Converting Science and Medicine Lectures into Highly Motivating Interactive Learning Environments

by

Hanspeter Amend
Chemistry teacher
3140413@gmail.com

Contents

Abstract ............................................................................................................................. 1
Objective ......................................................................................................................... 3
Method .............................................................................................................................. 3
Results .............................................................................................................................. 4
   Roche Pharmaceuticals ............................................................................................... 4
   Basel University ........................................................................................................... 4
Concerns .......................................................................................................................... 5
Conclusion ....................................................................................................................... 5
   The following is a short outline of the pros and cons of clicker questions and text fields. ... 5
Future objectives ............................................................................................................ 6
References ...................................................................................................................... 7
Biography ......................................................................................................................... 8

Abstract
This presentation will explain how to enable professors to significantly increase the learning efficiency of their lectures by transitioning learning from passive to active. It will show how to continually inspire students' analytical thought.

It will also show how students can seamlessly express their thoughts while developing an understanding of the concepts presented without interrupting the lecture flow. This real time feedback indicates how students are doing. That can help professors to fine-tune their lectures to their students' needs. The presentation will also show how professors can respond to students' expressions of their thoughts, thereby catalyzing their motivation and engagement.

The concept will be demonstrated using a lecture for second year biology students at a Swiss university in 2016. It was elected the best science lecture of the semester.

This presentation will be a real-time demonstration of how the audience's responses are used to deepen their relationship with the presenter, thus refining their learning efficiency.
Objective
This paper draws upon results from using interactive environments that were created in 2016 for data management presentations at Roche Pharmaceuticals and for biology lectures for students in their second year at Basel University in Switzerland. In each setting the audience was able to improve their understanding as they were given opportunities to reflect and interact with each other or the lecturer. The paper recommends that more attention be given to interactive options in university lectures. The purpose is to realize learning environments with increased student motivation, didactic efficiency and sustainable study results.

Method
Slide decks were the basis for conversions into interactive learning environments. In all cases a given slide deck was enhanced with interactive questions which were usually created by the presenter.

The content of the slides remained unchanged. Questions were asked after certain slides or after certain slide series. Once entered the responses were immediately presented to the audience. Unlike conventional clicker environments the response forms used also allowed for text entries.

For all lecturers this approach was entirely novel. Great care was therefore taken to support them in a smooth transition from the current lecture style to the more challenging interactive style. It was well received that the lectures could be held like a normal one. Only when it came to questions, the students would have to be told to then open the question forms and submit their responses. The questions, especially the ones requiring text responses, were designed to seamlessly integrate into the lecture flow. It was indicated to the lecturers that there was no need to study any new software, no need to learn how to program the integration of their questions into their lecture slides, and no need to familiarize themselves with a learning management system, and it was emphasized that no additional software skills were required. The lecturers in particular welcomed the fact that no additional hardware was required and there was no need to distribute clicker devices to students and later collect and count them. Students would simply use their cell phones or laptops.

Lecturers could make use of two question types, namely "knowledge questions" addressing memory and "thought questions" addressing understanding. Both types were designed for text based or clicker format responses. Clickers came in single choice or in more challenging multiple choice versions.

The concept used is an extension of the method employed by Deslauriers who had students use clicker questions during an undergraduate physics course. He found "increased student attendance, higher engagement and … students in the experimental section did more than twice as well on this test as those in the control section." (Deslauriers, L., 2010).
Results

Roche Pharmaceuticals

Several powerpoint presentations were enhanced with clicker and text questions. In a survey about 60% of the participants acknowledged that the interactivity had added value to the presentation and the same fraction of participants said they would like to find interactive questions in future presentations.

Basel University

A biology lecture was enhanced with interactive questions. In a large final evaluation questionnaire at the end of the semester the students gave highest marks to interactivity, lecturer competence and preparation. Students did welcome interactivity for future lectures, but asked for more time so they could more carefully think about their text based responses.
Concerns
1. Interactive questions, especially text questions, and their discussion, need a lot of lecture time at the cost of content
University students do want interactivity, do want more time for thinking about the questions and do want more time for evaluating and discussing their responses. Instructors on the other hand have a desire to want the students to know a certain minimum amount of content. So for a given time window there is a discrepancy between time for teaching and time for presenting content. Instructors need to find a balance between time for interactivity and merely presenting content.

2. Too much time is needed for preparing the questions and evaluating responses
Once prepared merely reading out slides requires only a minimum of time and effort. Lecturers must decide how much material they want to teach and how much time they want to spend for preparation and what part of the material they want to assign to their students for self-study.

Conclusion
The following is a short outline of the pros and cons of clicker questions and text fields.

Clicker questions
Pros
Entering responses is easily possible within a few seconds for any number of students. Unbiased evaluation of answers is easily possible. The cumulative responses can be viewed and evaluated by the audience as well as the lecturer within seconds. Clickers are suitable for intense learning, strong collaboration and keeping students activated.

Cons
Clickers provide no way of freely entering thoughts and offer only a very restricted way of expressing real understanding. Also a certain fraction of randomly correct responses must be taken into account when evaluating clicker responses. Because answer options are preset, students' responses may be significantly biased. Also it remains unclear if students really know the correct answer they selected or are just reminded by the clicker option. Clickers have moderate didactic and evaluation value because real assessment of understanding is severely limited.

Text fields
Pros
Text fields allow for free entry of unbiased thoughts for students using their own words. Well suited to assess the level of true understanding. A random quota of correct answers is highly unlikely and must not be taken into account when evaluating.

Cons
Entering and evaluating answers is time-consuming. Furthermore assessment of texts may be evaluator dependent. During the lecture only a few answers can be evaluated and one must rely on the assumption that they represent the remaining answers.

Using clickers and text fields
As a suggestion one could use a combination of both types of questions with the pros complementing each other and the cons cancelling each other. The approach would be to use
clicker questions during the lecture and to seamlessly integrate students' attention into the lecture flow and then, at the end of the lecture or after, having them answer in text format the very same set of questions again, in their own words.

Text based questions must be worded in such a way that participants can answer them briefly for easy review during the lecture.

It is recommended to also proactively think about how to integrate text responses into the expected upcoming interaction with the audience.

For a given time window, consider the balance between time for delivering content and time for interaction, i.e., high teaching quality and presentation of less content versus moderate teaching quality and presentation of a maximum amount of content.

**Self-study versus interactive learning**

As an alternative to reducing content to gain time for interaction the complete content can be handed out to students before the lecture. For lecturing, the content can be organized into sections that are taught interactively and sections for self-study, akin to a text book. The content for interactivity can be chosen to be a study basis for the remaining content allocated for self-study.

**Future objectives**

There are various aspects that are worth considering for further investigation.

**In lecture halls, how comfortable do students feel with the lecture?**

Didactic endeavors aiming to improve teaching and learning quality often focus on cognitive processes. Focusing on the affective conditions during learning is thought to provide valuable insights into how various parts of the lecture are received.

**What points in lecture time are suitable for interactivity?**

Great care should be taken when deciding at what points interactive questions should be posed. They would usually be linked to a concept just presented, but can also serve as introductory questions for concepts that would follow. Questions summarizing larger concepts or reviewing the whole lecture can be asked at the end.

**How does interactivity fit into the overall concept of contemporary teaching at universities?**

When working in interactive environments the purpose of such an approach should be made clear to students from the beginning. In sciences interactivity should be coordinated with lab work and tutorials.

**What approaches are particularly well suited for interactivity in university lectures?**

There are various interactive formats at lecturers' disposal.

1. Each participant answers a given question individually.
2. Participants form groups with their neighbors and discuss the question. Both agree on one answer. If text responses are requested, ample time must be allocated.
3. Students get questions they can respond to with text entries between two successive lectures. This allows the lecturer to study their answers and know what fraction of students is
working with the questions. So it becomes possible to understand how students are doing and therefore the next lecture can be prepared in better accord with the students' goals.

During the lecture a question related to an upcoming section of content may be asked twice. Firstly before presenting the content and discussing students' responses. Once content is presented, the question is asked again and, with the just presented content in mind, the students will now be in a better position to respond correctly. The correct response is then given to the students and they will be much more ready to absorb and able to understand it.

**Exploring the presented concepts in depth**
Questions and/or tasks that go beyond the realm covered by interactive questions during the lecture can be offered at the end of a lecture for preparation of upcoming lectures. Such questions and tasks should lead students to explore presented concepts in more detail and help them exploring new concepts derived from given concepts.

**Drill and practices versus transferring and generalizing**
There should be a fine balance between interactive questions focusing on transferring and generalizing concepts presented and those focusing on drill and practice.

**Animations and movies**
Animations and short movie sequences for demonstrations of reaction mechanisms or experiments can be shown during lectures and interactive questions can be directly related to these.

---

**References**
Biography
I am a chemist from Basel, Switzerland where I worked in a high school using e-learning environments that I created with an authoring system developed specifically for highly interactive learning environments. In 1996 I joined Roche Pharmaceuticals in Tokyo where I developed and implemented intranets and knowledge sharing systems. Additionally I also ran a computer school. In 2003 I moved to Roche headquarters in Basel where I worked as a programmer in clinical development creating databases and analysis tools for clinical oncology and neurolog trials. At Basel University I developed and implemented interactive learning environments for science lectures.