

handed out. It's really easy to just tune out.' After my ego recovered, I asked whether they thought they would get more out of the class and be more engaged if I scrapped the transparencies and used the chalkboard instead. Both said 'yes.' For the rest of the semester, I went back to the chalkboard (no transparencies in or before class), attendance went back up to traditional levels, the class became more interactive, and my teaching evaluations at the end of the semester were consistent with the ones that I had received previously. Ever since that experience, I have never been tempted to structure my teaching around transparencies or PowerPoint."

The point of this column is not to trash transparencies and PowerPoint. We use PowerPoint all the time—in conference presentations and invited seminars, short courses, and teaching workshops. We rarely use pre-prepared visuals for teaching, however—well, hardly ever—and strongly advise against relying on them as your main method of instruction.

Most classes we've seen that were little more than 50- or 75-minute slide shows seemed ineffective. The instructors flashed rapid and (if it was PowerPoint) colorful sequences of equations and text and tables and charts, sometimes asked if the students had questions (they usually didn't), and sometimes asked questions themselves and got either no response or responses from the same two or three students. We saw few signs of any learning taking place, but did see things similar to what George saw. If the students didn't have copies of the slides in front of them, some would frantically take notes in a futile effort to keep up with the slides, and the others would just sit passively and not even try. It was worse if they had copies or if they knew that the slides would be posted on the Web, in which case most of the students who even bothered to show up would glance sporadically at the screen, read other things, or doze. We've heard the term "Death by PowerPoint" used to describe classes like that. The numerous students who stay away from them reason (usually correctly) that they have better things to do than watch someone drone through material they could just as easily read for themselves at a more convenient time and at their own pace.

This is not to say that PowerPoint slides, transparencies, video clips, and computer animations and simulations can't add value to a course. They can and they do, but they should only be used for things that can't be done better in other ways. Here are some suggested dos and don'ts.

► **Do** show slides containing text outlines or (better) graphic organizers that preview material to be covered in class and/or summarize what was covered and put it in a broader con-

text. It's also fine to show main points on a slide and amplify them at the board, in discussion, and with in-class activities, although it may be just as easy and effective to put the main points on the board too.

► **Do** show pictures and schematics of things too difficult or complex to conveniently draw on the board (e.g., large flow charts, pictures of process equipment, or three-dimensional surface plots). **Don't** show simple diagrams that you could just as easily draw on the board and explain as you draw them.

► **Do** show real or simulated experiments and video clips, but only if they help illustrate or clarify important course concepts and only if they are readily available. It takes a huge amount of expertise and time to produce high-quality videos and animations, but it's becoming increasingly easy to find good materials at Web sites such as SMETE, NEEDS, Merlot, Global Campus, and World Lecture Hall. (You can find them all with Google.)

► **Don't** show complete sentences and paragraphs, large tables, and equation after equation. There is no way most students can absorb such dense material from brief visual exposures on slides. Instead, present the text and tables in handouts and work out the derivations on the board or—more effectively—put partial derivations on the handouts as well, showing the routine parts and leaving gaps where the difficult or tricky parts go to be filled in by the students working in small groups.^[1,2]

If there's an overriding message here, it is that doing too much of *anything* in a class is probably a mistake, whether it's non-stop lectures, non-stop slide shows, non-stop activities, or anything else that falls into a predictable pattern. If a teacher lectures for ten minutes, does a two-minute pair activity, lectures another ten minutes and does another two-minute pair activity, and so on for the entire semester, the class is likely to become almost as boring as a straight lecture class. The key is to mix things up: do some board work, conduct some activities of varying lengths and formats at varying intervals, and when appropriate, show transparencies or PowerPoint slides or video clips or whatever else you've got that addresses your learning objectives. If the students never know what's coming next, it will probably be an effective course.

References

1. Felder, R.M., and R. Brent, "Learning by Doing," *Chem. Engr. Ed.*, **37**(4), 282 (2003). On-line at <<http://www.ncsu.edu/felder-public/Columns/Active.pdf>>
2. Felder, R.M., and R. Brent, "FAQs. II. Active Learning vs. Covering the Syllabus, and Dealing with Large Classes," *Chem. Engr. Ed.*, **33**(4), 276 (1999). On-line at <<http://www.ncsu.edu/felder-public/Columns/FAQs-2.html>> □

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