An Experiment with Peer Instruction in Computer Science to Enhance Class Attendance

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Outline

1. Motivation
2. Materials & Methods
3. Results
   - Peer Instruction and class attendance
   - Course evaluations
   - Peer instruction learning curve
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Setting

- Computer Science courses in HE
- Lecture attendance is not compulsory
- Declining lecture attendance during the semester
- Various hypotheses and opinions exist to explain why this is the case
- *Assumption: a different set-up of the lecture, being a more interactive way of knowledge transfer and learning, will increase attendance*

Interactive lectures

- "flipped classroom" (Tucker, 2012)
- Make it partially 'tutorial-like'
- Peer instruction (Crouch and Mazur, 2001)
- Other research-based options (Borrego et al., 2013)

Peer instruction (in a nutshell)

- Is about students teaching each other (their peers)
  - Concept test ('MCQ') posed by the lecturer
  - Students vote on an answer, then see the response
  - Students discuss the question and answers with their neighbours
  - Students vote again on the same question
  - A class-wide discussion of the question
- Variations exist (e.g., Zingaro & Porter, 2014; Koppen et al., 2013)

PI in CS

- Main online resource `http://www.peerinstruction4cs.org`
- Gaining momentum in CS (Bailey Lee et al., 2013; Borrego et al., 2013; Koppen et al., 2013; Simon et al., 2013; Zingaro & Porter, 2014)
- Shown to work also for the more abstract topics such as theory of computation (Bailey Lee et al., 2013)
- Normalised Gain of PI (regardless topic) about 34%-45% (Bailey Lee et al., 2013)
- Personal experience with small 3rd-year course and large service course with low-resource PI positive

Student-centered viewpoint

- Mostly positive feedback (e.g., Duncan (2006), Good (2013))
- Lectures with PI overwhelmingly "interactive" (argue/explain concepts, learn from or teach partner) cf. plain "active" (listening and/or note-taking) (Simon et al., 2013)
- Interactive decidedly deemed positive, thanks to, a.o., valuing the interaction in the classroom with peers, higher perceived approachability of the lecturer, and a community spirit (Simon et al., 2013)
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Questions and hypothesis

- Given the positive perception of PI by students, **can inclusion of PI increase class attendance?**
- Duncan (2006) claims yes, but reference to the study claiming an increase from 60-70% to 80-90% is missing
- Kaleta & Joosten (2007) indirectly indicate that PI may increase class attendance (64% of the students would sign up for another course that uses clickers)
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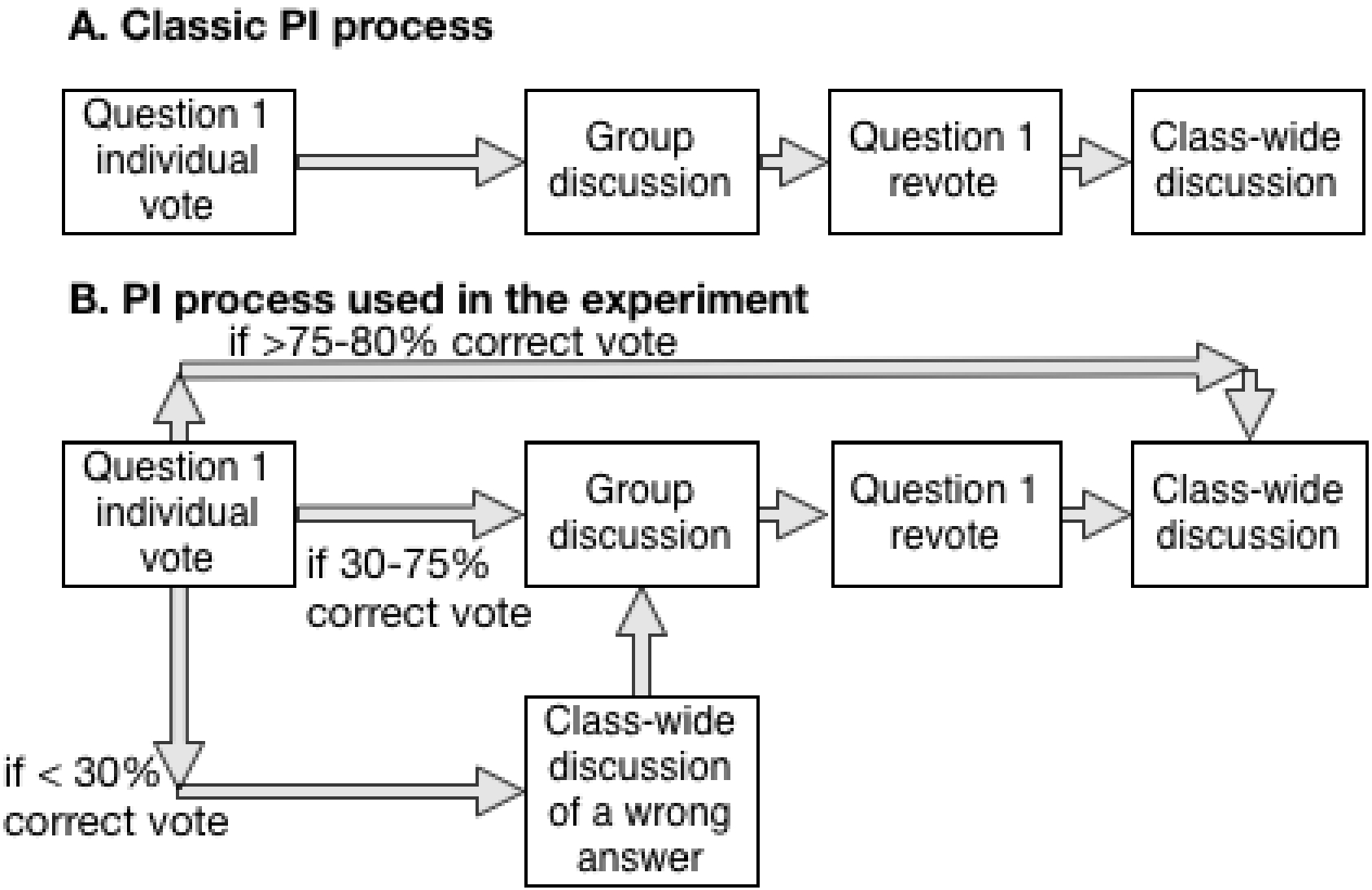
Set-up, running, and evaluation of the peer instruction (condensed overview)

- Choose software for medium-resource PI (software-based ARS)
- Choose course, select which lectures to have PI
- Develop the questions online and offline
- Record the number of students in class for each of the 19 lectures by silent manual headcount by the lecturer
- Make any other notes that may be relevant
- Conduct PI and record participation in the quiz and the answers
- Evaluate the data in standard spreadsheet software
- Use the general course and lecturer evaluation forms to obtain feedback about the PI specifically

Methods: PI procedure



Materials

- Wireless connection and online voting with a 'software-based clicker' (ARS)
- Evaluation of ARS software:
  - (McGraw Centre for Teaching & Learning, 2012), covering 19 different software-based ARSs,
  - Socrative and eClicker did not meet requirements upfront
  - 4 selected for evaluation:
    - Google Forms and Pinnion are too cumbersome for releasing the individual questions
    - Qurio had an annoying website.
    - Mentimeter chosen (by elimination)
- Mentimeter limitations: 100 char max, no figures, no symbols, no saving results

Materials: the course

- "Networks course" 2014
- Third (and last) block of the larger 3rd-year CS compulsory course
- From mid-April to the end of May over 19 lectures, one each working day from 9:00-9:45, except the (many) public holidays
- Typically about 100 registered students
- Networks is a 'run-of-the-mill' CS course
- Chapters 1-6 of the textbook (Kurose and Ross, 2013)

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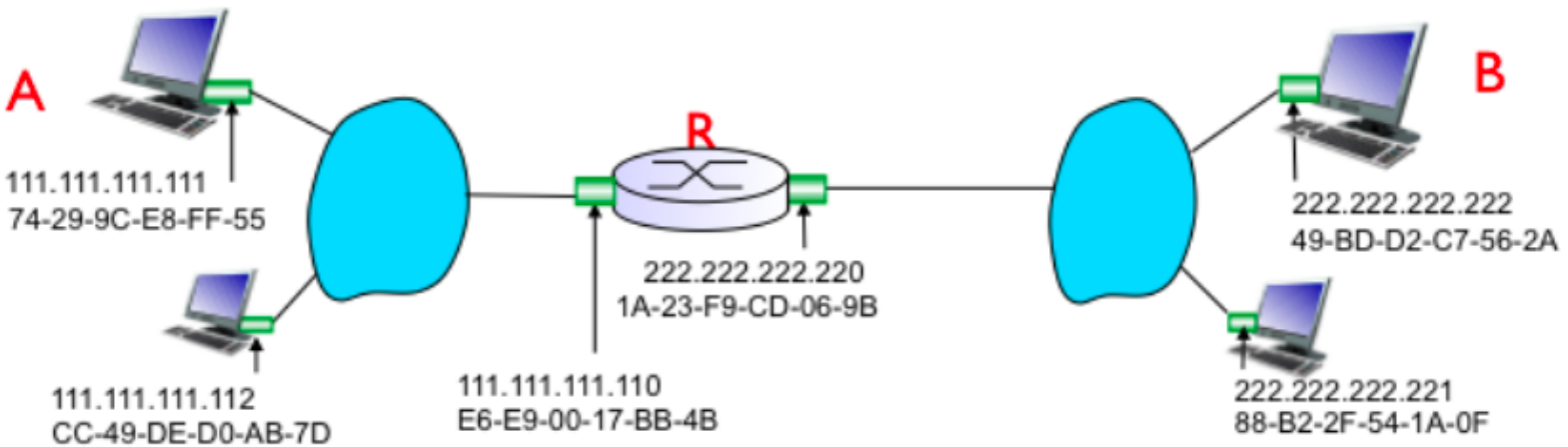
Materials: sample concept test

L15Q5. Consider the following network configuration and addresses.



Host A wants to communicate with B. It did so yesterday. Which of the following will NOT happen/is NOT true?

A. Host 111.111.111.112 also receives a frame from A.
B. Router R will put <111.111.111.111, 74-29-9C-E8-FF-55, 20> in its ARP table, if not already there
C. A's frame has destination addresses 222.222.222.222 and 49-BD-D2-C7-56-2A
D. Router R sends a frame containing addresses 1A-23-F9-CD-06-9B and 49-BD-D2-C7-56-2A, and 111.111.111.111 and 222.222.222.222

(Correct Answer: C)

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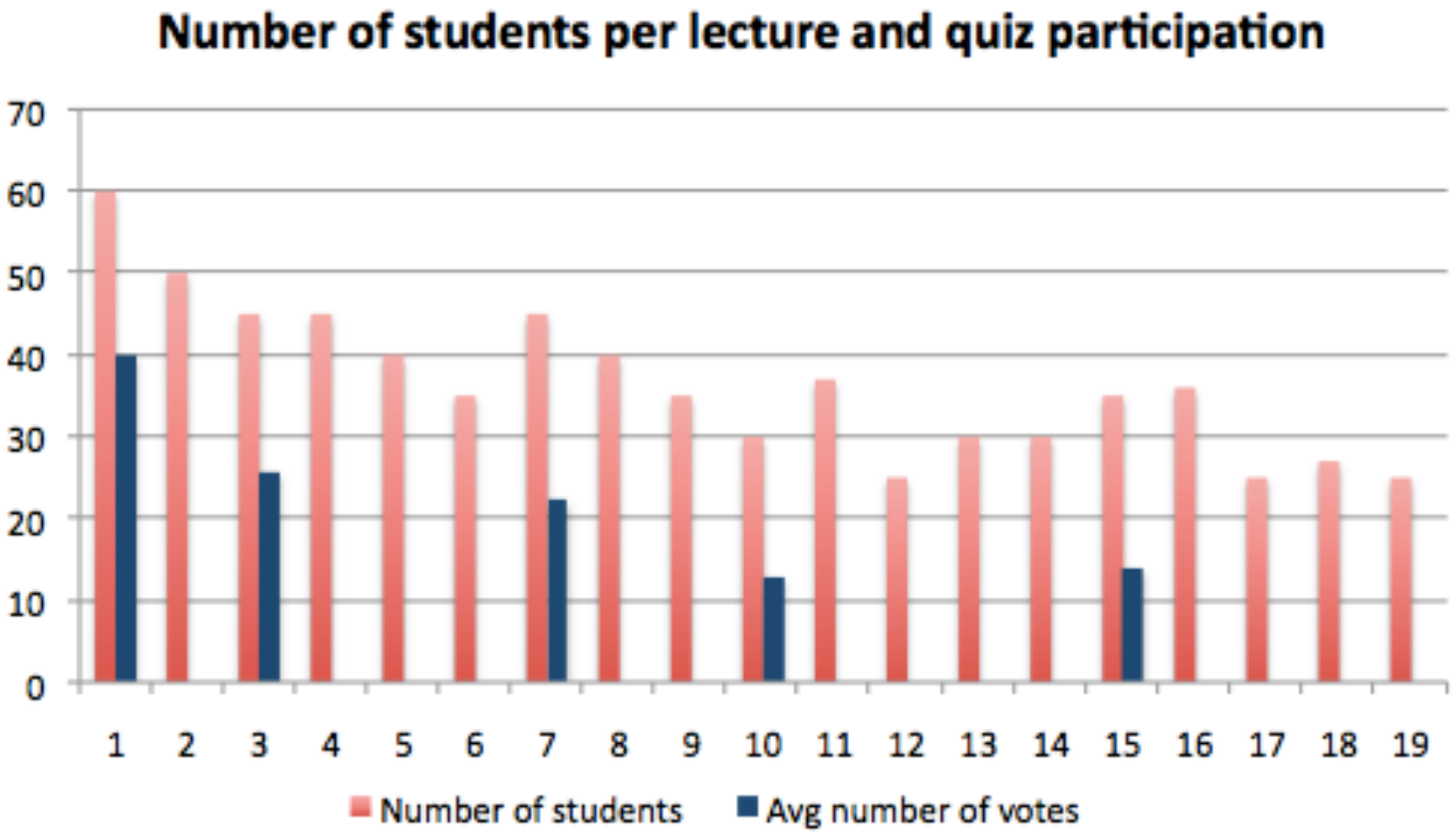
Attendance and participation



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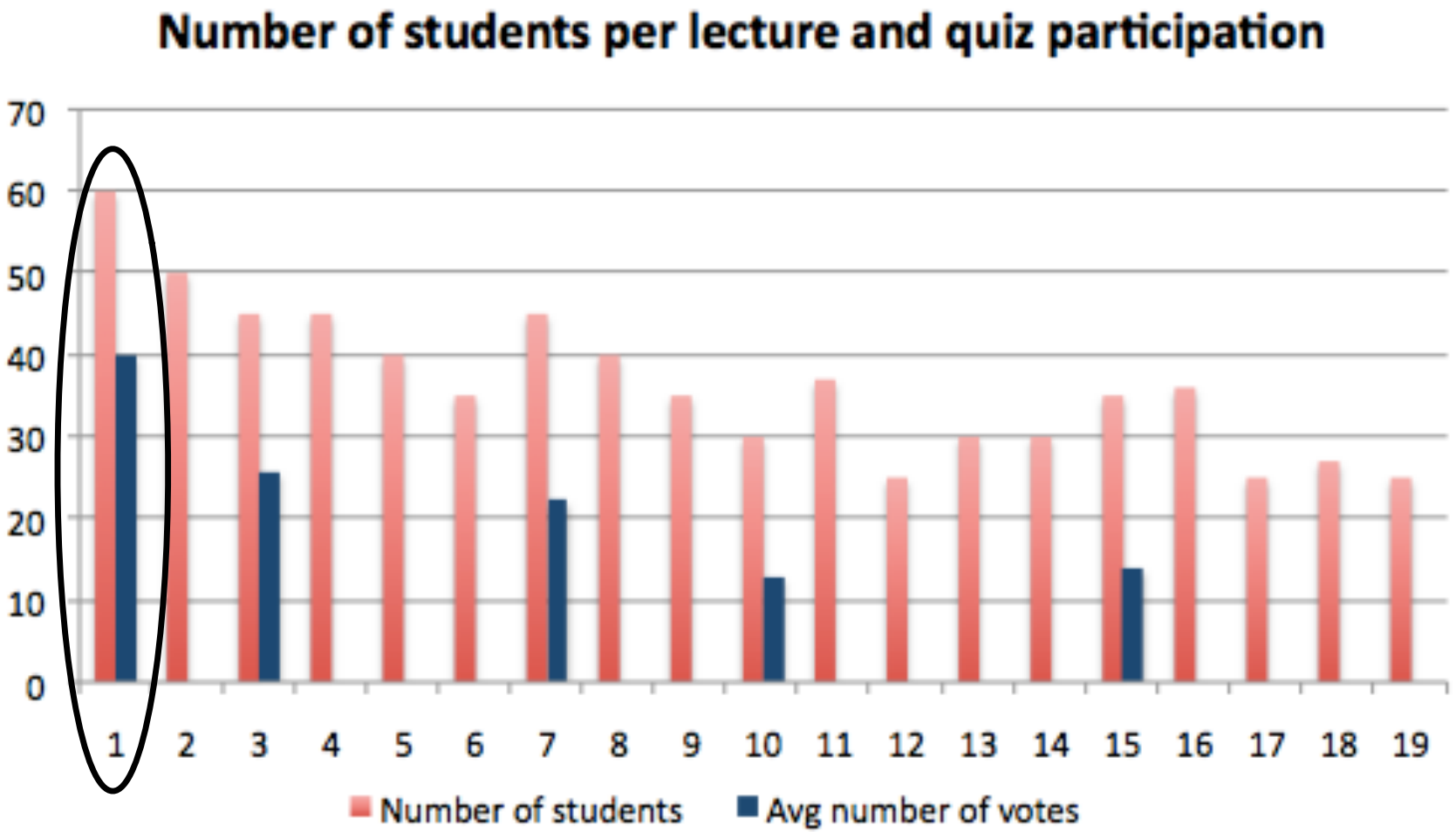

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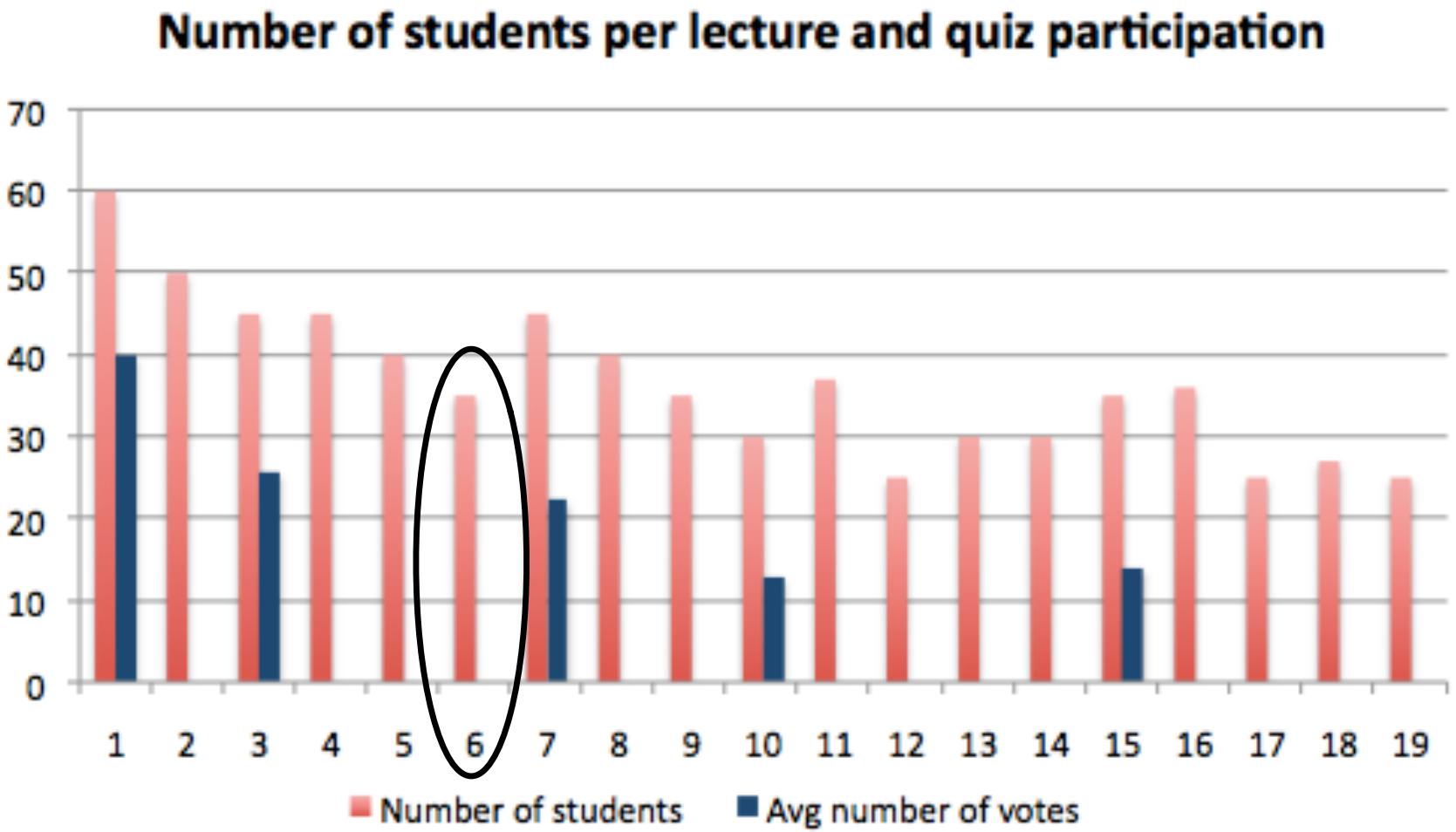

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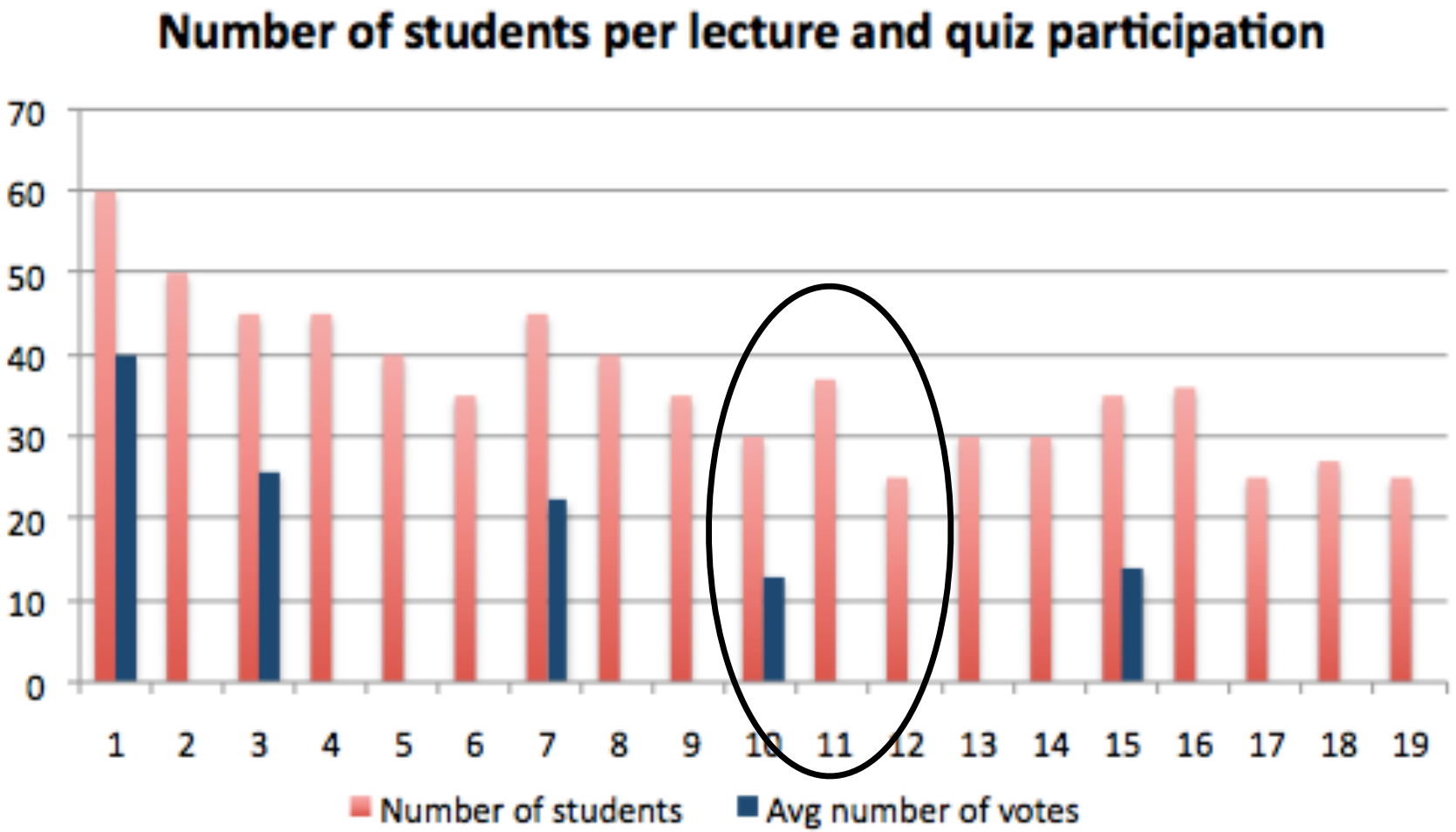

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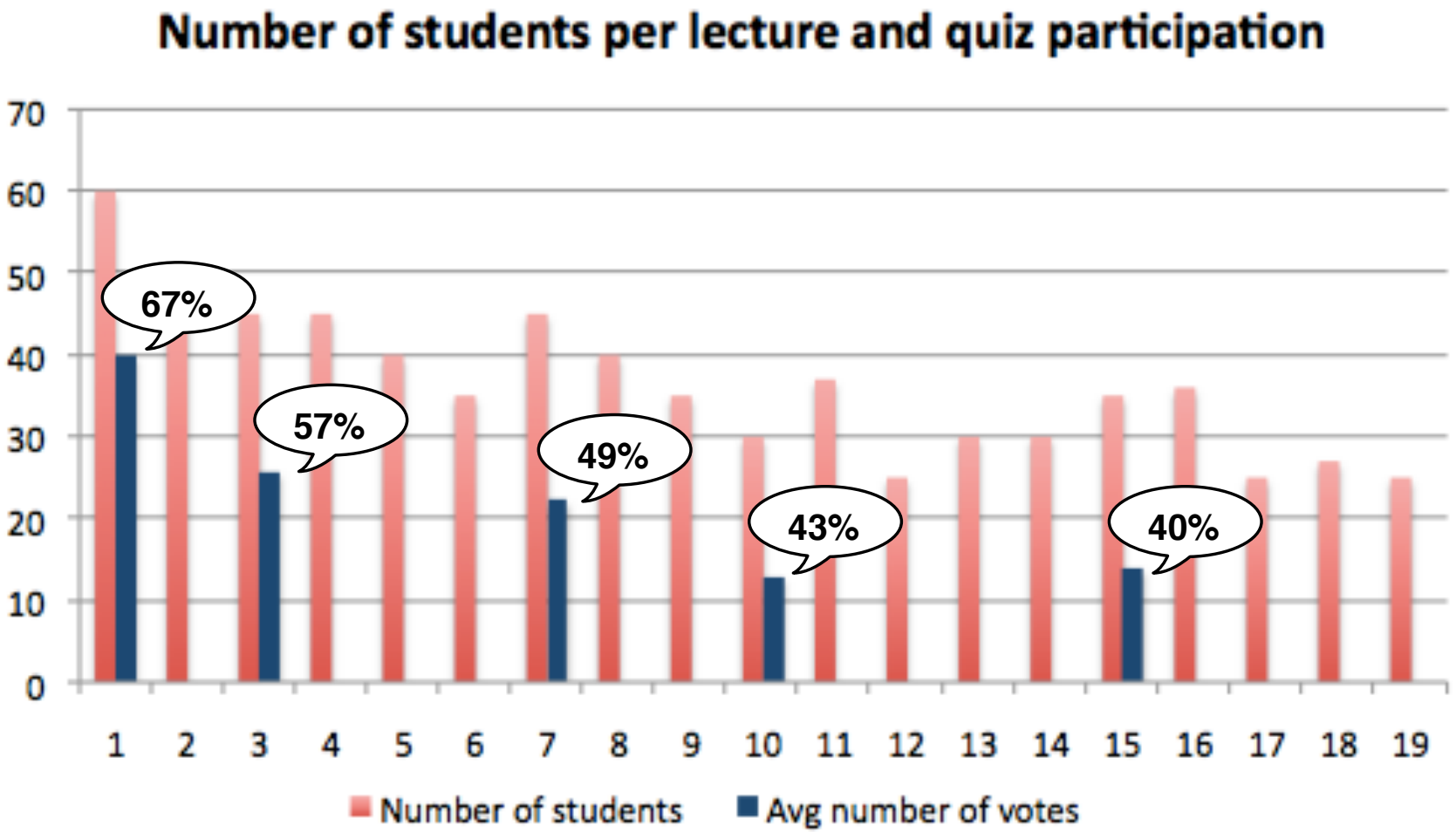

Aggregate results course evaluation on PI

- 43 answers for the question about 'quizzes'
- 11 below average, most students average (n = 22, i.e., 51%), and 10 above average; overall **slightly positive**
- Lecturer evaluation form about PI: 26 answers (of which 7 N/A) with a mean of 3.38 out of 5 (5-point Likert scale)
- Better evaluation PI in lecturer evaluation than in course evaluation

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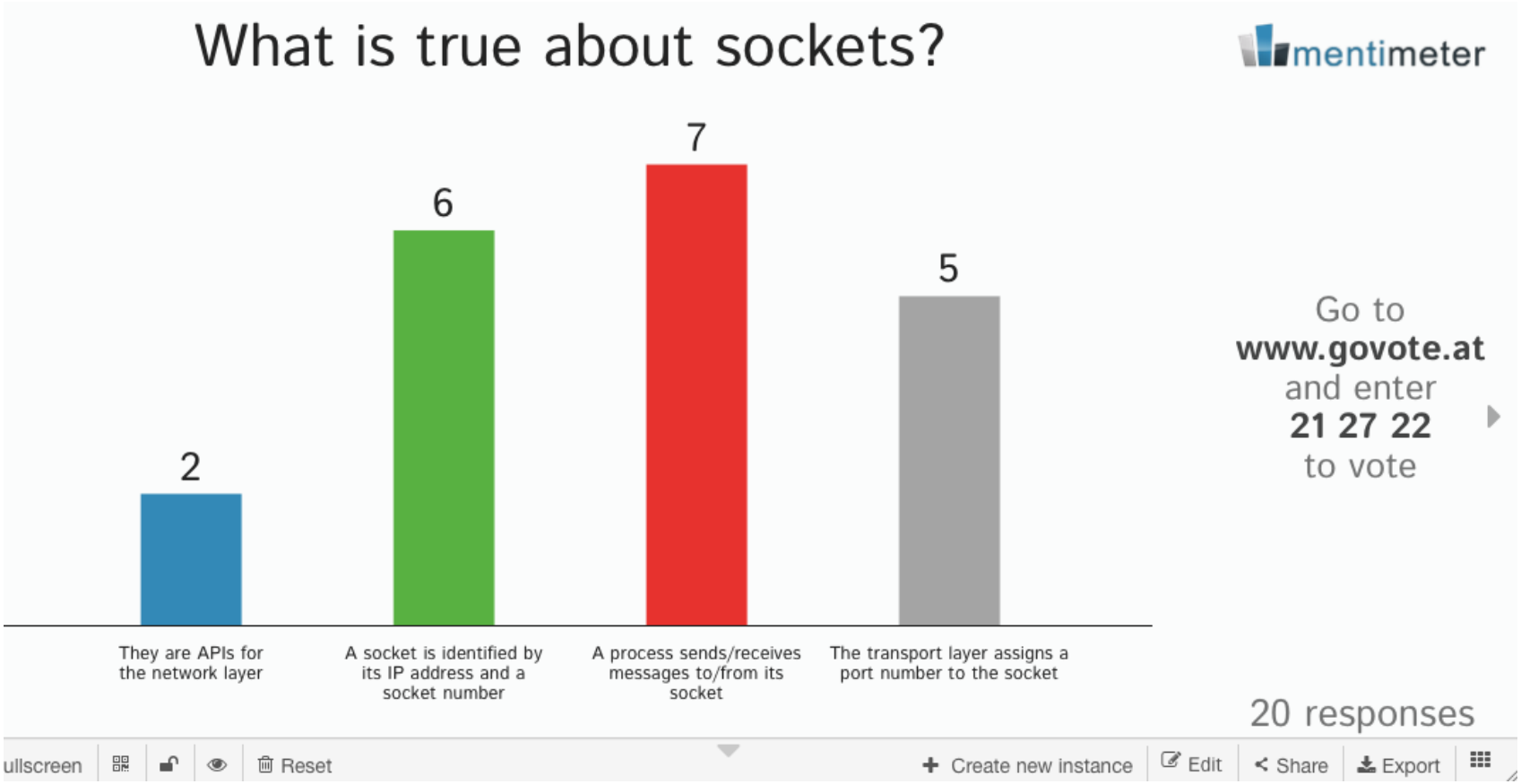
Free comments section (selection)

- "I liked the quizzes, they made the lectures more interactive."
- "The online voting tool that [xxx] used made the lectures more interesting and useful, as it encouraged class participation."
- "Using GoVote really added to the lectures."
- "enjoyed the online classes quizzes helped me stay awake!"
- "... boring ..." (but with low lecture attendance)

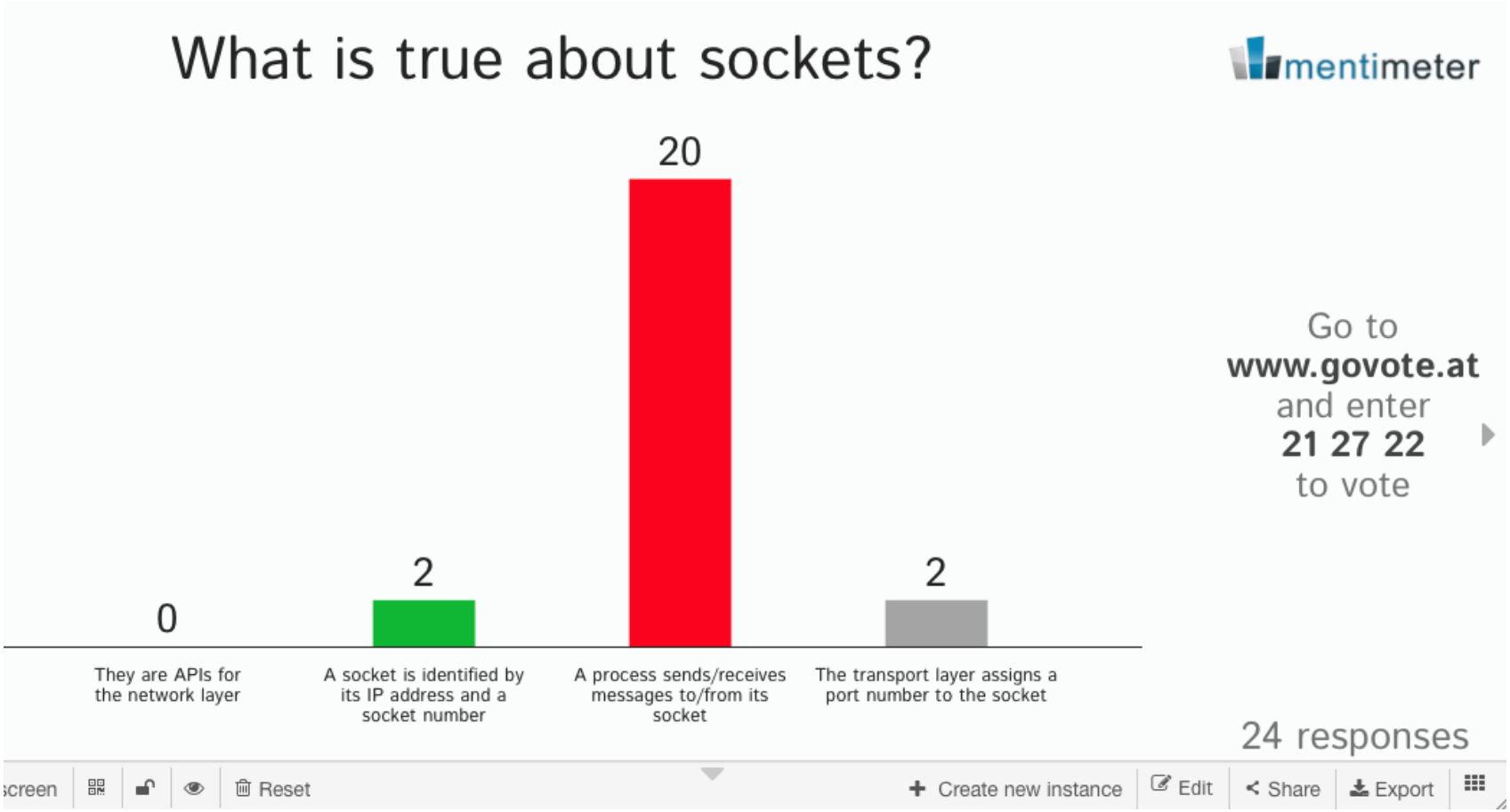
Peer Instruction

- Learning curve for peer instruction among students
- Waiting & revoting vs. discussion and revoting—latter good illustration of PI.
- Last PI: few voters, but active engagement in the lecture

Example of a PI success (L7Q1-v1)



Example of a PI success (L7Q1-v2)



Example where PI and Mentimeter fail (L15Q5)

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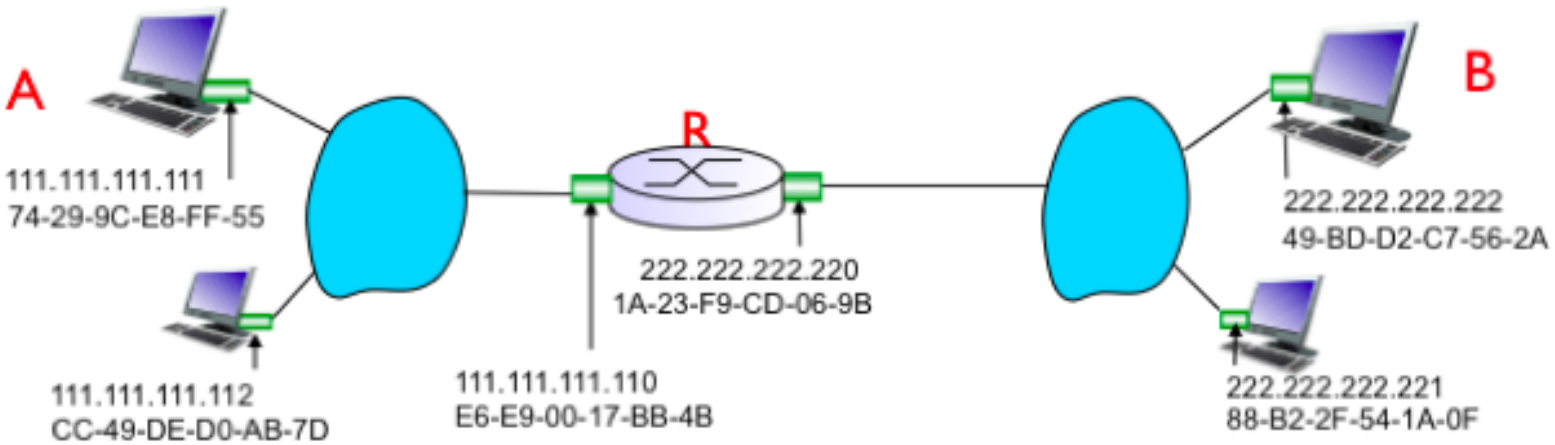

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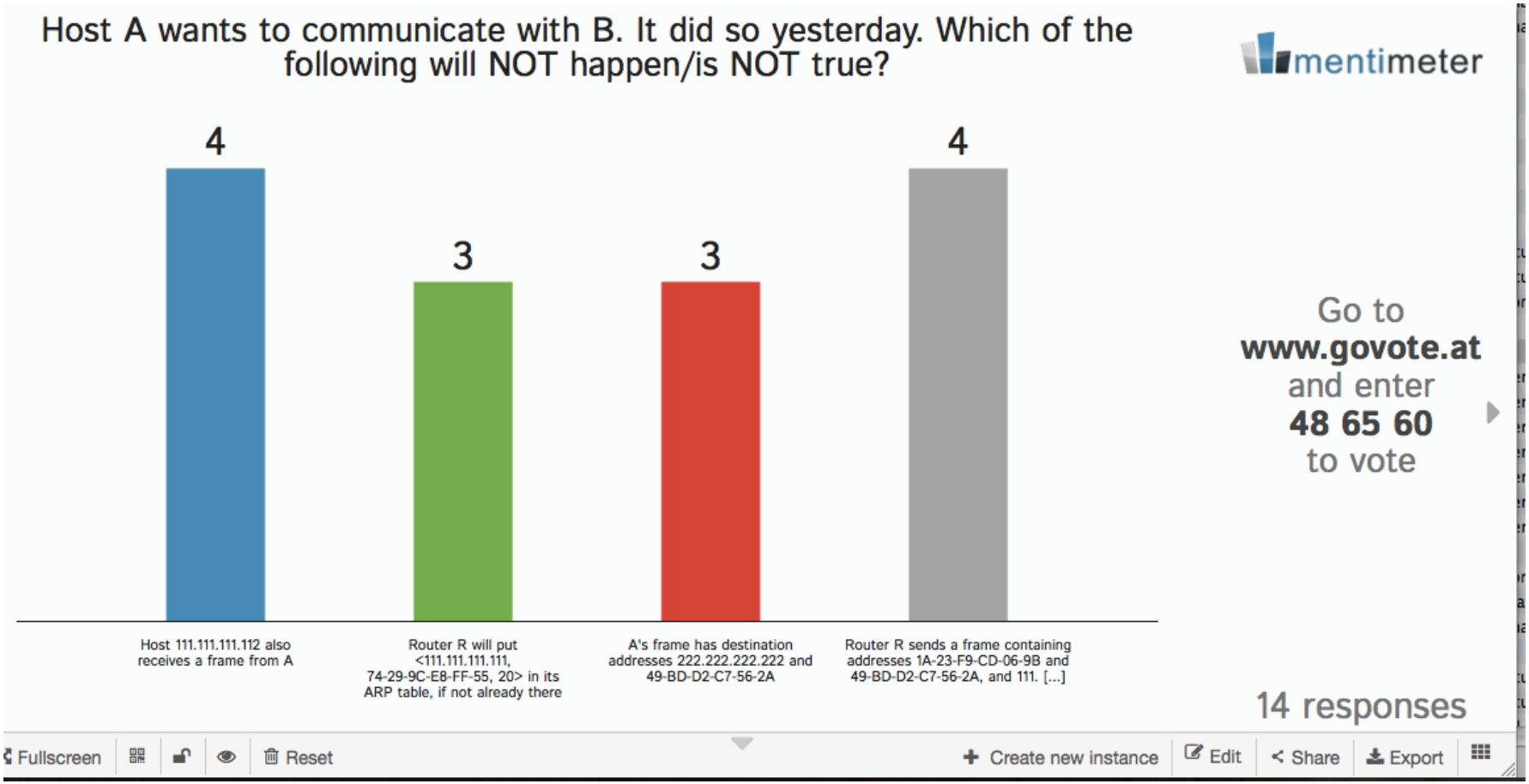
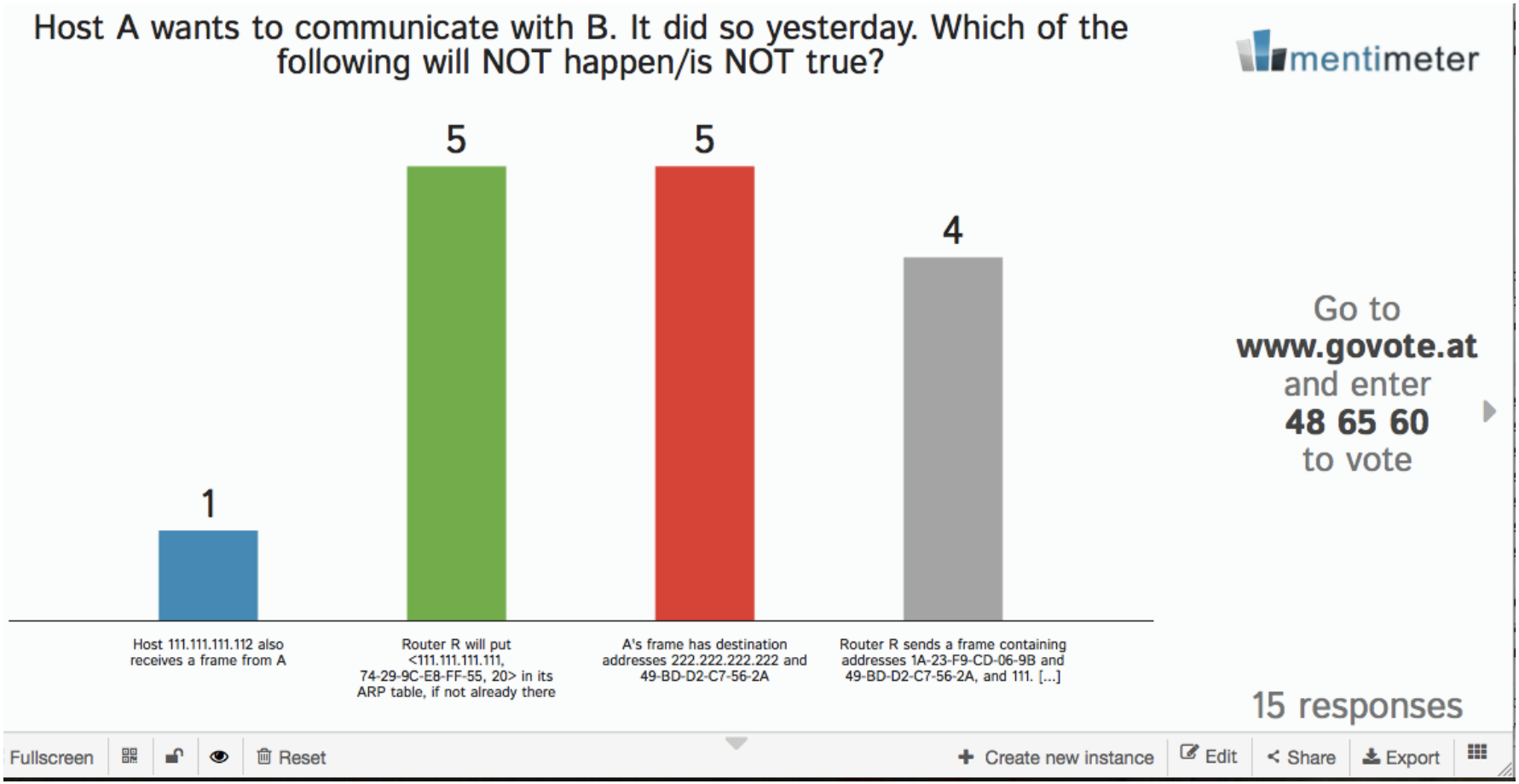


Example where PI fails—but useful feedback (L15Q5-v2)



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- 45% 'lost' upfront
- Core set of students diligently attends lectures regardless the quality of the lectures?
- Type of feedback in line with other works (Simon et al., 2013)
- Limited features of the 'software clickers'
- Decreasing voting participation also elsewhere (Koppen et al., 2013), but only 1% without device "didn't think along", vast majority worked together with their neighbour(s), validating (Smith et al., 2009).
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- Quality of the Concept Test quiz questions used
- *To better choose interventions to increase lecture attendance, one will have to find out why attending students do attend, and why those who do not, stay away*

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- Overall decline in attendance from about 45% to 25-30%
- Participation rate in voting decreased from 57% to 40%
- Student evaluations indicate a moderately positive opinion of the use of peer instruction.
- Results are moderately in favour of continuation of peer instruction (just not for class attendance)
- Unclear whether attendance is thanks to the peer instruction or a hard-core group diligently attend lectures anyway
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Future (current) work

- More concept tests
- Better concept tests?
- Better software-based ARS (recently funded project)

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Thank you!

Questions?