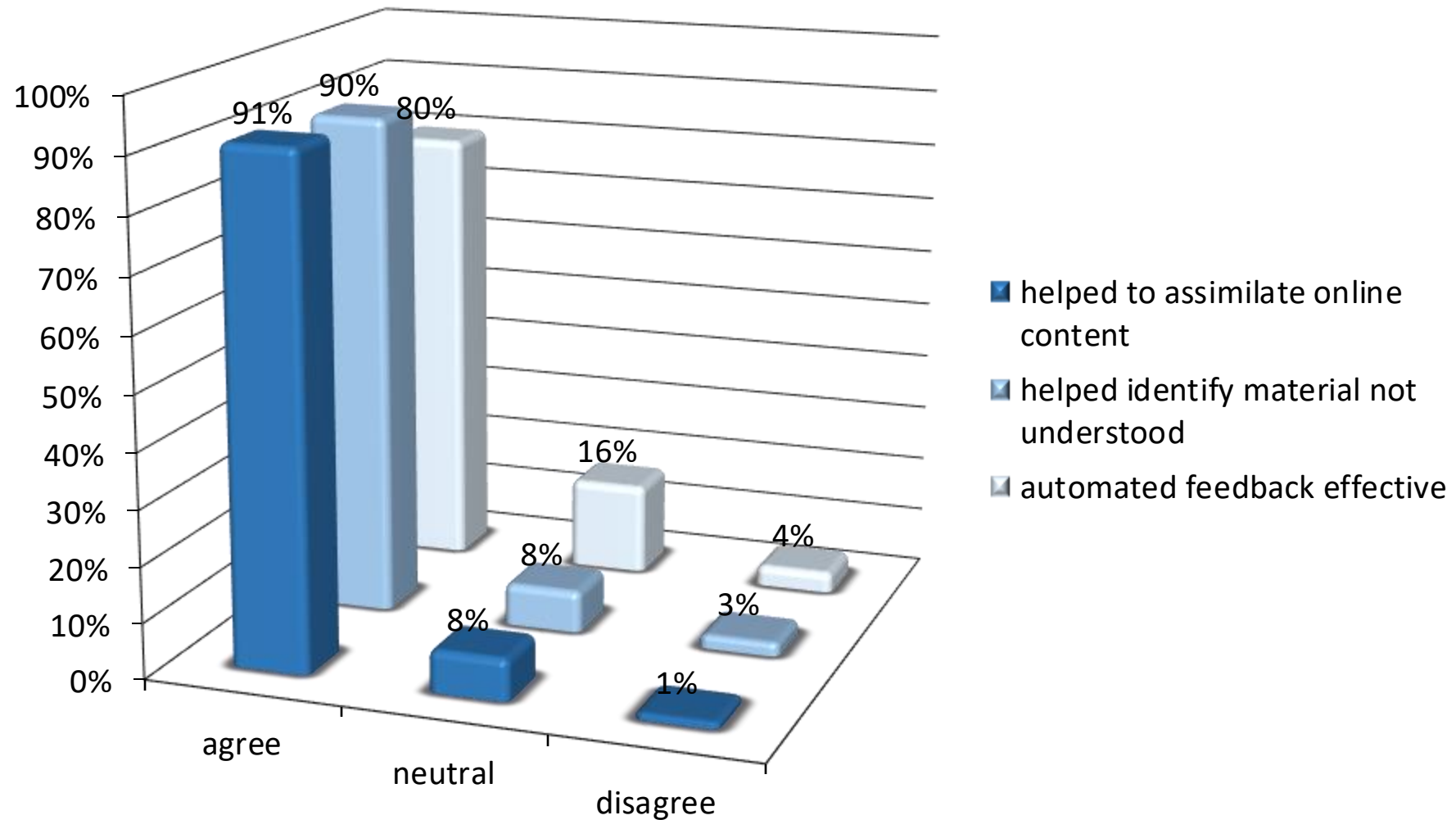
Student feedback: large-class review sessions



Student feedback: active learning tutorials



Student feedback: weekly online quizzes



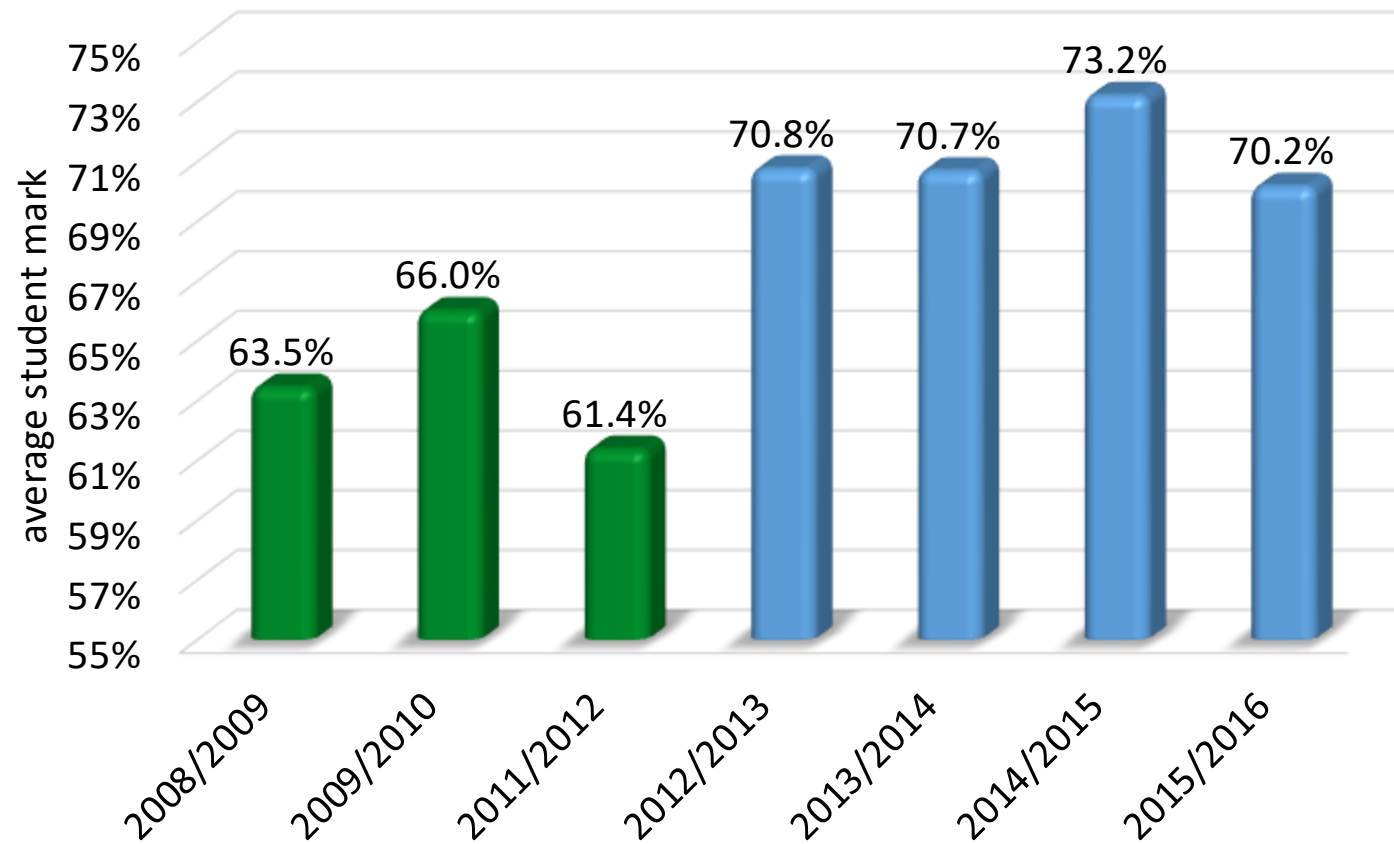
Qualitative feedback: active learning tutorials

"They are much more effective than normal tutorials. Actually, normal tutorials aren't necessary because most students go there just looking for the answers to problems, which can be uploaded to IVLE directly. Active learning tutorials are different, we go there not knowing what to expect and the lessons are much more engaging."



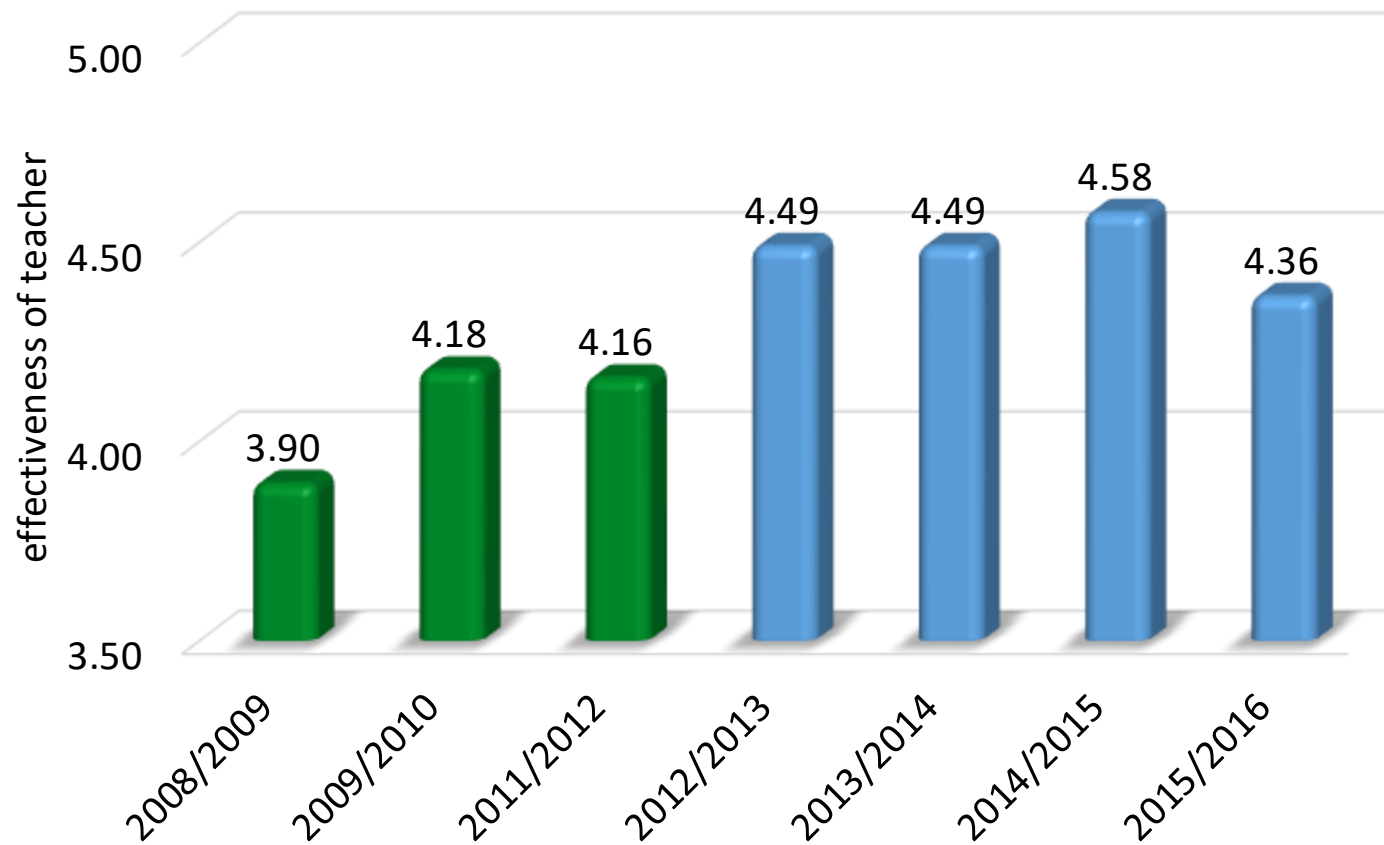
"I wished they were longer because we tend to only solve one question. But I must say the depth of discussion and mode of discussion coupled with your attentive feedback and encouragement really boosts self confidence in the topic and reinforces concepts much better... First time I was exposed to this style and actually really felt I was learning."

Student learning gain



Cohen's $d = 0.59$
 $p \text{ value} < 10^{-16}$

Teaching effectiveness



Cohen's $d = 0.57$
 $p \text{ value} < 10^{-22}$

Thinking about flipping?

- What learning environments do you have available?
- How would you use your timetabled face-to-face contact time?
- How will you ensure that your students are prepared for face-to-face class?
- How would your face-to-face class differ from current practice?



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