# How has technology changed university teaching?

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In the 27 years that I have been teaching undergraduate, graduate and medical students, much has changed regarding the technologies available to me and my students. There have been myriad discussions and retreats about how to use these opportunities to improve education.  But I was taken aback when asked recently what has actually changed and whether, on balance, it was better for learning.

Lots of faculty at lots of institutions have always been and are still experimenting with new approaches based on whatever new technologies afford:  textbooks, mimeographs, filmstrips, whiteboards, slide projectors, television, computers, e-readers, webcasts, Skype, MOOCs.  But does any of this change the process or the results in any fundamental way?  Lots of chefs now happily use freezers and microwave ovens, but mostly when that can be hidden. There is generally an inverse relationship between the quality of the resulting cuisine and the importance of or dependence on those technologies.  The  technologies themselves may degrade the quality of the ingredients.  Could this be true of technology in education?

Let's take the highly touted, contemporary concept of the "inverted classroom."  The idea is to get away from having teachers spend their limited face-to-face time with the students teaching didactic material that can be conveyed in one-way media such as textbook readings and prerecorded lectures with Powerpoint handouts.  Instead, the classroom time can be spent in multi-party discussions about examples and projects.

Reality is somewhat different.  Faculty first spend an inordinate amount of their valuable time recording and editing lectures using low grade equipment and badly designed software.  In the absence of a live audience and in comparison with entertainment programming, the material is dry and the playback is tedious.  With all the attention to dynamic audiovisual media, students have lost the will and the skill to read textbooks and to integrate such information into their minds.  The students blow off both, hoping to wing it by following what happens in class, so they come to class with no basis for a meaningful discussion. The hapless teacher gets blank stares or vacuous musings in response to the first provocative question.  The teacher is then forced to present live much the same lecture that he/she has always presented.  (Yes, I could put a little quiz at the beginning of each class to motivate students to read, but there is so little time then for meaningful questions and the weight of each quiz on the final grade is so low that these become trivial exercises in trivia.)

Worse than all that, the students *think* they have already captured the material in the unwatched and unread recordings and handouts, so they don't take notes.  But having the material in bullet points prepared by the teacher is not the same as integrating new knowledge into the unique framework that exists in each student's mind.  That is what the long-lost process of note-taking was all about.

Many of the technologies on which professionals now rely have the perverse property of letting them think they can "punch above their weight."  We used to reward professionals for memorizing facts and equations that can now be located via search engine faster and more accurately than they can be recalled from such memories.  So there is no point in teaching or rewarding memorization; students rightfully resent exams based on such obsolete criteria.  What is rewarded in the workplace is the very skill that we were supposed to teach in the interactive sessions of the upside-down classroom – the ability to apply first principles and a body of knowledge to address a real problem.  Unfortunately, that is difficult to do unless those principles and knowledge are in the brain rather than in the 197,341 search results.

Don't get me wrong.  I love these technologies.  I can put together pretty slides much faster in Powerpoint than I can write on the whiteboard.  I can ask my students to Google journal articles, patents and technological products that once would have taken them weeks to locate in a library or on the telephone. But have they improved the process of real learning?  No, mostly they have made it more difficult and unlikely.

Oddly, my most popular courses have been the ones in which I have eschewed technology and gone completely "old school." I make my students read the background texts and come prepared for a discussion by relying on Socratic Method – demanding that they propose and criticize answers to my leading questions. I synthesize what they say and what is known in crude lists, drawings and graphs that I create on the whiteboard as the discussion unfolds, not as beautiful, premade, fixed-order slides. I offer no handouts, insisting that they handwrite into their notes whatever information they think they need to summarize and retain what we have discussed. I provide them with supplemental, optional readings in case they have become curious to learn more. I give exams that are open book, open notes, open internet – they can use any resource to which they would normally have access as a professional solving a problem.

All of these measures tend to increase the spread of grades achieved in such courses, the antithesis of "no child left behind." The harder we make our students think rather than memorize, the more visible their differences become. One of the biggest services that formal education provides to society is the sorting and ranking of talent. It is sad when graduate school turns out to be the first time that students are confronted with their relative strengths and weaknesses rather than their self-esteem. But even the weakest seem to appreciate that getting a C- because they took the wrong course is better than getting fired because they took the wrong job.