Seeing student understanding during a lecture

Henrik Skov Midtiby
University of Southern Denmark, Denmark, hemi@mmmi.sdu.dk

ABSTRACT
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Please indicate clearly the type of contribution you are submitting: _x_ hands-on, ___explore, ___poster.

This hands-on session we focus on how to see students understanding during a lecture through the use of the student response system Classroom Shared Drawing. The system lets a teacher send and image out to students, that the students then can draw their answers on top of. While the students are drawing their answers, the teacher can follow along in real time. This makes it possible to actually see how well the students have understood elements of a certain topic. This approach of using drawings as an answer type can be applied in all classes that rely on visual models. Examples of such visual models could be a map of the human body (anatomy), a diagram of an electric circuit (electronics) and a force diagram (physics).

I Background

For a lecturer to adapt a lecture to the current audience the lecturer needs feedback from the audience. How to obtain that feedback is the topic of this hands-on session. If the students understand the topic well, the lecturer can move forward to the next topic. If the students have large gaps in their understanding it might be better to revisit some of the earlier class material. Eric Mazur has successfully implemented such an approach by using ConcepTests to gauge the students' understanding and then adapt the lecture to the students' answers using Peer Instruction [Crouch 2021].

A central question is how to obtain that kind of feedback. Traditional approaches have been to request an answer from students in plenum or to use a student response system to collect responses to a multiple-choice question. By posing a question in plenum, the lecturer can get a detailed answer from one or maybe a few students. The main issue with this approach is that only a few of the students in the class provide feedback to the lecturer and that this sample of students is likely biased towards the students that indicate that they would like to answer the question.

Using a multiple-choice question has some different upsides and downsides compared to asking a few students. The good thing about multiple-choice questions is that a large fraction of the class is heard as they provide their answer to the posed question. There are however two issues with multiple-choice questions: the first issue is that they only provide a limited set of answer possibilities for the students and the second issue is that it is difficult to make good multiple-choice questions including incorrect answers that are plausible.

II Explanation

In this hands-on session, we will look into an alternative method of getting feedback from the students, which can gather feedback from all students in the class and where it is easier to generate new questions compared to high-quality multiple-choice questions. The method is based on handing out images to the students that they then draw on top of. The system aggregates all drawn answers into a single image which is shown to the lecturer.

As an example take a lecture about linear equations. Here the lecturer wants to test well the students are able to draw align given the equation for that specific line. The teacher provides an equation for a line and a coordinate system in which each student should draw the line specified by the equation. As as the students are drawing their answers the lecturer can follow along in an aggregate view of all student contributions in real time. This aggregate view provides the lecturer an overview of the students understanding of the topic. The lecturer can see how many of the students that provided the correct answer and more important can get an overview of the misconceptions among the students in the class. The drawing answer type also forces forces the student to generate a solution which requires more effort from the student than choosing one out of four shown drawn lines.
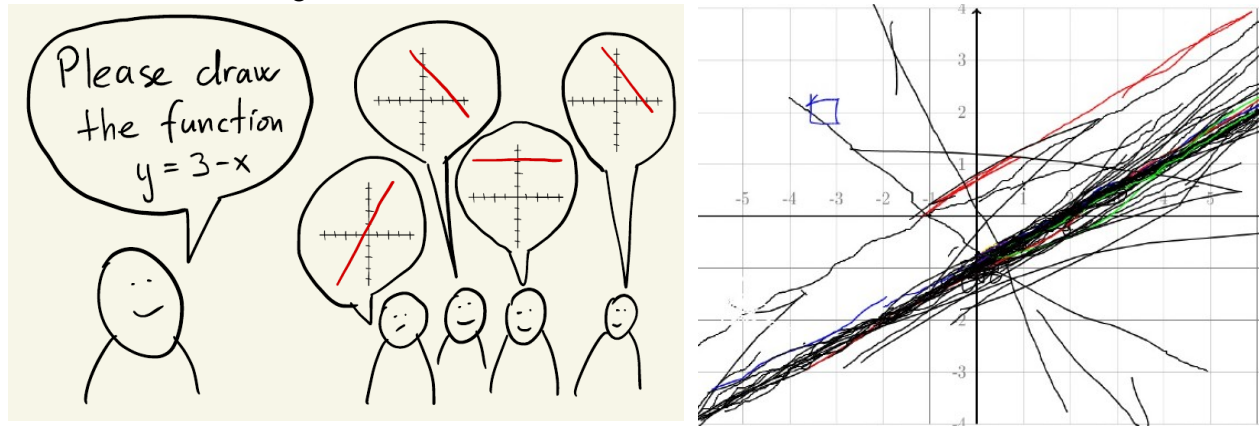

Figure 1: An example of a question posed to students and a set of student answers to a similar question.

III Set-up
This approach of using drawings as an answer type is implemented in the system Classroom Shared Drawing. The Classroom Shared Drawing is developed at part of an e-learning project at the University of Southern Denmark. To use Classroom Shared Drawing as a teacher you will have to log in to the system, then upload the image you want to send out to the students, press "push canvas to students" and finally you need to provide the link to the students well they can in fact with the system. When the students then draw their answers, you can follow along in real time. Logins to Classroom Shared Drawing will be provided to the participants of the hands-on session.

VI Expected outcomes and results
During the hands-on session you will try to use the Classroom Shared Drawing system as a student, then we will discuss how to make good visual questions and finally you will try to use the system as a teacher.

I have used Classroom Shared Drawing as part of teaching first year mathematics for electrical engineering students. In multiple occasions the students drawing has revealed misunderstandings, that could be addressed immediately. The students often request to see the aggregated view of the answers, that makes it possible for them to assess their own understanding relative to the rest of the class. It also provides a great starting point to discuss different approaches to the posed problem.

REFERENCES
Crouch, C. H., & Mazur, E. (2001). Peer Instruction: Ten years of experience and results. American Journal of Physics, 69(9), 970–977. https://doi.org/10.1119/1.1374249