

ENHANCING CONCEPTUAL UNDERSTANDING WITH CLASSROOM RESPONSE SYSTEMS

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What is Classroom Response System (CRS)?

- Clickers, Personal Response System (PRS), Interactive Response System
- Allow students to give personal response anonymously in a class
- Rapidly collect students' answers and provide immediate analysis and display of the students' feedback



0.01 mole of each of the following compounds is added to 1 dm³ of water. Which one will produce a solution with the highest pH value?

1. SiO₂(s)
2. Na₂O(s)
3. Cl₂O(g)
4. SO₂(g)
5. KOH(s)

Pedagogy with the use of clickers

Lecture



Concept test / MC questions
Students answer individually



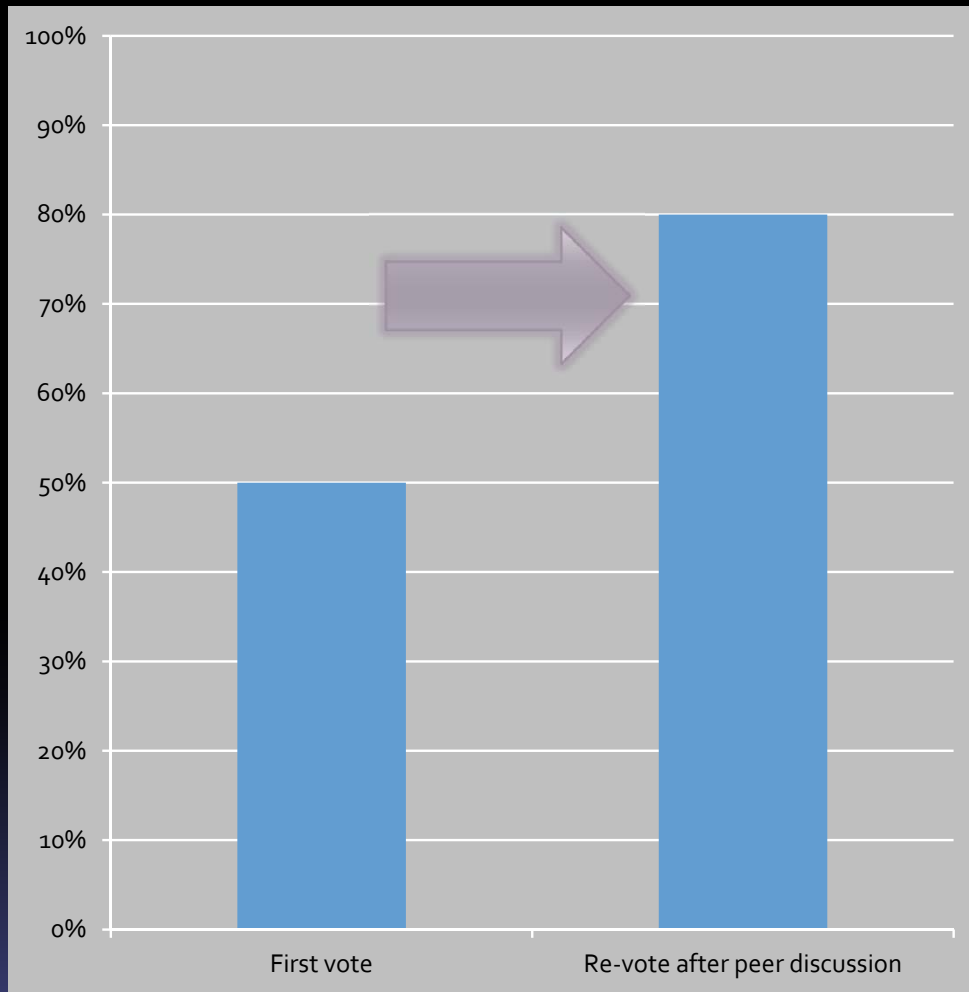
Peer discussion
Students try to convince each other



Students answer again individually

Students may see histogram of results but correct answer is not revealed

Students see histogram of results and correct answer is revealed and discussed

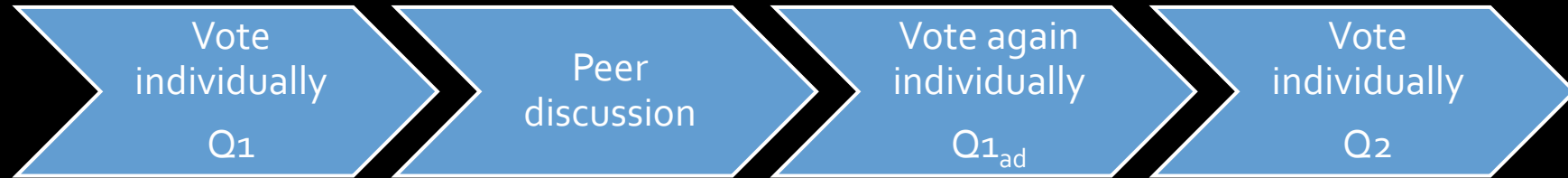


Gains in understanding during discussion, or simply from peer influence?

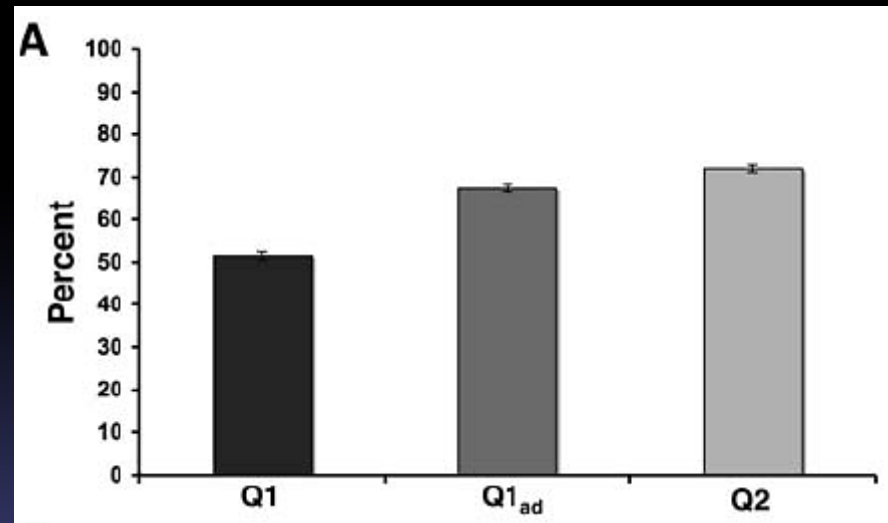
Which is more effective: Peer discussion or teacher explanation?

What factors are key to making clickers work

Smith et al., 2009

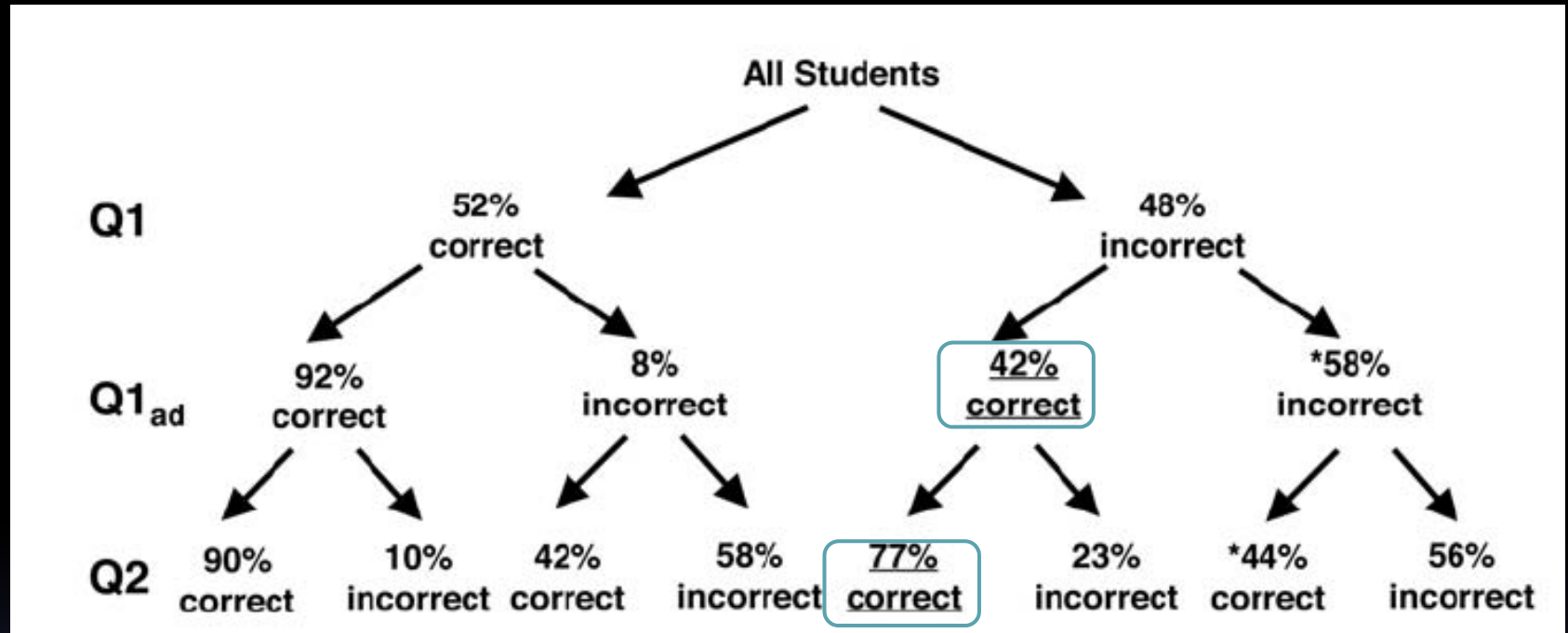


- Neither the answers nor the histograms of student answers were revealed until after the voting on Q2

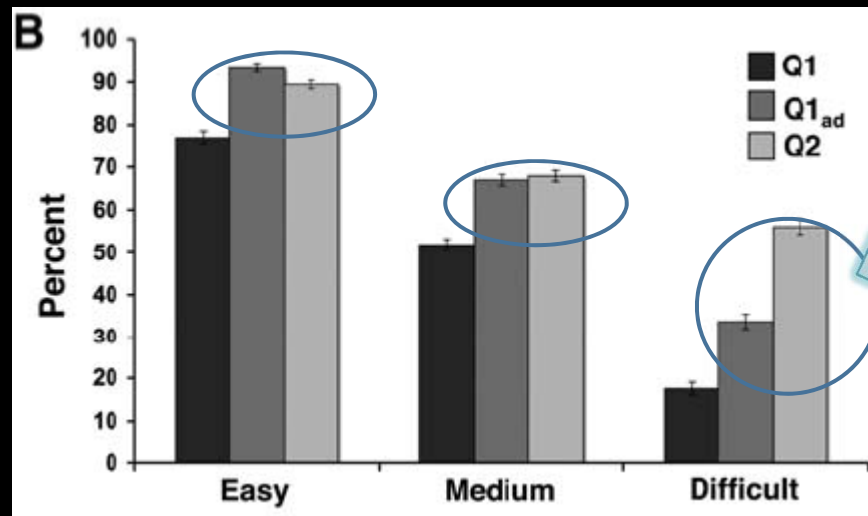


n = 350
No. of question pairs = 16

- Peer discussion leads to increased conceptual understanding and improved performance.



Most students who initially did not understand a concept were able to apply information they learned during group discussion and correctly answer an isomorphic question.



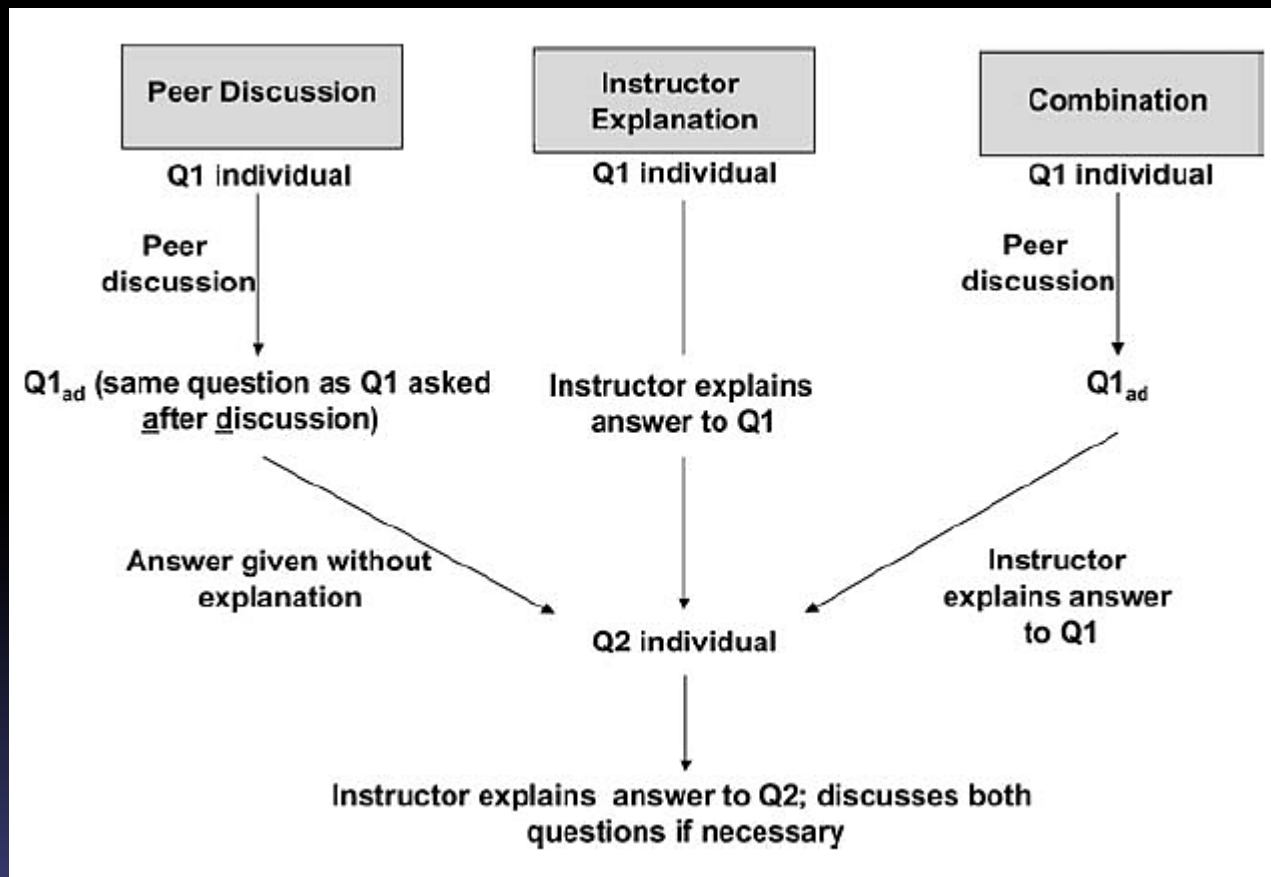
Student opinion

- Students performed significantly better on Q1_{ad} and Q2 compared to Q1 for each difficulty level.
- On the most difficult questions there was another significant increase between Q1_{ad} and Q2, even for groups in which no student initially answered Q1 correctly.

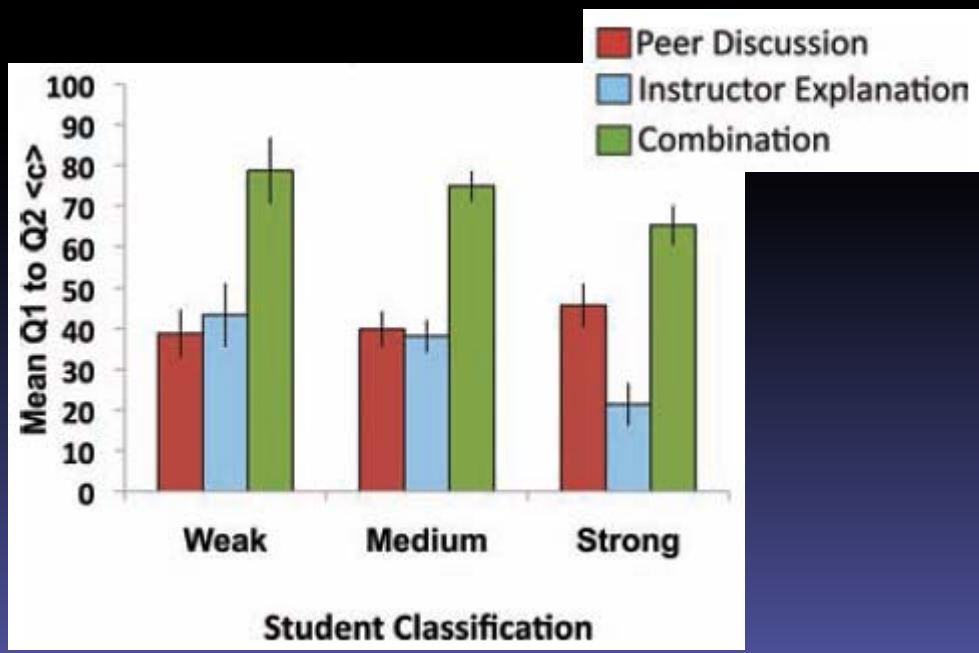
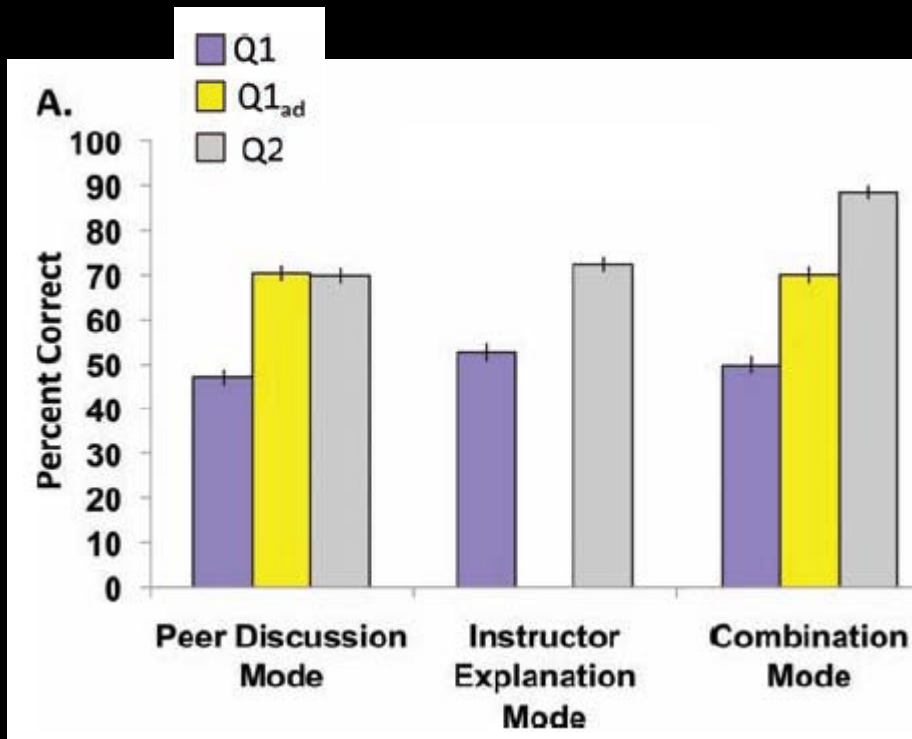
“Often when talking through the questions, the group can figure out the questions without originally knowing the answer, and the answer almost sticks better that way because we talked through it instead of just hearing the answer.”

What factors are key to making clickers work

Smith et al., 2011



- Histograms of student responses were shown only after the Q2 vote



Student opinion

“It gets me thinking about the topic before [the instructor’s] lecture, rather than just passively listening to what he has to say – I am already engaged.”

“Discussion helps get the ideas and thoughts flowing, which makes what [the instructor] says more concrete.”

What factors are key to making clickers work

- Peer discussion – encourage students to verbalize their thinking, figure out what they understand and what they have questions about.
- Use questions sufficiently challenging with multiple plausible answers
- Teacher's explanation on the answers after second vote

Benefits of clicker usage

- Allow students to have formative assessments of their learning without penalty to their grade
- Clarify student misconceptions when discussing wrong choices selected by students
- Engage all students, including those with lower motivation and lower learning ability

When to use...

- Right after teaching
- Revision
- Post quiz / examination debriefing
- Checking prior understanding

Project on Enhancing Conceptual Understanding in Chemistry with Quality Assessment Items and Classroom Response System

- Annotated assessment items:

- Chemical structure and properties
- Organic chemistry
- Chemical reactions and energy
- Rate of reaction
- Chemical equilibrium

- Try-out schools:

- Tuen Mun Catholic Secondary School
- Chong Gene Hang College
- Homantin Government Secondary School

References

- Smith, M. K., Wood, W. B., Adams W. K., Wieman, C., Knight, J. K., Guild, N., & Su, T. T. (2009). Why peer discussion improves student performance on in-class concept questions. *Science*, 323, 122-124
- Smith, M. K., Wood, W. B., Krauter, K., & Knight, J. K. (2011). Combining peer discussion with instructor explanation increases student learning from in-class concept questions. *Life Sciences Education*, 10, 55-63