Learning is not a spectator sport. Students do not learn much by just sitting in class listening to teachers, memorizing repackaged assignments, and spitting out answers. They just talk about what they are learning, write about it, relate it to past experiences, apply it to their daily lives. They must make what they learn part of themselves.- Chickering & Gamson (1987)

It was 1993 when Alison King introduced us to the dichotomy of teaching styles, “sage on the stage” and “guide on the side.” This was not the first time researchers had questioned the centuries old method of lecturing in classrooms. At the turn of the century people like Dewey challenged our educational practices. More recently, we see lectures challenged in the media and active learning highlighted by the likes of Salman Khan (Khan Academy), Eric Mazur (Peer Instruction in physics), Jonathan Bergmann and Aaron Sams (Flipping the Classroom), and Daphne Koller and Andrew Ng (Coursera, Massive Open Online Courses). However, lecturing is still a major format for the delivery of courses in the STEM (science, technology, engineering, and mathematics) disciplines.

In a recent survey (Oct. 2012) by the Higher Education Research Institute at the University of California, researchers found that men (69.7%) and women (50.4%) teaching in STEM fields are more likely to use extensive lecturing in all or most of their classes. They compared these numbers with those for all other fields and with data from a decade ago (Lindholm, Astin, & Korn, 2002). Some of their results are shown in Table 1.

<table>
<thead>
<tr>
<th>Methods used in all or most courses</th>
<th>2001-2002</th>
<th>2010-2011</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class Discussion</td>
<td>68.3%</td>
<td>78.9%</td>
</tr>
<tr>
<td>Cooperative Learning</td>
<td>32.6%</td>
<td>45.8%</td>
</tr>
<tr>
<td>Student Presentations</td>
<td>30.4%</td>
<td>36.9%</td>
</tr>
<tr>
<td>Extensive Lecturing</td>
<td>54.6%</td>
<td>52.7%</td>
</tr>
</tbody>
</table>

While more instructors have begun using methods other than lecturing, those reporting extensive lecturing has remained fairly constant despite the recent attention over the last

---

1 Author's email: hermanr@uncw.edu
decade, or more, to changing what we do in the classroom. This is more prominent in the STEM fields as noted in Table 2. Generally, STEM faculty use lecturing at a rate of 160% more than those in non-STEM fields.

Table 2. Comparison of STEM and non-STEM Use of Extensive Lecturing.

<table>
<thead>
<tr>
<th>Extensive Lecturing</th>
<th>Men</th>
<th>Women</th>
</tr>
</thead>
<tbody>
<tr>
<td>STEM</td>
<td>69.7%</td>
<td>50.4%</td>
</tr>
<tr>
<td>Non-STEM</td>
<td>43.7%</td>
<td>27.8%</td>
</tr>
</tbody>
</table>

Other interesting results were highlighted in the report. STEM faculty are more likely to grade on a curve (30.6% of Men and 16.6% of women in STEM fields vs. 16.2% men and 9.8% women in all other fields). The use of experiential learning/field studies came in at about 30% for men 20% for women in all fields and group projects were reported at 36-38% men and 27-29% women. Also, STEM faculty use student-centered pedagogy less often regardless of class size as compared to all other fields.

So, why do so many continue to use extensive lecturing and not take advantage of research-based instructional methods? This was addressed by Dancy and Henderson (2010), who had surveyed 722 physics faculty in the U.S. In the physics community there has been a concerted effort in the last two decades to understand how students learn. The PER (Physics Education Research) community has learned a lot starting from the physics education research of the 70’s and 80’s to the development in the 90’s of tools such as the Force Concept Inventory (FCI). These tools have shown that students do not learn physics concepts in a traditional lecture setting even from the best instructors (Halloun & Hestenes 1985; Hestenes, Wells, & Swackhamer, 1992; McDermott, 1993).

These studies led to research-based pedagogical practices such as Mazur’s Peer Instruction. Mazur recounts often how he was surprised to learn that his methods of lecturing did not challenge student preconceptions as an implementation of the FCI test showed. It was not long before he changed from extensive lecturing to active learning, leading him to become an early adopter of what is now called flipping the classroom. In a flipped classroom students are responsible for getting the content outside the classroom and then they come to class ready to discuss and reflect on what they read.

Peer Instruction is just one of the research based instructional 24 strategies that Dancy and Henderson (2010) asked faculty about their level of knowledge and usage. 87% of the faculty were familiar with at least one and the best known by 64% of the faculty was Mazur’s Peer Instruction. Even with this awareness, Dancy and Henderson found that faculty do not reform their teaching methods for the reasons one might think, such as 1) faculty are focused on their research; 2) faculty aren’t aware of research-based innovations; or, 3) faculty might not be convinced of their value. The main reasons that are reported have to do with the time needed to commit to learn and implement new research-based methods.
Even those instructors claiming to use reform methods generally do not use the exact PER strategies that have been proven to lead to gains in student learning. Dancy and Henderson (2010) describe these common features as

They involve student-student interactions, place importance on conceptual understanding, encourage higher level thinking over rote learning, and encourage active learning over passive learning. Additionally, low performance on measures of student learning are consistently associated with passive classroom activities such as traditional lecturing.

However, they found that faculty tend to cut out components like student-student interaction, hands on activities in the classroom, and student-faculty interaction, which are key to these methods producing gains in learning.

Why did lecturing work in the past, if it did? Perhaps students in the past were more motivated to work on their own than they are now. After all, we have been hearing about how the millennial student is so much different. Was it easier thirty years ago to get students (us) into the classroom and have them do more outside the classroom?

Babcock and Marks (2010) have recently found that students spend less time studying now than their counterparts did half a century ago. Students spent 24 hours per week studying in 1961, but in 2003 they spent 14 hours per week. That is a drop of 2.5 hours per decade. However, Babcock and Marks noted that most of the drop took place before 1981. So, if students spend less time outside classes than they used to, there may be less time spent on task and not engaging as much with the material as their counterparts had. Babcock and Marks had also considered that students might work for pay more now than in the past. However, when comparing students with similar work behaviors, they found that there was no significant difference between similar groups of students decades apart. The extra time not used for studying was used instead as leisure time.

From the trends in the data, it seems that the lecture is not going anywhere fast. It is an efficient means to conveying the material if the instructor believes that education is content-centered. However, students do not have time to make the material their own and there is little critical analysis taking place unless the students engage with the material outside of the classroom. On the other hand, who would believe that much can be absorbed in fifty minutes? Students should be prepared to engage with the subject for several more hours outside of the classroom no matter what teaching methodologies are being used. Whatever happened to the two-hour rule? (Actually, I remember that being more like a two and a half, or three, hour rule when I was in school.)

Many of the research-based instructional methods flip the engagement around – let the student get the content by reading, or using short video lectures, while outside the classroom and leave the class time for added active learning strategies. This might give students something to do when they are not in class. This can lead to times of chaotic gatherings instead of the well-controlled sage on the stage environment. It also means that more time has to be spent per topic and less content would be covered. This is difficult for
STEM subjects as there is an expectation in the current curriculum that students proceeding from one course to another have established common skill sets. This might be one reason STEM faculty in general are slow to adopt methods other than lecturing in spite of the past several decades suggesting that lecturing by itself is not effective. However, the flipped classroom seems to have excited teachers in K-12 especially since the origins of this format came up from public school teachers and not down from administrators.

There are many reasons why STEM instructors choose to continue to use lectures extensively in their teaching. It is probably more that the mode in which they were brought up. There is plenty of evidence that research-based methods lead to significant gains in learning. However, there instructors who are more comfortable with lecturing will most likely need to adopt a whole change in educational philosophy before we see significant decreases in the extensive use of lectures. We will also need to find ways to have students take more responsibility in their learning by starting to devote more time to studying. These goals are not necessarily independent.

References


