Icebreaker questions

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

NUS
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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)

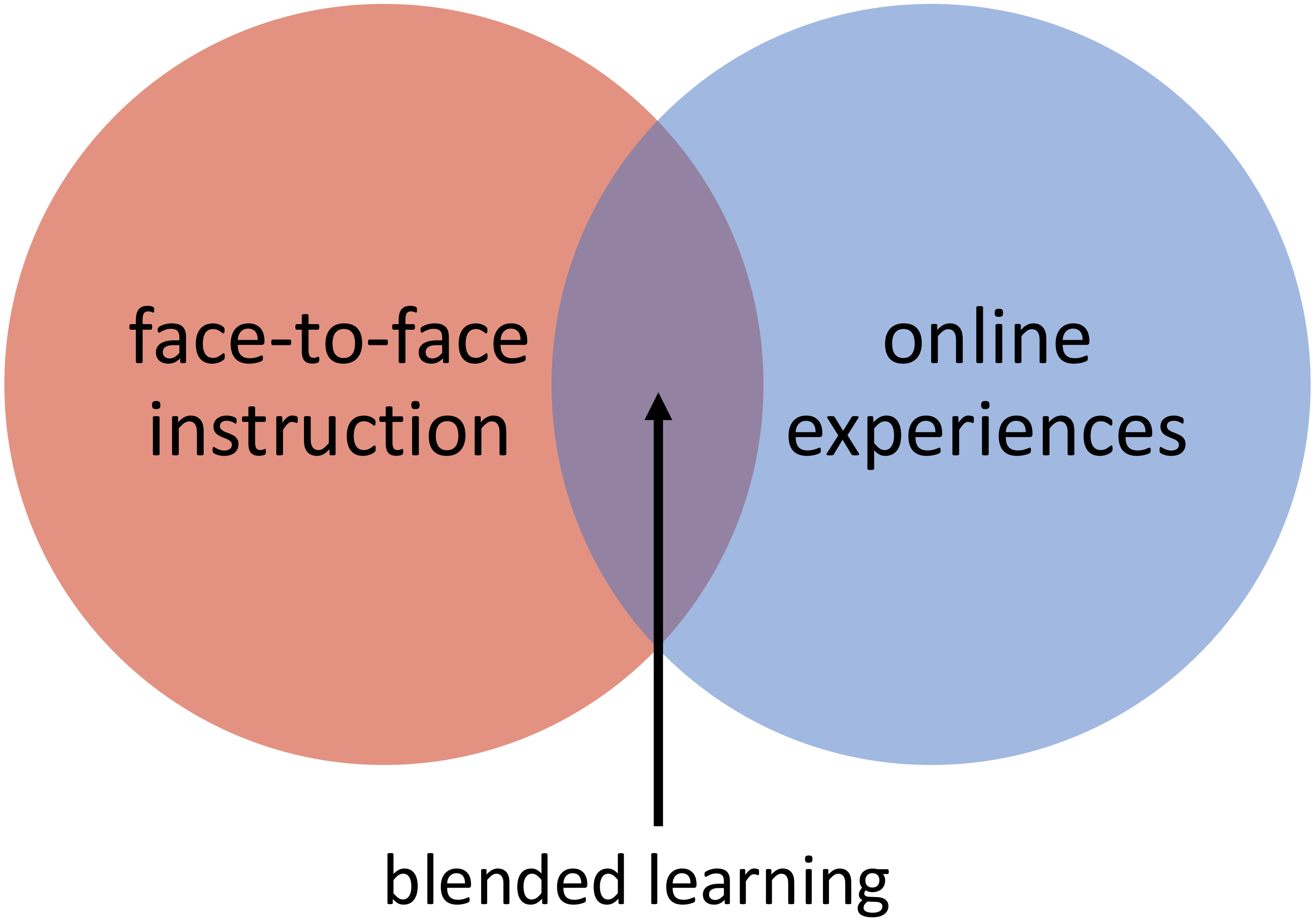
Price, L., and A. Kirkwood (2008) *Technology in the United Kingdom's higher education context*. In S. Scott & K. Dixon (Eds.), *The 21st Century, Globalised University: Trends and Development in Teaching and Learning* (pp. 83–113). Perth: Black Swan.

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)

Stein, J., and C. R. Graham (2014) *Essentials for blended learning: A standards-based guide*. New York: Routledge.


face-to-face
instruction
online
experiences
blended learning

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

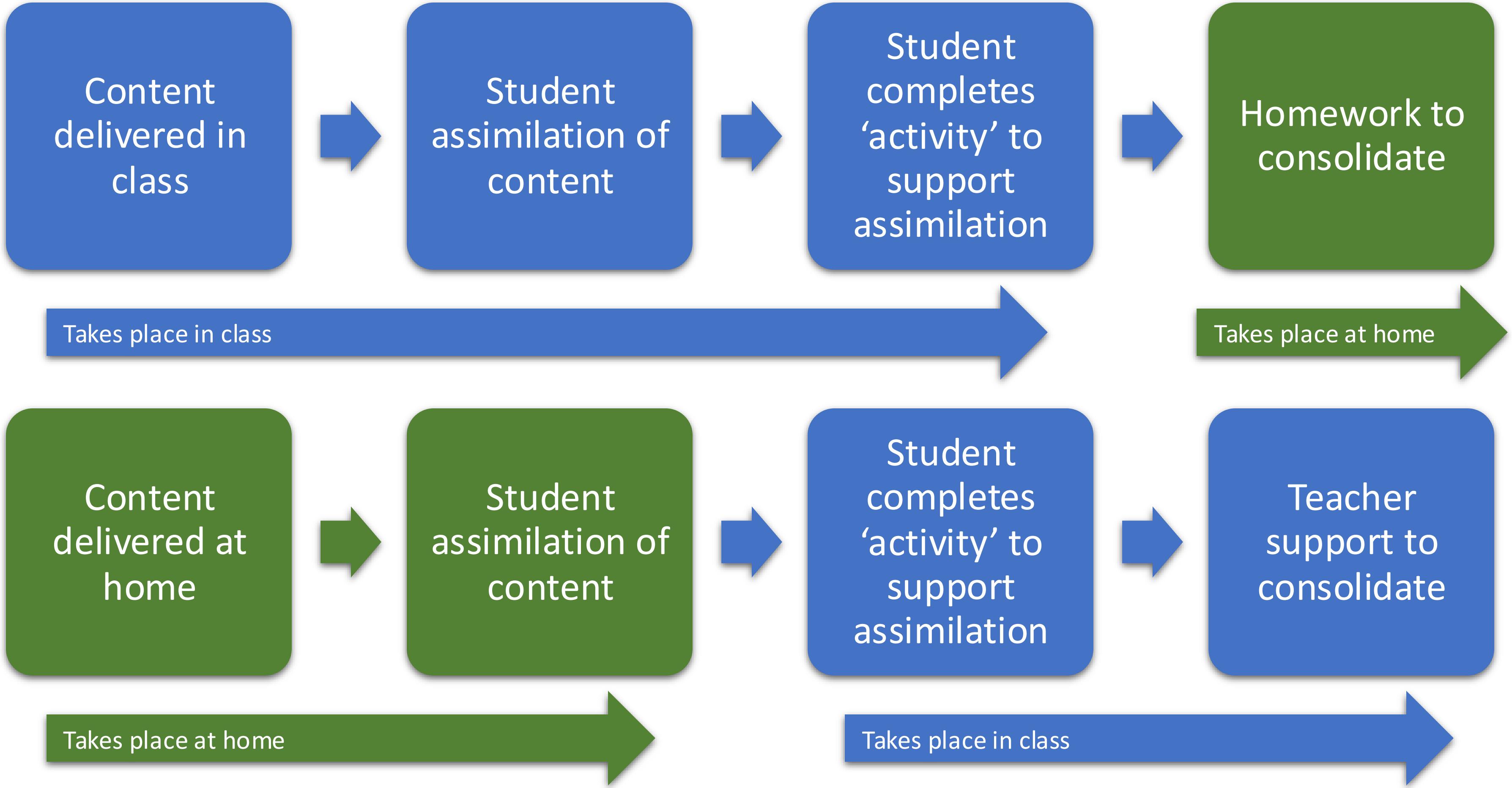
- Face-to-face time can be repurposed for more interactive engagement

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)

Bransford, J. D., A. L. Brown and R. R. Cocking (2000) *How people learn: Brain, mind, experience, and school*. Washington, D.C.: National Academy Press.

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)

Bransford, J. D., A. L. Brown and R. R. Cocking (2000) *How people learn: Brain, mind, experience, and school*. Washington, D.C.: National Academy Press.

What are the key elements?

- Provide an opportunity for students to gain first exposure prior to class
- Provide an incentive for students to prepare for class
- Provide a mechanism to assess student understanding
- Provide in-class activities that focus on higher level cognitive activities

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

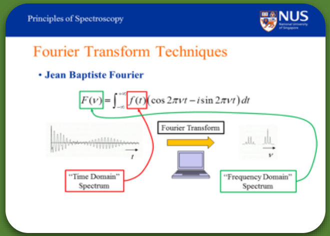
Breakout activity

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

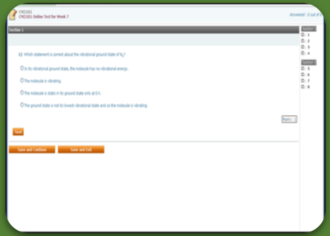
Week before class



Online Lectures

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

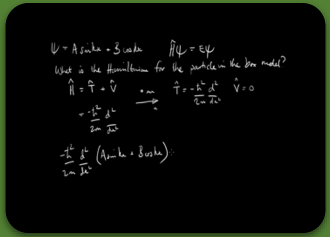
One day before class



Weekly Online Quizzes

- Identification of student misconceptions

In class



Large Class Review Session

- Review of online material
- Learner response system

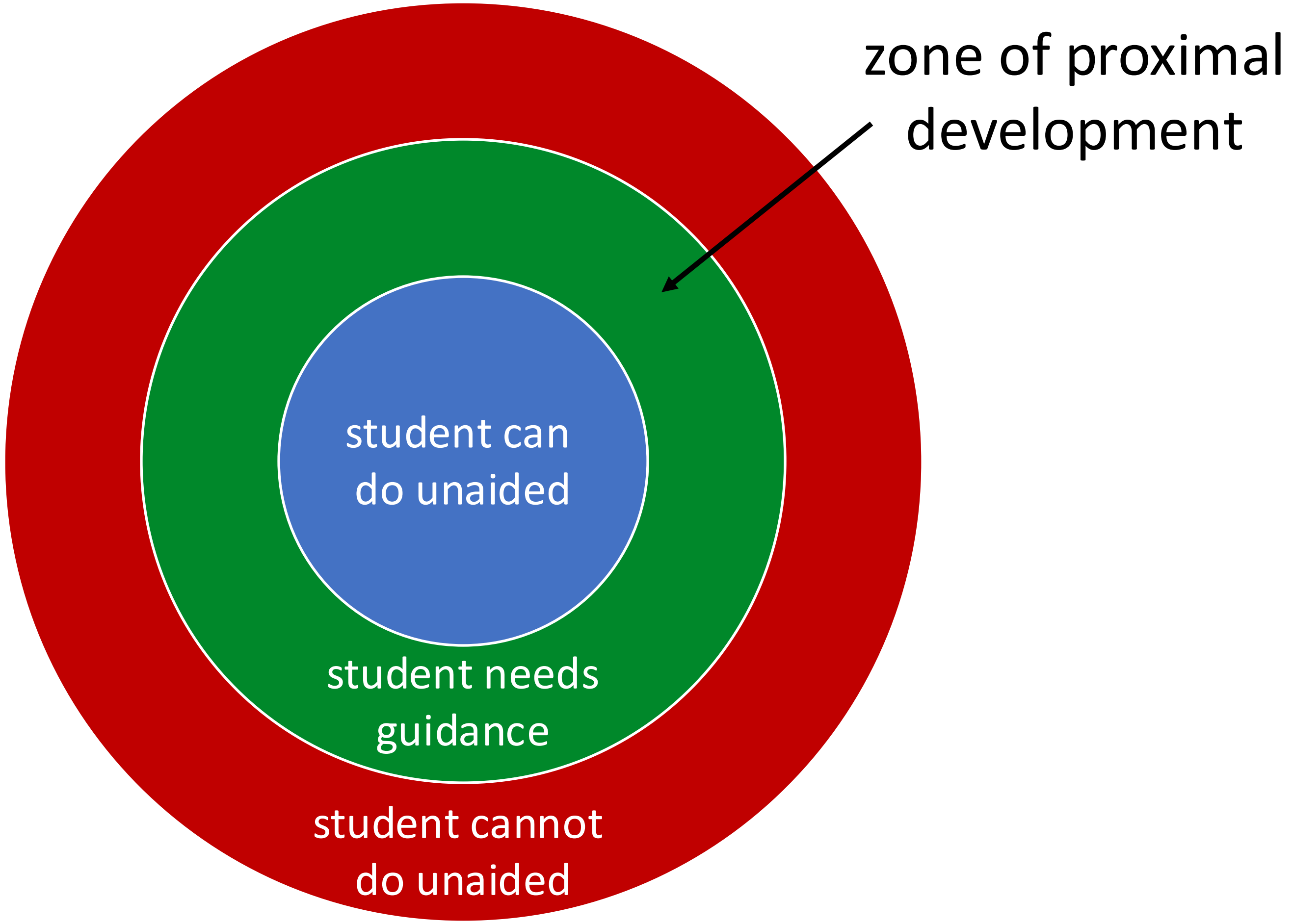
Following week

Small Group Active Learning

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

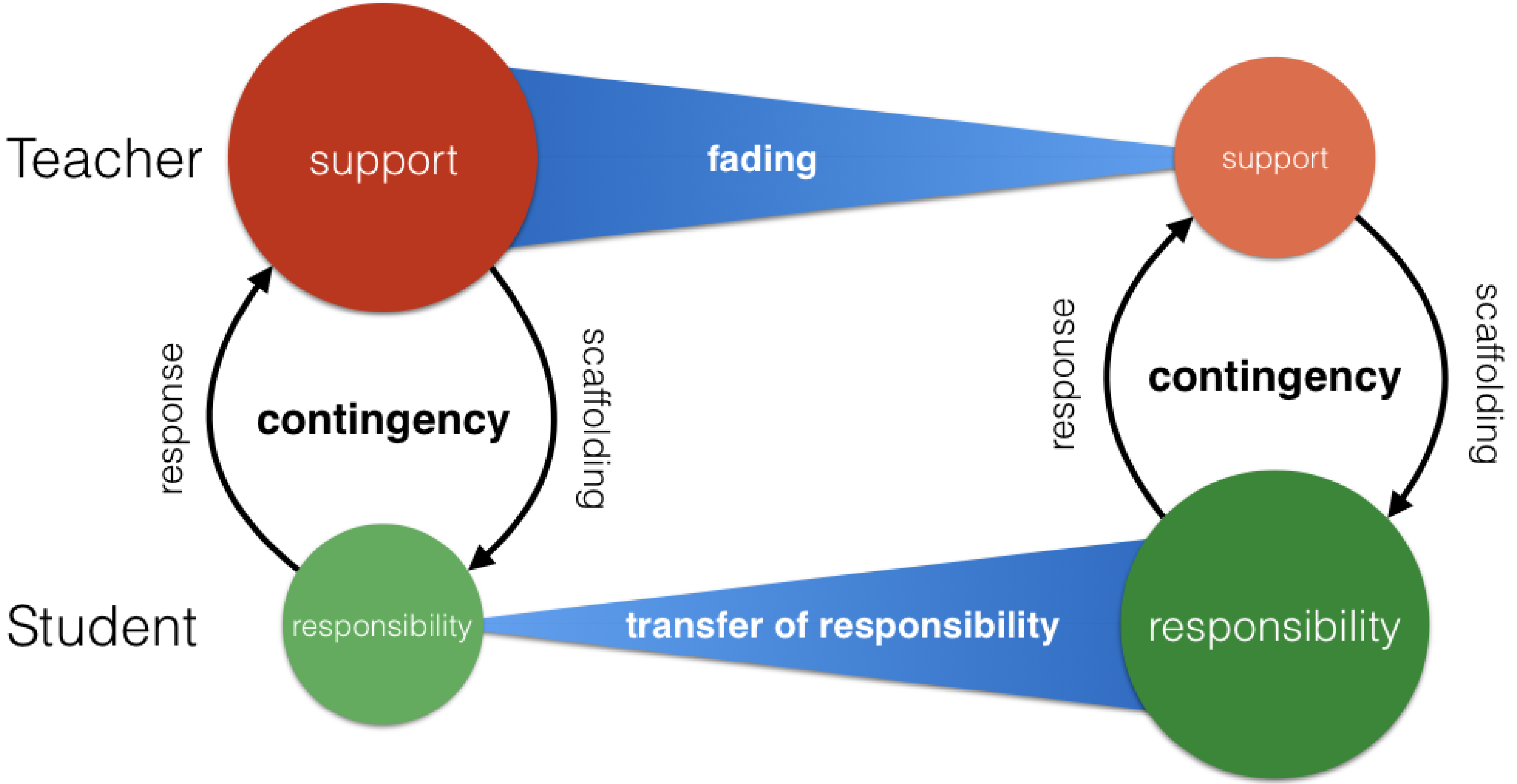
Important pedagogical components

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



van de Pol, J., M. Volman, and J. Beishuizen (2010). Scaffolding in Teacher–Student Interaction: A Decade of Research, *Educational Psychology Review*, **22(3)**, 271–296.

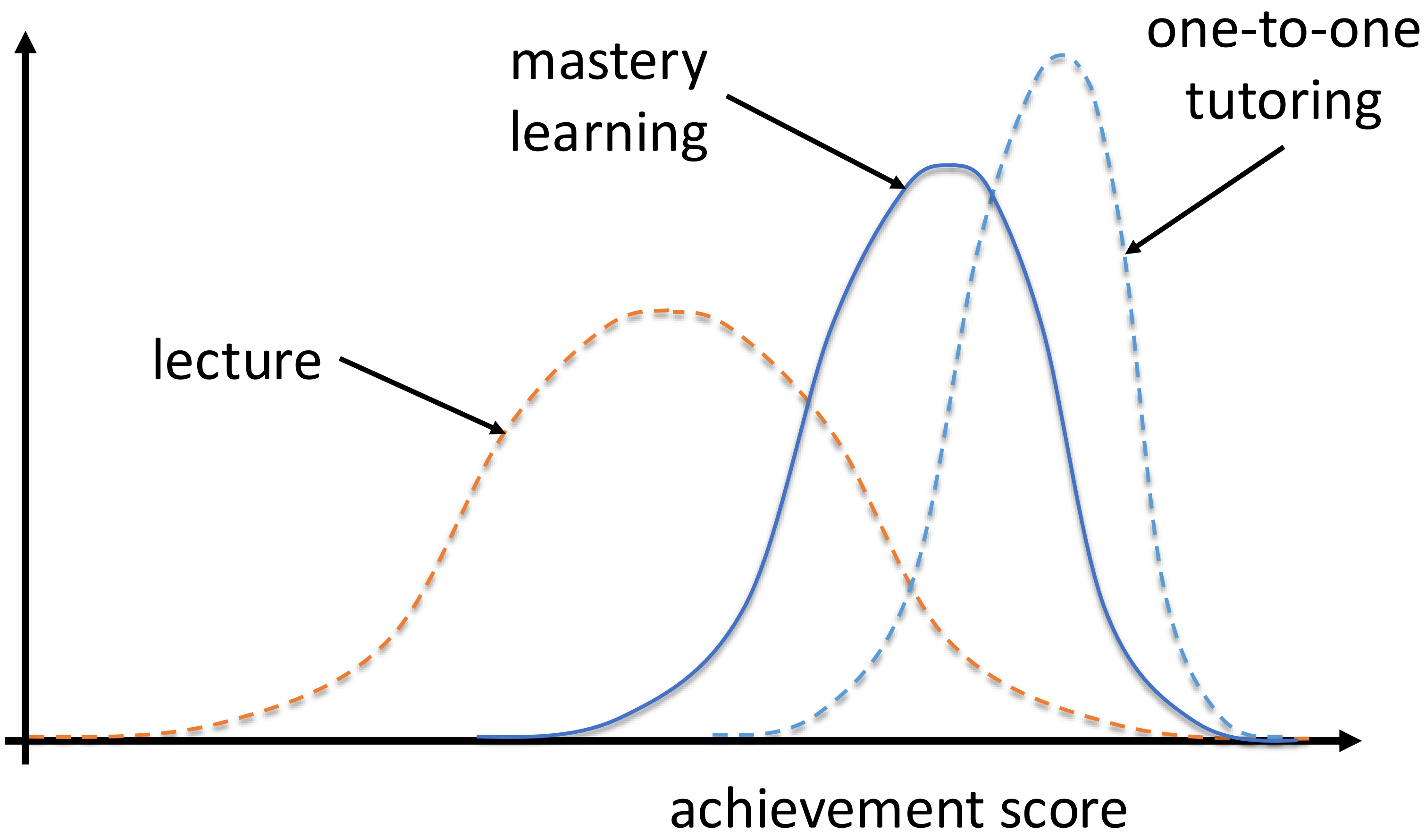
Just-in-time teaching

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

Ausubel (1968)

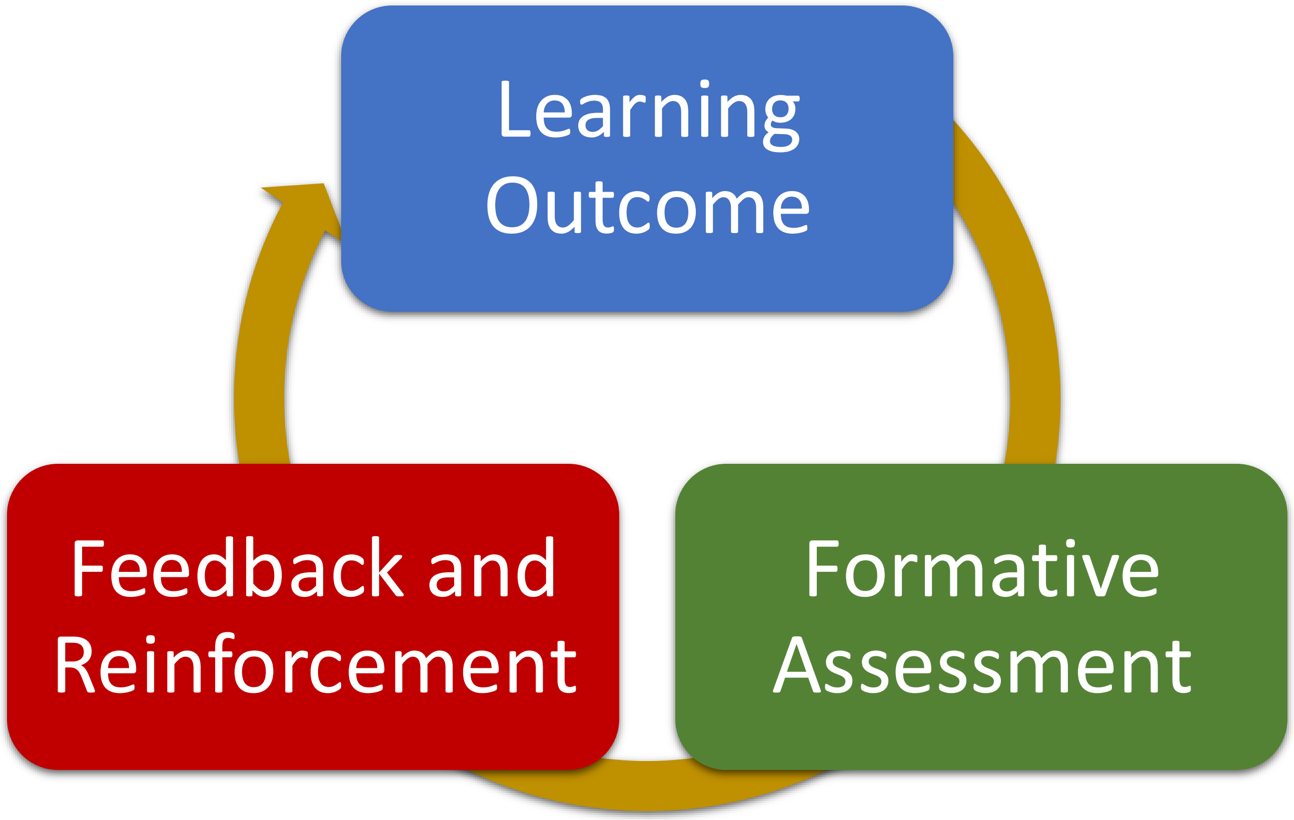
Novak, G. N., E. T. Patterson, A. Gavrin, and W. Christian (1999) *Just-in-Time Teaching: Blending Active Learning and Web Technology*, Saddle River: Prentice Hall.
Ausubel, D. P. (1968) *Educational Psychology: A Cognitive View*, New York: Rinehart and Winston, Inc.

Mastery learning



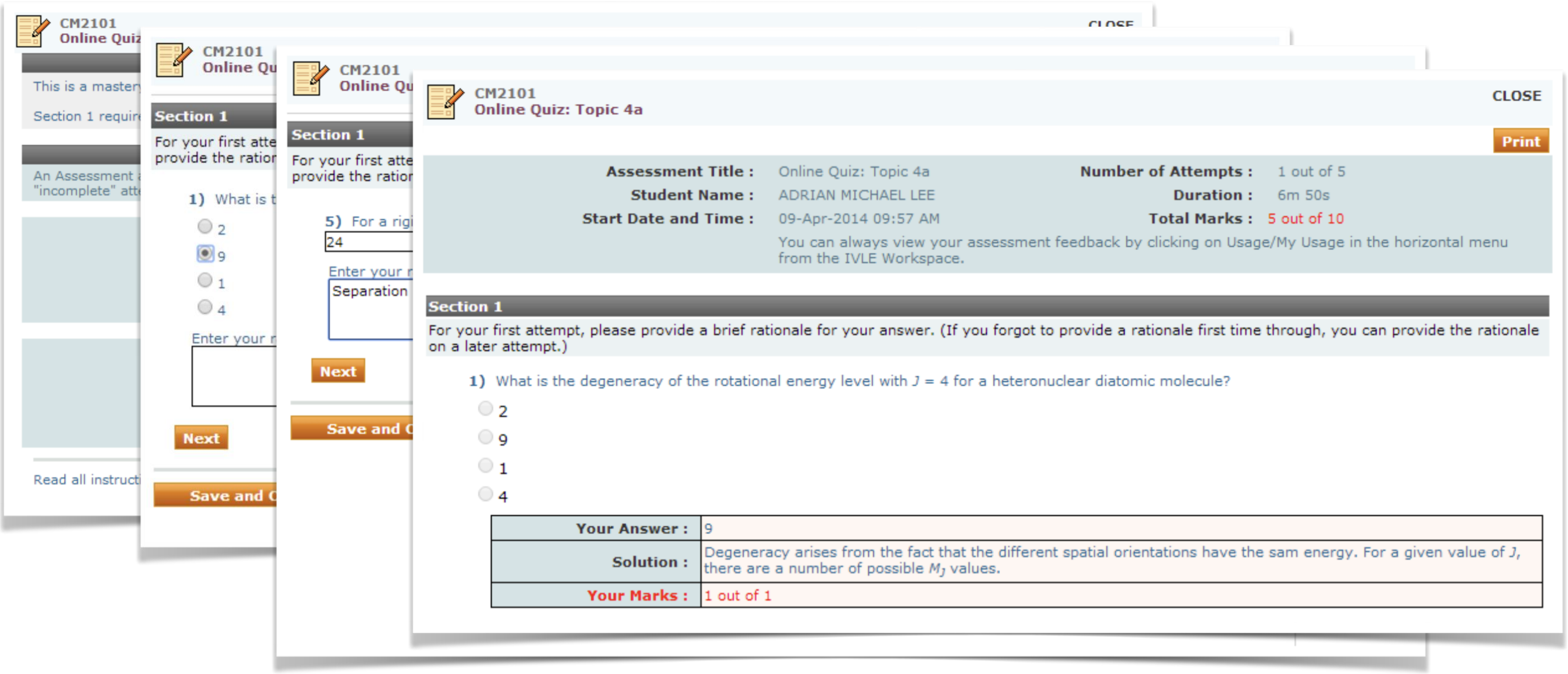
Bloom, B. (1984) The 2 Sigma Problem: The Search for Methods of Group Instruction as Effective as One-to-One Tutoring, *Educational Researcher*, **13(6)**, 4–16.

Mastery learning

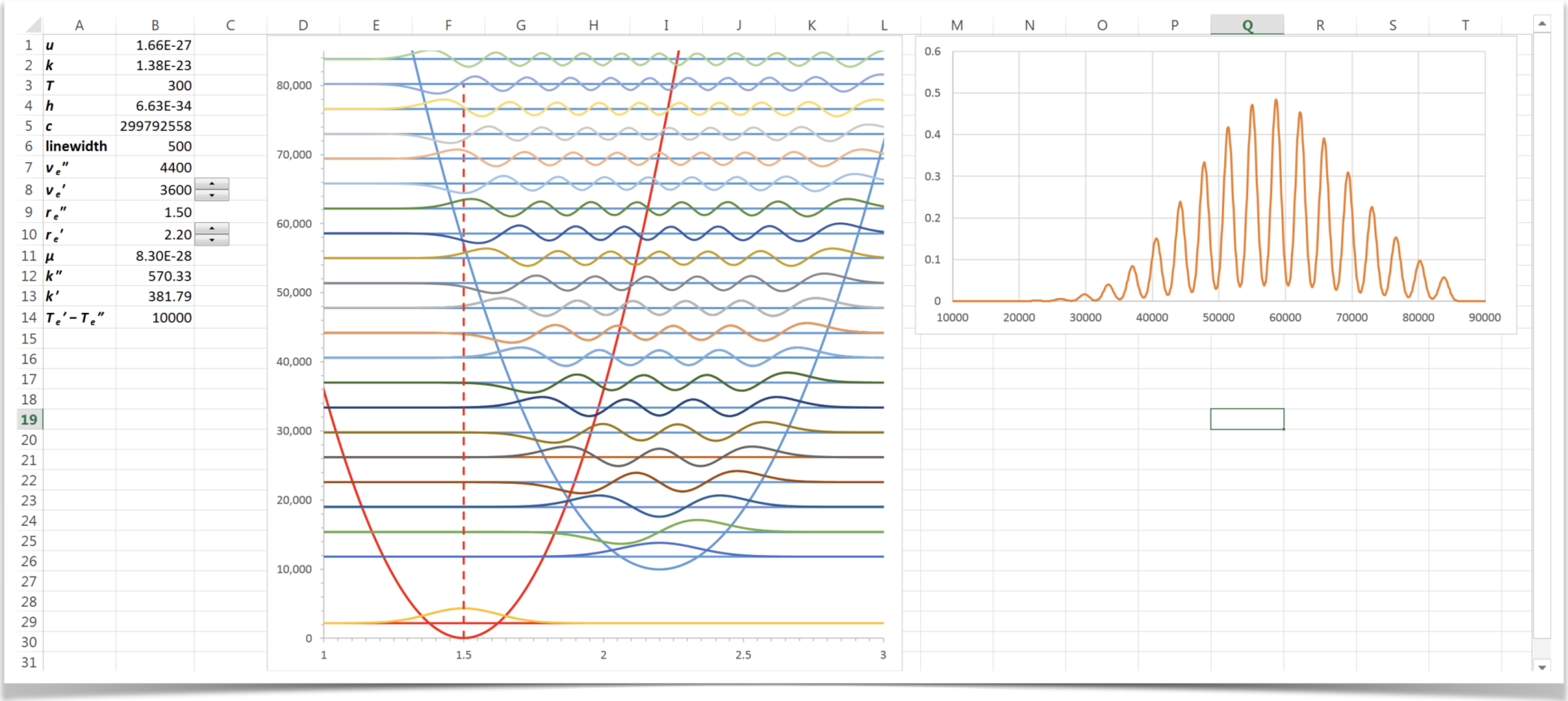


Bloom, B. S., and J. B. Carroll. (1971) *Mastery learning: Theory and practice*, New York: Holt, Rinehart and Winston.

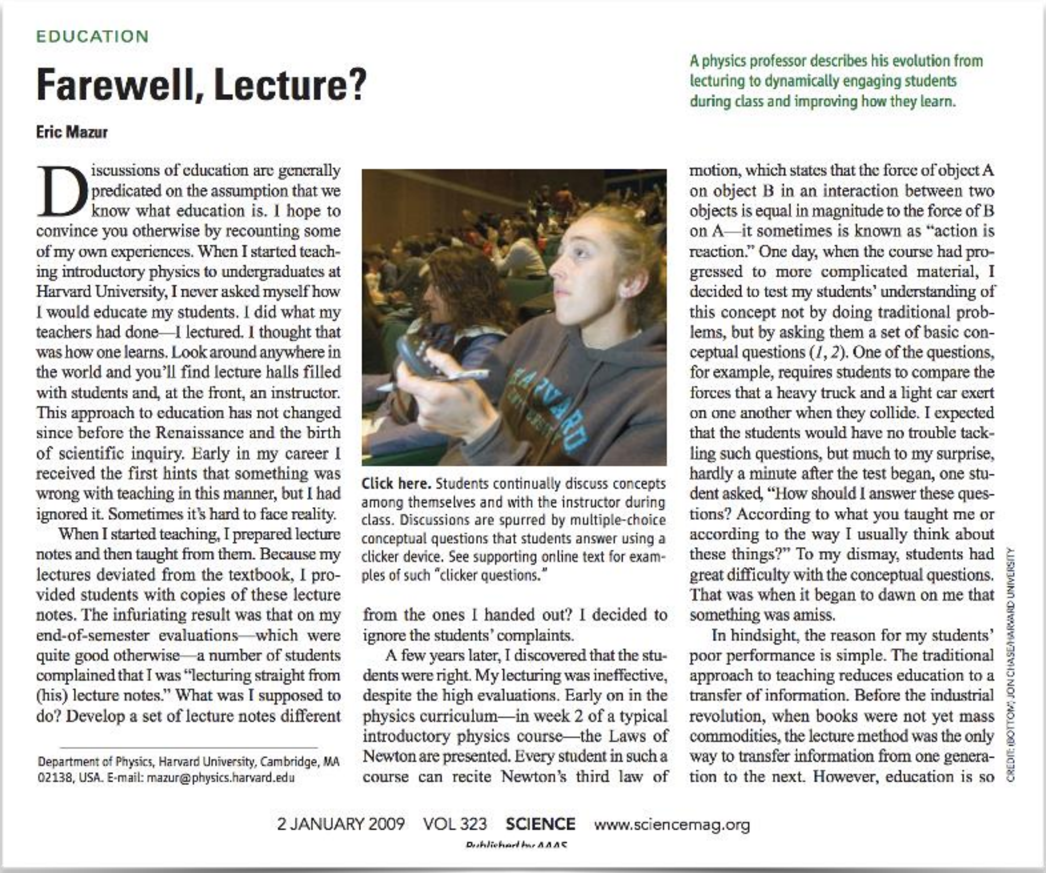
Weekly online quiz



Interactive visualisations



Peer instruction



EDUCATION

Farewell, Lecture?

Eric Mazur

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

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

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."

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

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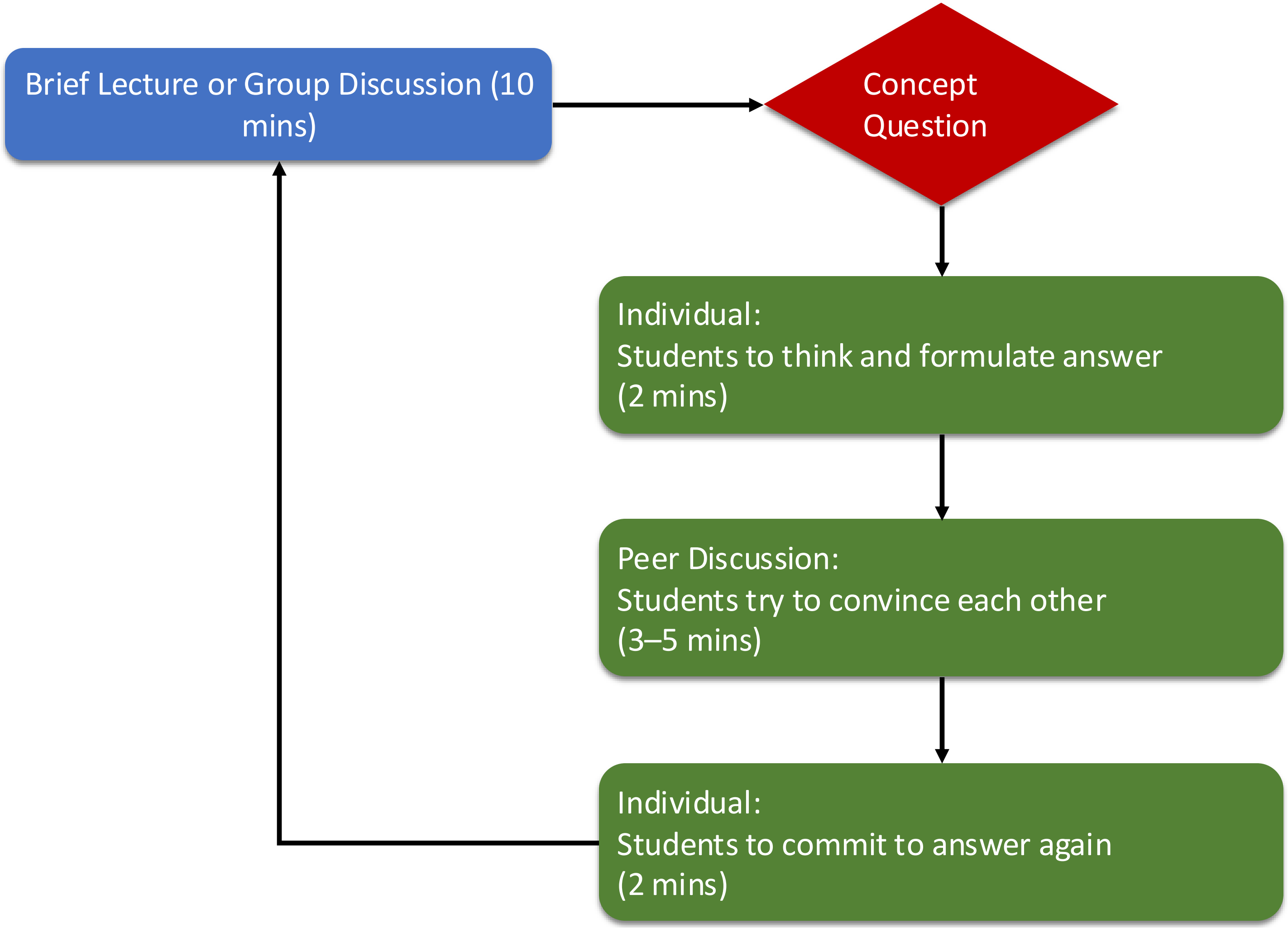
Department of Physics, Harvard University, Cambridge, MA 02138, USA. E-mail: mazur@physics.harvard.edu

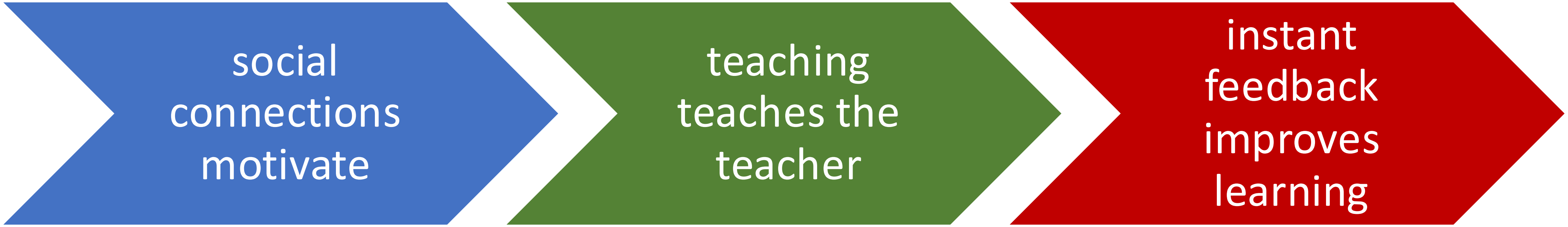
Mazur, E. (2009) Farewell, Lecture?, *Science*, **323**, 50–51.

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

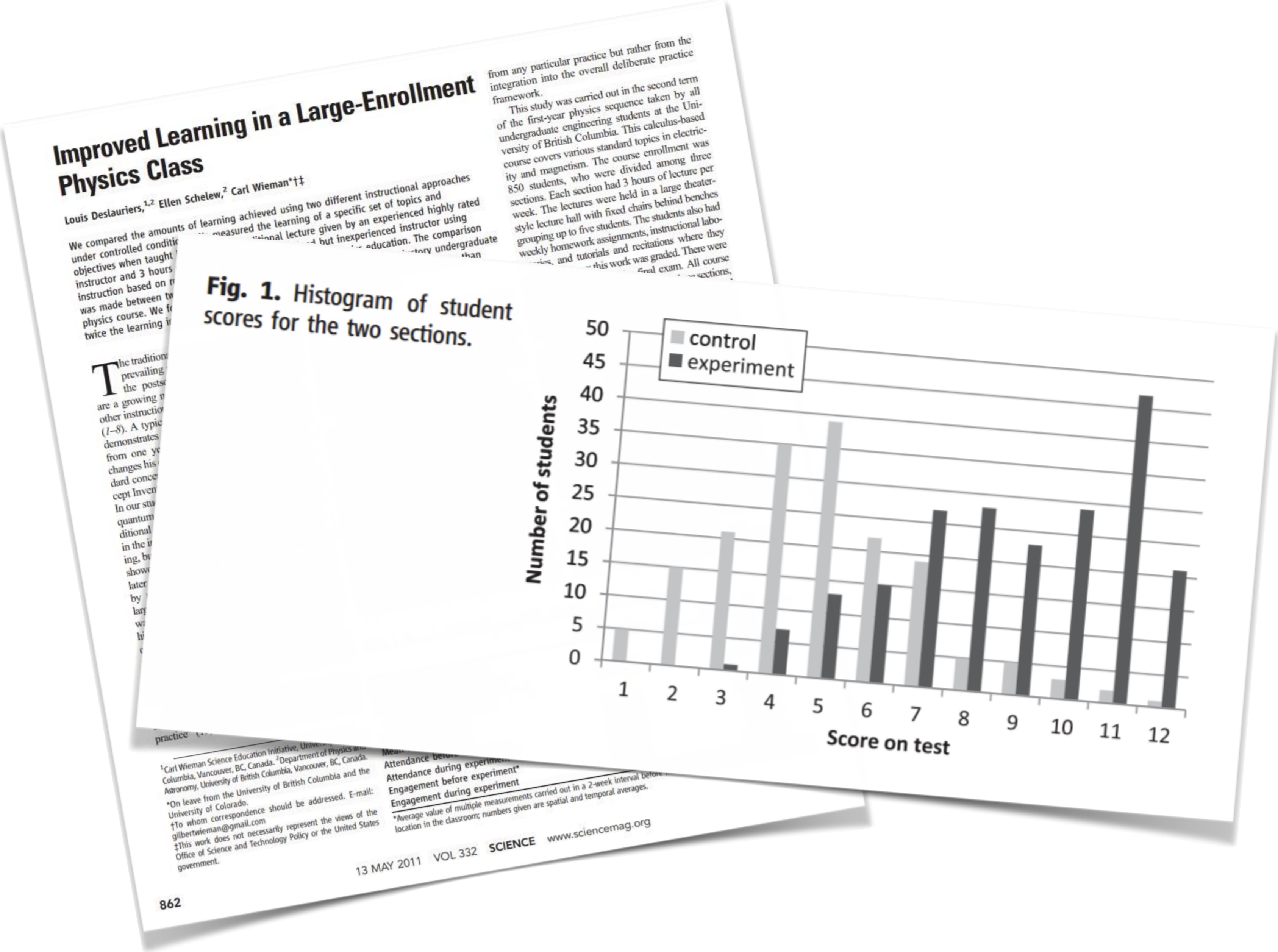
Active learning tutorial: peer learning

Active learning tutorial: facilitation

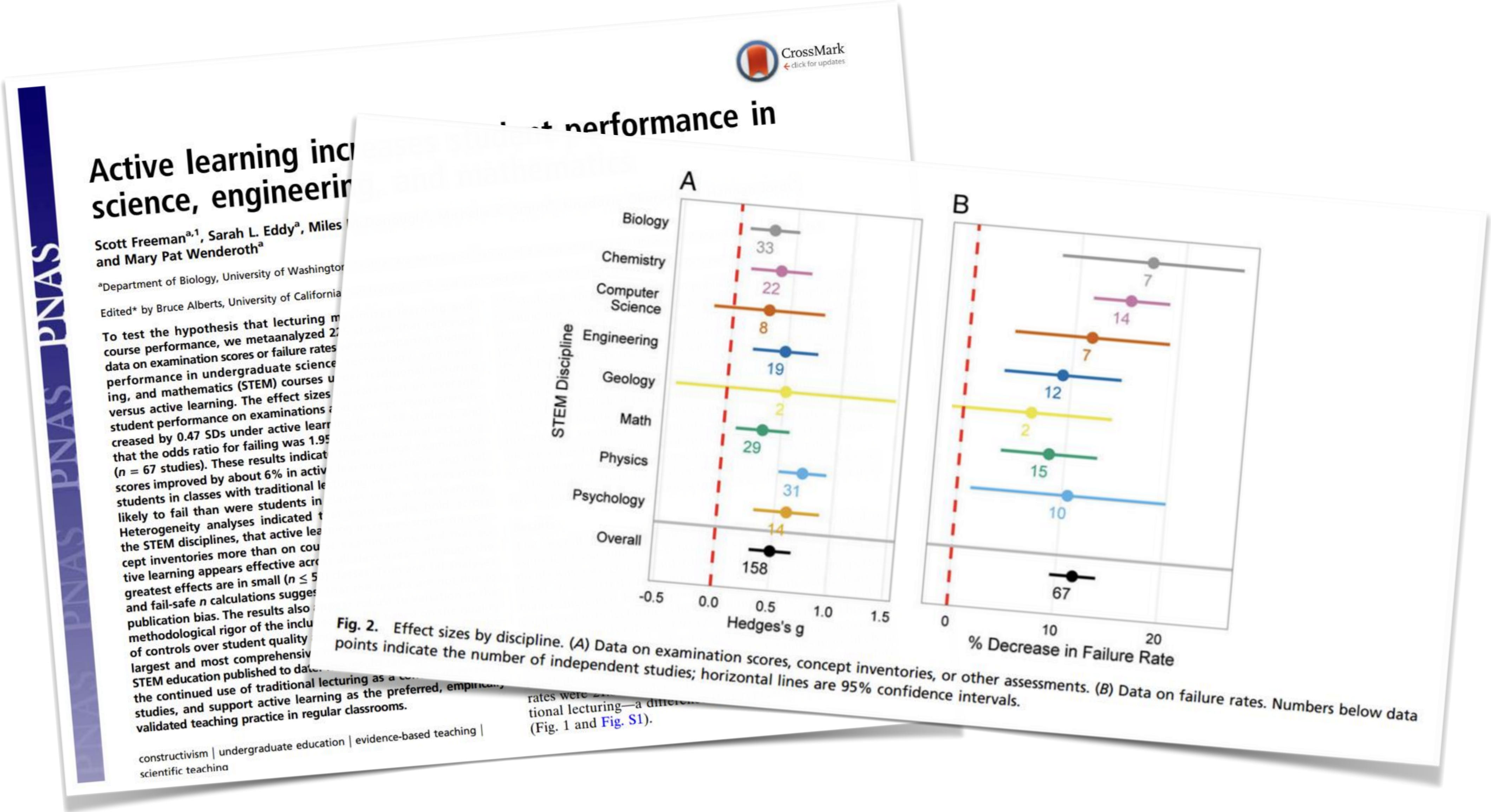
Teaching in an active learning classroom

https://youtu.be/ea6q4Ah3JPc

Does it work?



DesLauriers, L., E. Schelew and C. Wieman (2011) Improved learning in a large-enrollment physics class, *Science*, **332** 862–864.



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 res

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 Instructio
algebra-based introductory physics courses for nonmajors; our resu
mastery of both conceptual reasoning and quantitative problem solvi
also discuss ways we have improved our implementation of PI sinc
notably, we have replaced in-class reading quizzes with pre-class w
introduced a research-based mechanics textbook for portions o
cooperative learning into the discussion sections as well as the le
intended to help students learn more from pre-class reading and t
the discussion sections, and are accompanied by further increases
American Association of Physics Teachers.

[DOI: 10.1119/1.1374249]

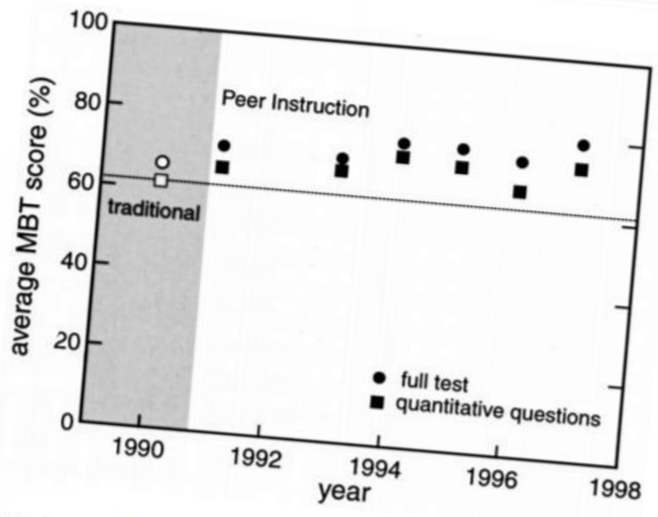
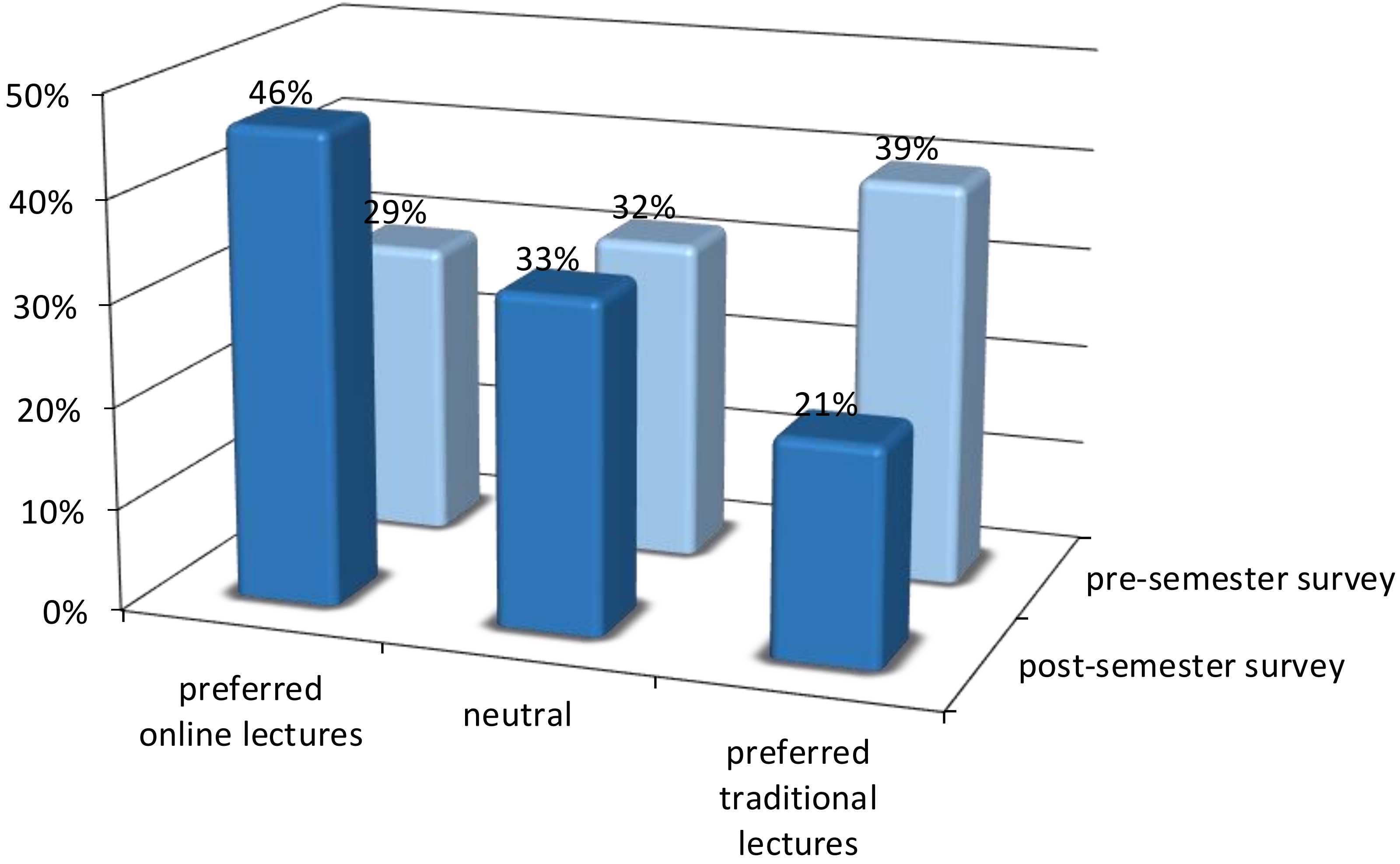


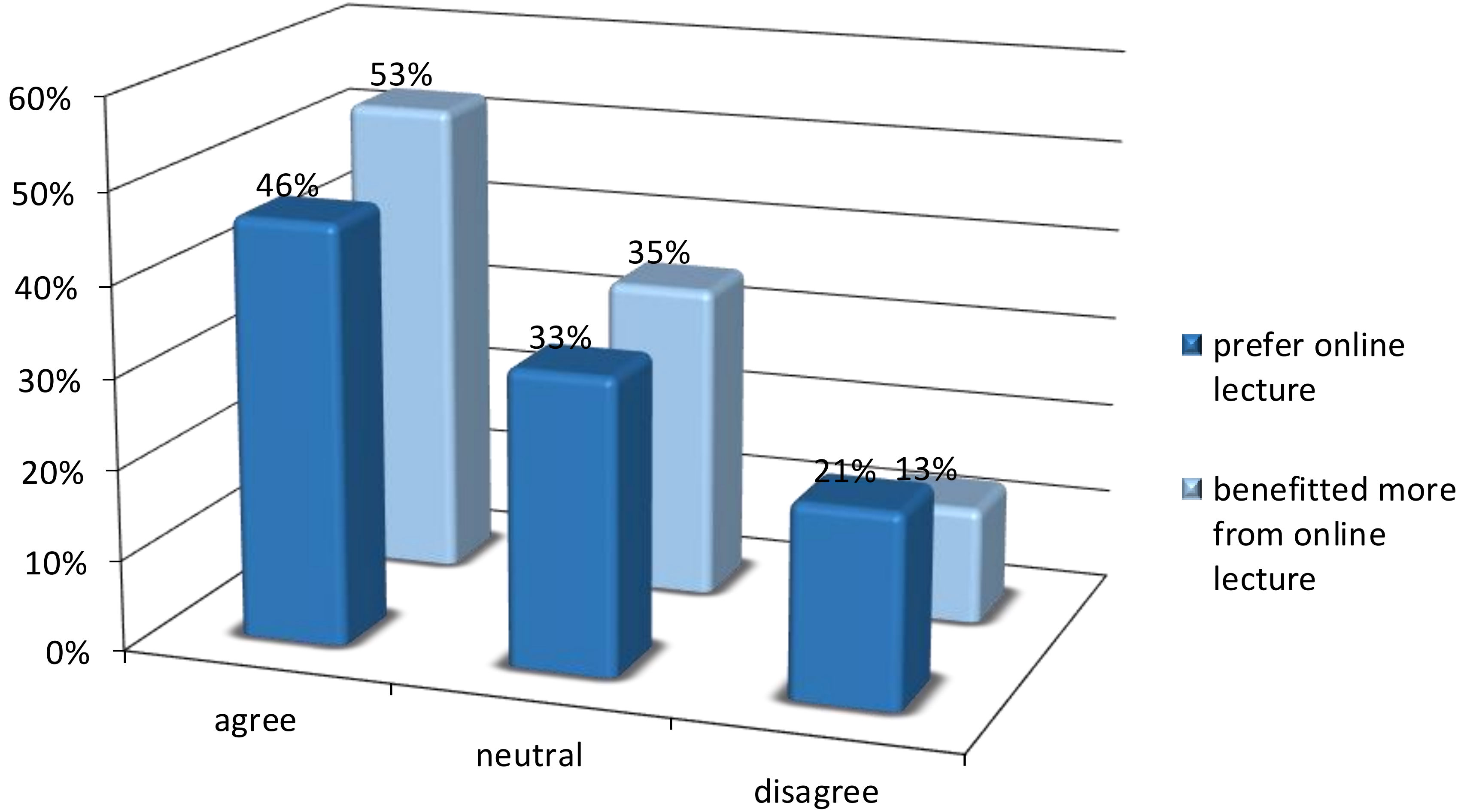
Fig. 3. Mechanics Baseline Test (Ref. 13) scores for introductory calculus-based physics, Harvard University, Fall 1990–Fall 1997. Average score on entire test (circles) and on quantitative questions (Ref. 17) only (squares) vs year are shown. Open symbols indicate traditionally taught courses and filled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

Crouch, C., and E. Mazur. (2001) Peer Instruction: Ten Years of Experience and Results, *American Journal of Physics*, **69**, 970–977.

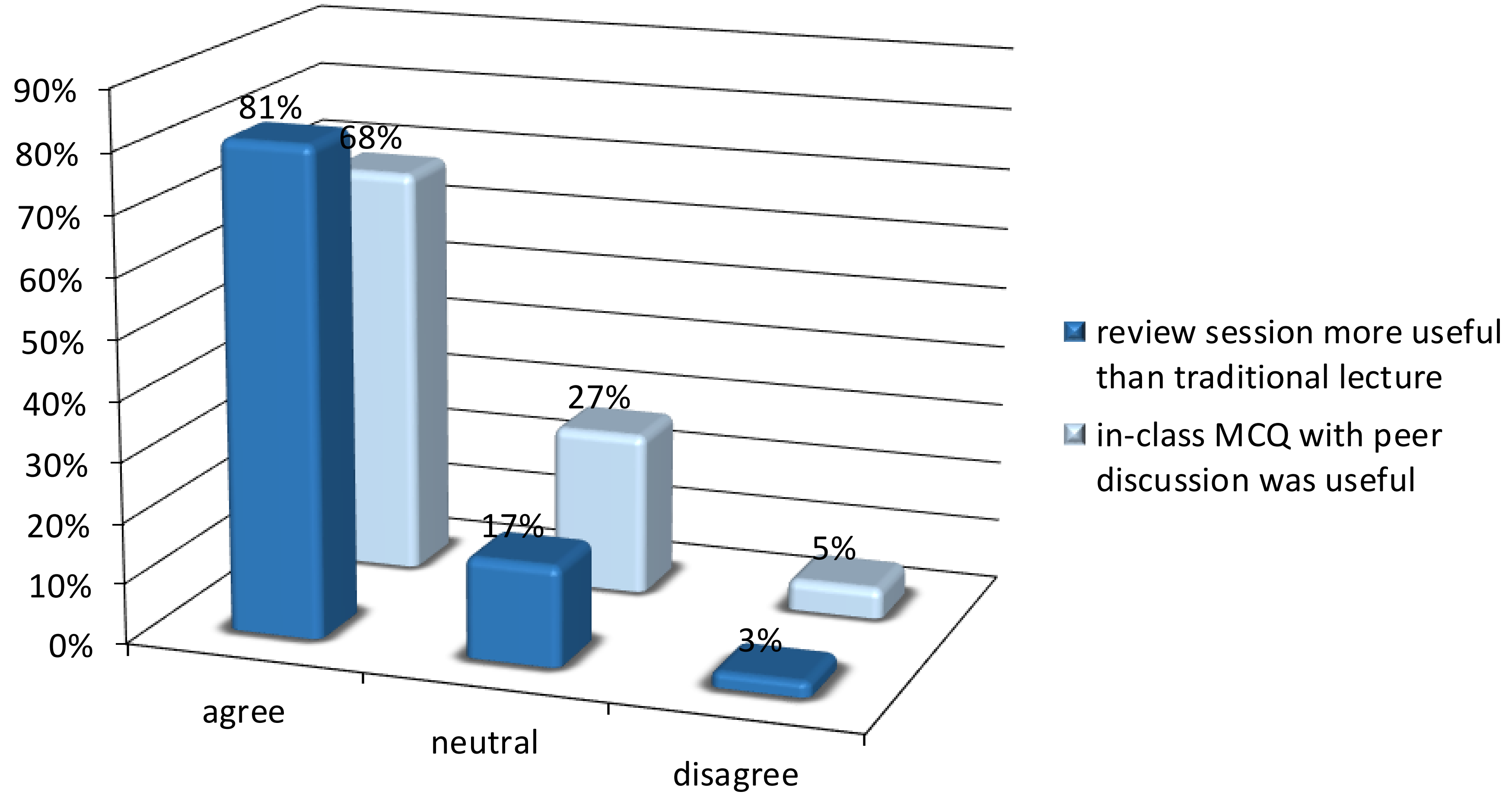
Student feedback: online lectures



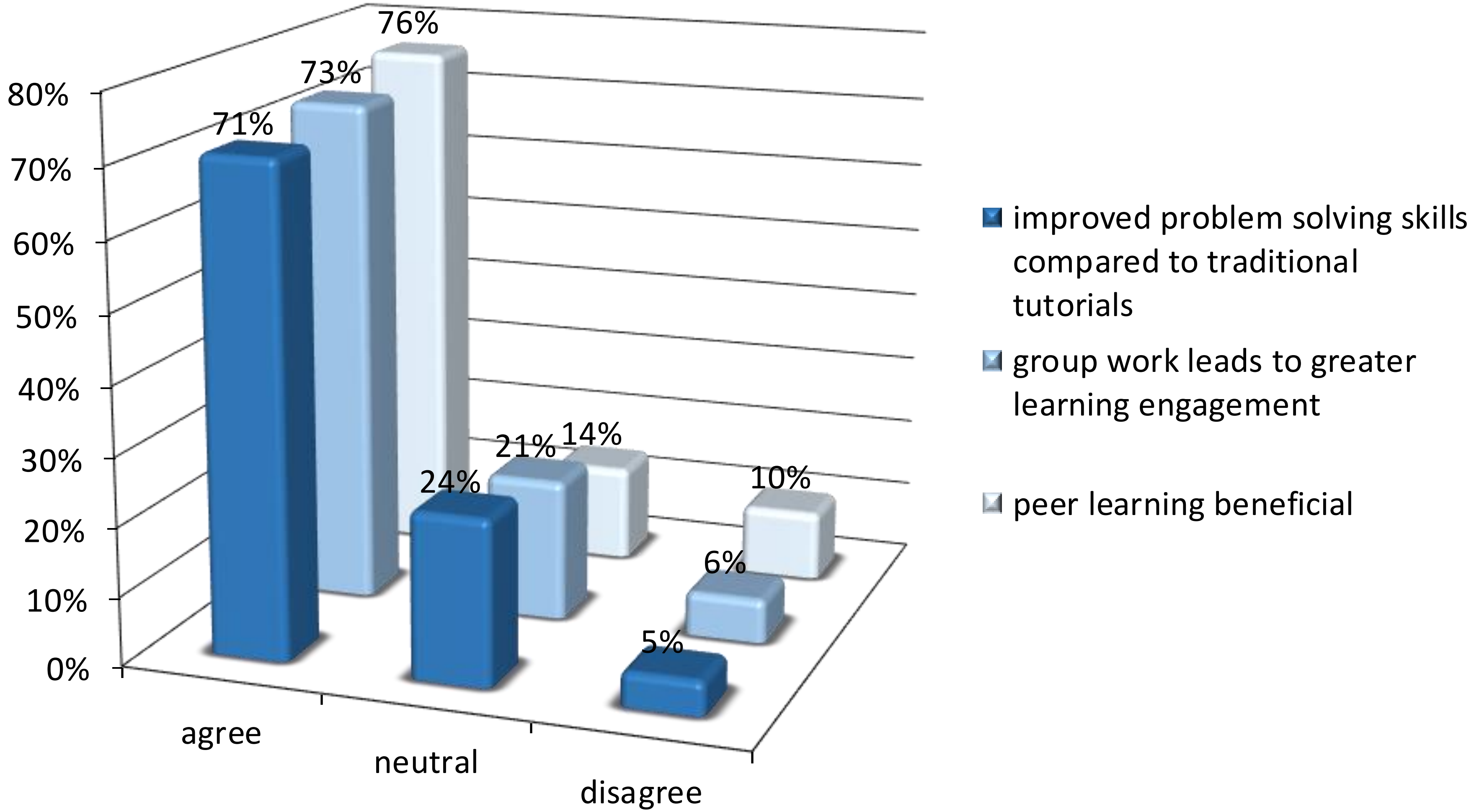
Student feedback: online lectures



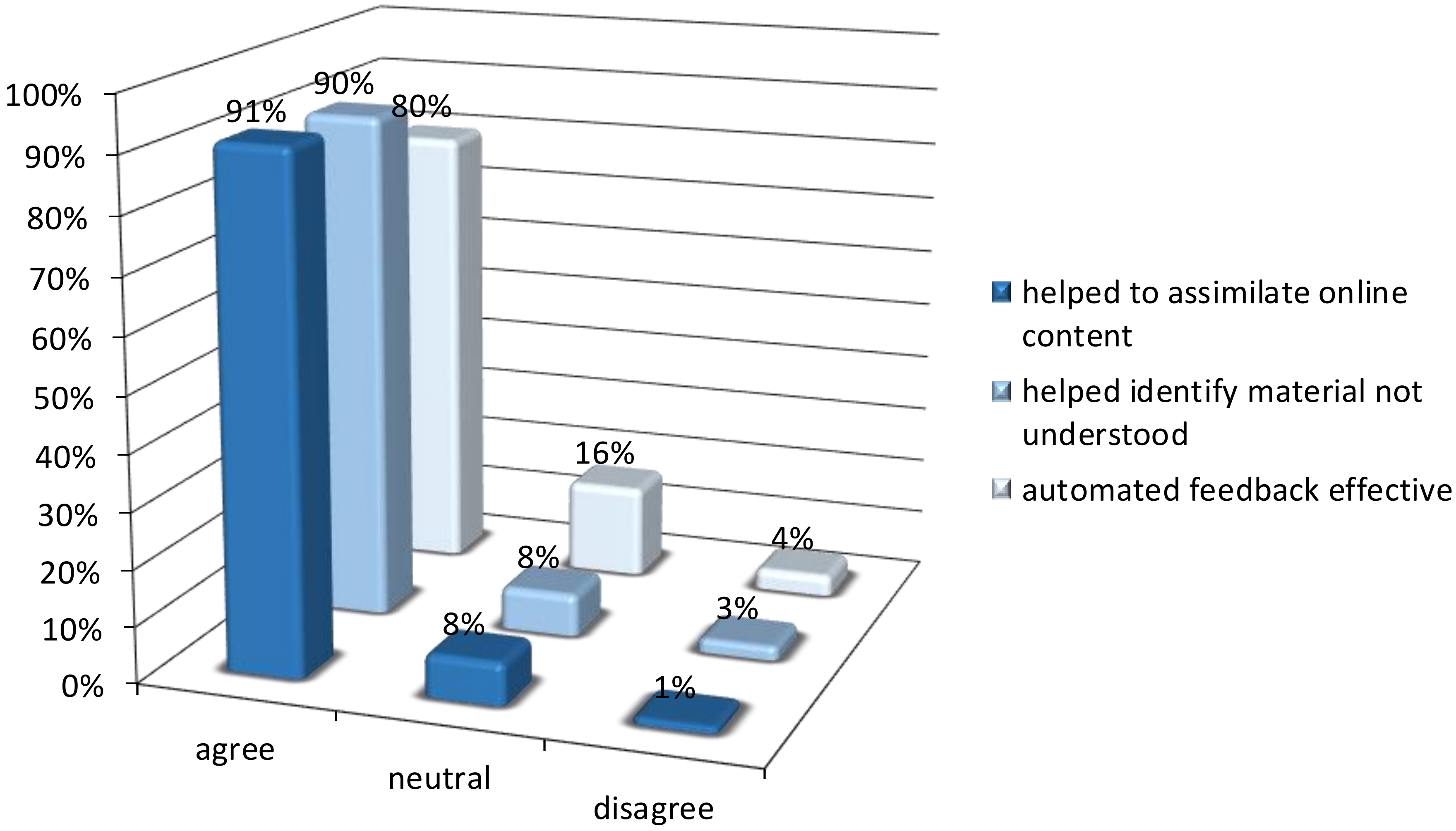
Student feedback: large-class review sessions



Student feedback: active learning tutorials

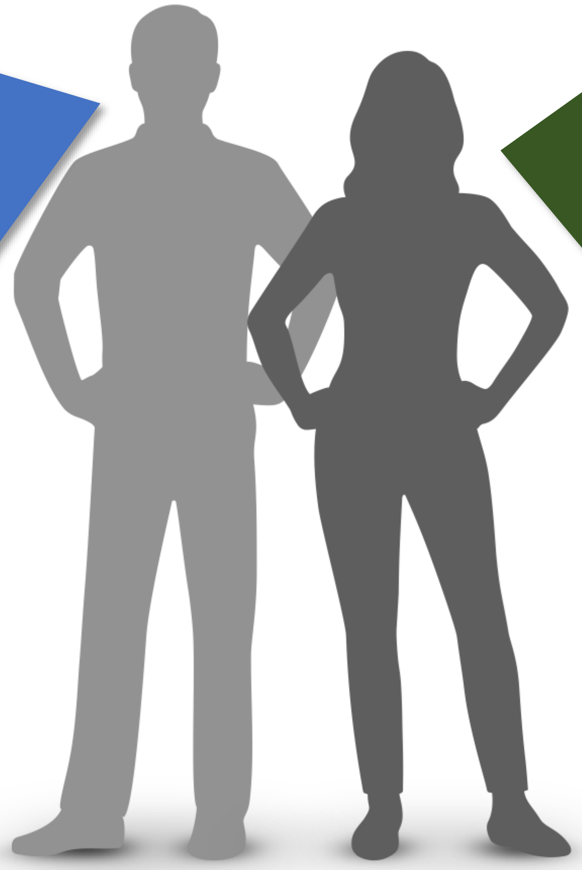


Student feedback: weekly online quizzes



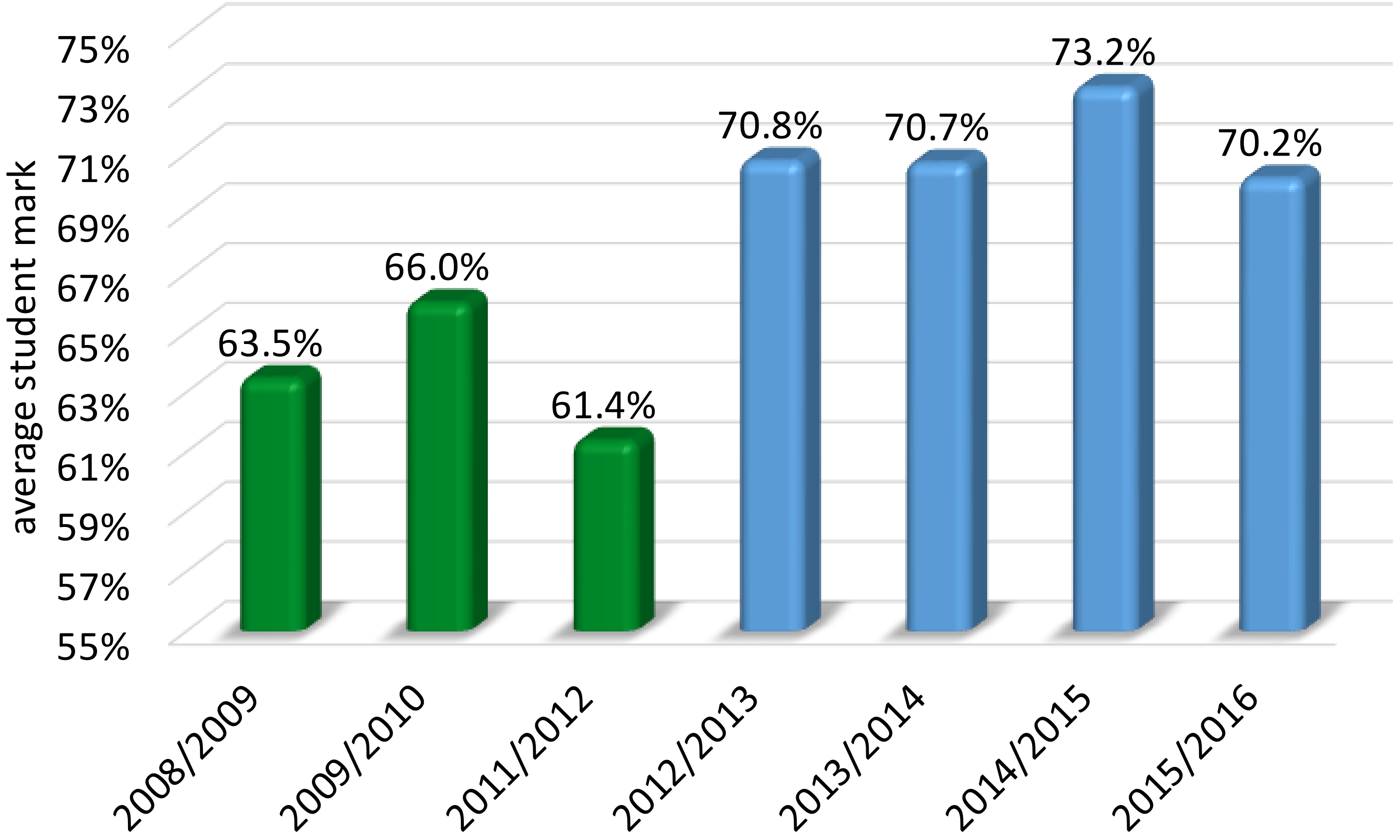
Qualitative feedback: active learning tutorials

"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."



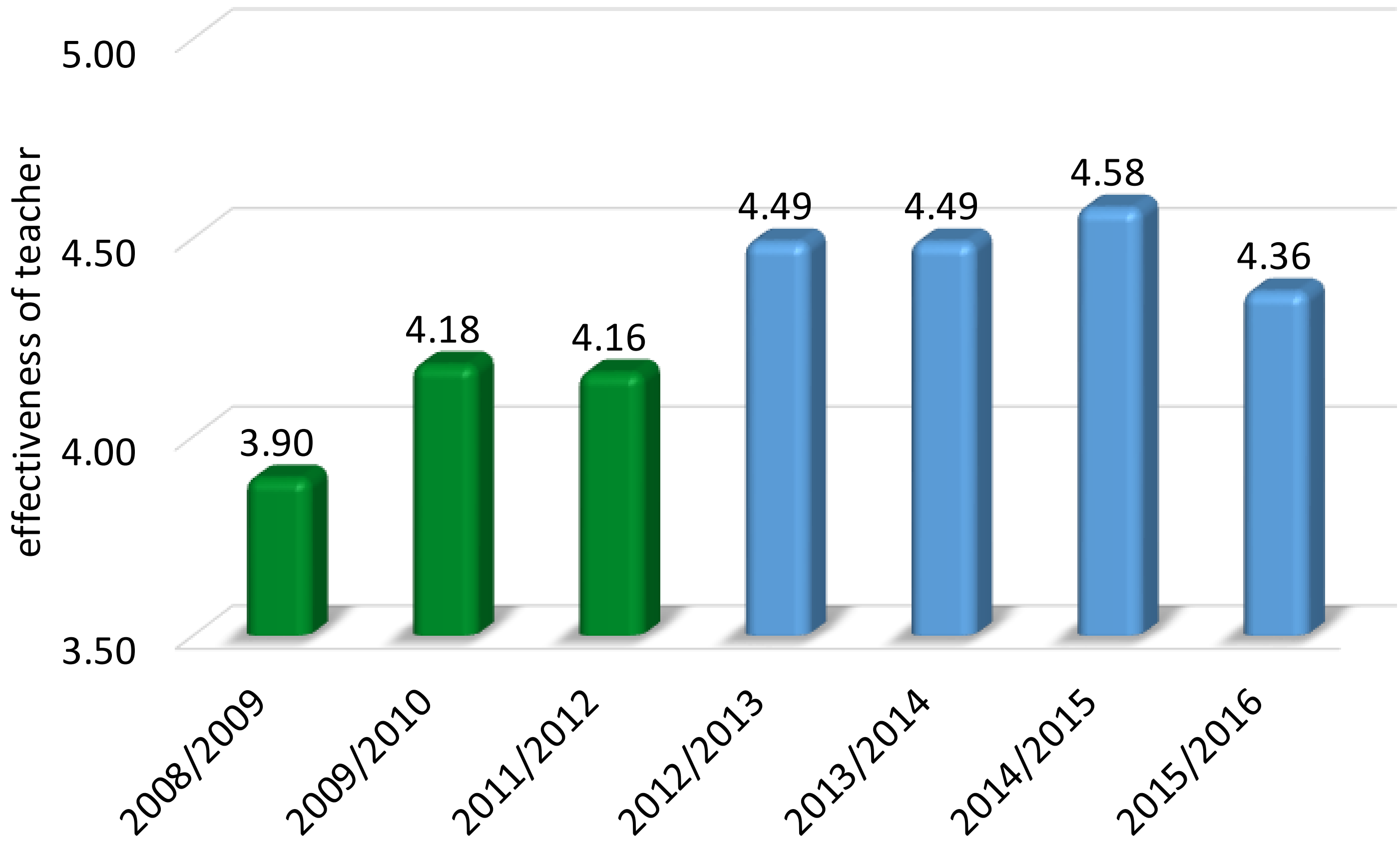
"I wished they were longer because we tend to only solve one question. But I must say the depth of discussion and mode of discussion coupled with your attentive feedback and encouragement really boosts self confidence in the topic and reinforces concepts much better… First time I was exposed to this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

Student learning gain



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

Teaching effectiveness



Cohen's d = 0.57
p 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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