



## Back to the Lecture

The latter days of August are the warm-up period for the new academic year and a time when professors reorient toward that part of the job which, for many of us, primarily pays our household bills: teaching students. It is a time during which I often contemplate new course content, teaching strategies, and how to make use of innovations that promote what is popularly called “active learning”. These are techniques meant to enhance student engagement in the classroom setting, such as organizing students in small groups that solve problems together on the fly, using peer-to-peer instruction and interactive devices that allow students to ask and answer questions *in situ*—basically anything other than the “traditional lecture”, defined as the situation wherein students sit (or sleep) and listen (or not) while their professor drones on about material they could just as well read about in the comfort of a local café.

For those of us who are data-driven, there is reason to give these active learning strategies a good hard look. In an influential study, Freeman et al. meta-analyzed 225 studies that each compared student performance in undergraduate science, technology, engineering, and mathematics (STEM) courses taught exclusively by traditional lecturing or with use of active learning techniques.<sup>1</sup> They found that students in the active learning environments had higher exam scores and lower failure rates than students taught by old-school lectures. Shifting undergraduate STEM teaching to the more active style, the authors speculated, may help staunch the exodus of undergraduates from STEM majors by delivering a better experience earlier in their college education.<sup>2</sup> Even large introductory courses can apparently benefit from use of active learning tools, as evidenced by Walker et al.<sup>3</sup> in their analysis of lectured vs active Biology 1001 students at University of Minnesota—Twin Cities, a class with as many students as its course catalog number.

For long-time active learning evangelists, such as physics professor Eric Mazur, these data surely came as no surprise. Years ago, Mazur at Harvard as well as his colleagues down the road at MIT switched their introductory physics classes from traditional lecture style to small groups around a table doing hands-on collaborative work. At MIT, the more senior faculty were at first skeptical and resisted adopting the new style of interactive pedagogy, but younger faculty have

embraced the active classroom and, at least for freshman physics, it is clearly here to stay.

Is it a sign of aging, then, for me to admit my affinity for a recent article by Christine Gross-Loh in *The Atlantic* (“Should Colleges Really Eliminate the College Lecture?”), defending the traditional lecture as a precious yet disintegrating medium of communication and persuasion? Gross-Loh makes the point that academics generally have no specific training in public speaking, so it is no wonder that our lectures—in the classroom, conference, or department colloquium—often fall flat. I will disclose right here that I skipped almost every physics class in college once I discovered that our professor was simply reading from the textbook. And I will bet that everyone reading this has endured ineffective lectures in the recent past—the meandering type with no discernible take-home message, the rapid-fire data dump, the overtime marathon that leaves an audience exhausted. To be sure, I am guilty of delivering an hour of torture here and there—packing in too much information, stumbling with uneven pace, failing to connect with the audience. It is no one’s intent to fail their listeners, but among the various demands of an academic job, public speaking is one we have little incentive to perfect. Our lecturing prowess has minimal impact on promotions, somehow we still get invited to speak at conferences, and, with active learning taking center stage, we might simply excuse ourselves from lecture perfection and focus on more pressing issues. Which brings us to the important question, are studies that rank active learning over lecturing not so much indictments of the traditional lecture’s potential, but rather, indictments of academics’ level of motivation to realize that potential?

Gross-Loh notes that, in ancient times, “oratory skills were a social asset ... a way to persuade, influence, and participate in civic life ... Oratory, like writing, emphasizes the ability to formulate coherent thoughts into compelling and well-crafted arguments.” Skill in public speaking was critical for a successful academic career back then, and it continues to be important (though perhaps less vital) today. And not just in the professoriate. The ability to distill complex information into digestible points that are convincing and memorable,

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bring a subject to life, give it a personality, instill in the audience an emotional connection—these are powers one can wield in a grant review, a boardroom, or a job interview. Training in the art of lecturing could transform how we inspire students to learn while also elevating our influence in society at large.

How do we receive such training in the modern era, when subjects like rhetoric are no longer integrated into a conventional science education? We all know how a great lecture looks and feels and we can model our approaches based on those examples. I have often looked to role models like Harvard chemistry professor [Jeremy Knowles](#), who in the 1970s and 1980s taught a course in enzymology that inspired many of us to pursue careers working at the chemistry/biology interface. Here are some of the key components of his brilliance.

1. Practice. Before each class, Knowles rehearsed his lecture in the privacy of his office, reviewing every detail down to the minutiae of which structure would be placed in what position on which blackboard.
2. Storytelling and humanization. Each lecture told a story that began with character introductions, established a plotline, built up tension with conflicting experimental data and vigorous mechanistic debate, then reached catharsis as a model was finally established that reconciled discordant observations. Importantly, Knowles talked about the people who made the key discoveries, many of whom he knew personally (and he himself was among them).
3. Going beyond the page. Nothing in that class came from a textbook. Those lectures took us on a journey and made us feel as though we were right there at the moment of discovery.

Collectively, these elements transcended the standard lecture. As Gross-Loh says, “The combination of hard-earned knowledge, eloquence, and passion endows the lecture with a singular power: the power to move and change its audience.”

I also learned some important nuts and bolts from my graduate advisor, Prof. Mark Bednarski. He taught us there are two kinds of lectures: #1, the kind where you aim to convince your audience of an important point, and #2, where you aim to convince your audience that you are better than they are. “Choose #1”, he would say, and in doing so, limit your lecture to 1 topic, no more than 1 slide per minute, and no more than 1/3 of slides showing data (and only 1 piece of data per slide). This is now the “rule of 1” that I pass on to my own students.

Curiously, some of the same people who drift off during classroom lectures seek them out in droves online, on a myriad of topics. Take the TED talks, for example. Brilliant individuals, some of them from our ranks in academia, fascinate millions with nothing but their words and the most simple of visual aids. When you watch the top TED performers, what shines through is that they are at the same time very rehearsed and also very natural. [One of my favorites is Tim Urban](#), founder of long-form blog site *Wait But Why*. In [recounting his preparation curve for his own TED talk](#), Urban describes a scale that goes from “Winging it” (level one) to “As memorized as Happy Birthday” (level five) in terms of effort, and to some degree, payout as judged by audience engagement. Both reading off the page, like my physics professor did (very easy), and memorized, but only just (rather involved), are two other points on this curve and represent common lecture strategies, but are rightly deemed by Urban as much less interesting to the audience.

In some ways, active learning represents a midlevel effort, akin to the level two “Talk through a set structure” format. You invest some time in your activities, and then your students provide the content, which is obviously not over-rehearsed and thus is rather interesting. Perhaps, we should endeavor to give one “Happy Birthday” lecture on our favorite topics each year, like Knowles essentially did, where every aside and gesture is as practiced and natural as if we had been doing them our whole lives. This is one your students will remember years from now. The rest, however, can still be a level two. But with appropriate outlining (keeping in mind character-building, a story arc, and keeping one overarching message in hand), while leaving the door open for surprise and improvisation, we can keep our audience nearer to the edge of their seats. We might resist putting the storied lecture to bed just yet, and instead aim to fulfill its promise.

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#### Notes

Views expressed in this editorial are those of the author and not necessarily the views of the ACS.

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