This is a continuing series of quarterly articles on lessons learned and best practices in civil engineering education. The intent of the series is to reinforce good practices, describe new or developing practices, and provide a forum for what works well and what does not. It is hoped that this series will be an important quarterly read for all civil engineering educators and all those interested in what’s going on in civil engineering education today. Writers and topics will vary from issue to issue. Contact the column editor, Steve Ressler, if you wish to contribute to an upcoming issue.

Whither the Chalkboard? Case for a Low-Tech Tool in a High-Tech World

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This is the first in a series of articles covering ideas and techniques that are included in the ASCE ExCEEd (Excellence in Civil Engineering Education) Teaching Workshops. The writers of the series are faculty members who have been involved with the development and implementation of Project ExCEEd since its inception in 1999

Introduction

In his 1841 treatise, The Blackboard in the Primary Schools, Josiah F. Bumstead wrote, “The inventor or introducer of the blackboard deserves to be ranked among the best contributors to learning and science, if not among the greatest benefactors of mankind.” But that was 1841, and this is now. Today, in the midst of the digital revolution, what could be more archaic than chalk and slate?

Indeed, in recent years, the chalkboard has come to symbolize a lack of technological sophistication in education, and chalkboard-based instruction has become virtually synonymous with lecturing—the Great Satan of educational reformers everywhere. The phrase “chalk and talk” has become pejorative. A recent conference at Oxford University was called “Beyond Chalk and Talk: Challenges and Opportunities for Teaching in the Digital Age” (“Beyond” 2001). One study jubilantly proclaims, “The way we are teaching science has... changed dramatically. There is no more chalk and talk. Teachers are far more confident in teaching science and are well aware of the need to engage the students” (“School” 2003). It would seem that chalk, in addition to being obsolete, also prevents teachers from engaging their students. No wonder that a recently introduced commercial Web-based course management system is called Blackboard—implying that physical chalkboards have effectively been replaced by virtual ones (“Blackboard” 2003).

Given that the chalkboard-based instruction is hopelessly outdated, and given the dazzling array of interactive, Internet-enabled alternatives for presentation and dissemination of information, who would ever opt for the stodgy old chalkboard? Well, I would.

Don’t get me wrong: I’m no Luddite. I strongly support the use of information technology in education, both in the classroom and beyond. I even use it myself sometimes (Ressler 1996; Lenox et al. 1997; Ressler et al. 2001). I contend, however, that the chalkboard remains a far superior tool for the delivery of many forms of classroom instruction—and it ought not be discarded simply because it lacks the technological sophistication of computer projection systems and “interactive whiteboards.” I suggest that we think of the chalkboard (and its more modern cousin, the whiteboard) as just another item of instructional technology—one with its own unique advantages and disadvantages. Our challenge is to recognize when this particular piece of technology represents the right tool for the job at hand.

Chalkboard as Instructional Technology

Anyone who uses computers in the classroom knows that they sometimes fail us when we need them most. Chalkboards, on the other hand, are extraordinarily reliable. They require no electrical power, no software upgrades, and only minimal maintenance. They experience no burned out projector bulbs, no crashed hard disks, no viruses, no failed network connections. They don’t require five minutes to boot up at the start of class. They can be accessed without a password.

Chalkboards are also relatively easy to use, requiring only a few sticks of chalk and an eraser to operate. I emphasize, however, that there is a big difference between using the chalkboard and using the chalkboard effectively. Using any tool effectively requires both planning and practice—and the chalkboard is certainly no exception. More on that later.

If reliability and ease of use were the chalkboard’s only advantages, then the utility of the tool would diminish as computer technology continues to improve. However, many characteristics of the chalkboard also provide significant advantages in facilitating student learning, in comparison with projected media like Microsoft PowerPoint.

First, information written on a chalkboard is persistent. It remains visible to students, even after the class has moved on to a new topic or concept. Thus the instructor can easily and instantly refer back to previously discussed ideas, without having to navigate backward through a series of slides. This characteristic is important because, fundamentally, the learning process is about making connections. Students learn, not by having information inserted into their brains, but by constructing meaning—by making personally meaningful connections between newly acquired information and a complex web of prior learning. A chalkboard—especially a large one—facilitates the creation of such connections by allowing students to view, discuss, and process several related topics simultaneously.

More than any other communication medium I have used in the classroom, the chalkboard is self-pacing. The instructor can write on the board at roughly the same speed as a student can take notes. In practice, writing at the board should be just a bit slower than writing in a notebook. Individual students only need to write with sufficient legibility to decipher their own writing at a later date. But because all students in the classroom must be able to decipher the instructor’s writing on the board, the standard for
legibility and clarity is higher. So writing at the board *should* take a bit more time, thus ensuring that students can keep pace with the instructor.

"But I can cover so much more material with a PowerPoint presentation!" responds my colleague, Dr. Digital, who has never met a computer application he didn’t like. True, Dr. D. If your objective is to cover as much material as possible, then PowerPoint is a far superior tool; but if you are trying to facilitate student learning, then pace matters, and the chalkboard will help you regulate your pace in a way that no other tool can.

"But you’re missing the whole point," argues Dr. Digital. "By using electronic media, I can spare my students from the drudgery of note-taking, I can provide them with handouts of the PowerPoint slides, or I can post the slides on our course Web site. Then students can give me their undivided attention in class, without being distracted by the need to write in their notebooks.” In response, I suggest that we not be too quick to abandon the practice of expecting our students to take notes. Though there is no universal agreement on this point, the literature provides ample evidence that note-taking promotes student learning. For example, Kiewra and Benton (1988) studied the relationship between student note-taking behaviors and academic performance, using such measures as GPA, predictive achievement tests, tests of information-processing ability, and course exam scores. They concluded that the "amount of note-taking is related to academic achievement" and the "ability to hold and manipulate propositional knowledge in working memory is related to the number of words, complex propositions, and main ideas recorded in notes.”

In engineering education, there is another critical benefit to student note-taking—the development of *graphical communication skills*. In my own experience, the advent of computer-aided design and drafting (CADD) has led to an inexorable deterioration in students’ drawing skills. CADD is important, of course, but the ability to sketch by hand is still integral to engineering analysis and design. I find the chalkboard to be an ideal tool for improving students drawing skills, in the context of routine classroom instruction. To understand why, let’s look at some classroom instruction.

Dr. Digital is teaching a statics course and, during today’s lesson, he will be discussing the procedure for solving two-dimensional equilibrium problems. In preparing the lesson, he has selected an example problem from the textbook, and he has created four PowerPoint slides. The first shows a complete free body diagram of the structure; the remaining three show the equilibrium equations, \( \Sigma F_x = 0, \Sigma F_y = 0, \) and \( \Sigma M = 0, \) one per slide. Let’s listen as he presents this material in class.

**Dr. Digital:** “Now I’d like to show you how an equilibrium problem is solved. We start with the free body diagram, which you see here on my first slide. Be sure to copy it down carefully in your notes. A good, complete free body diagram is essential to the solution of any equilibrium problem.... Good. Now let’s look at the equations of equilibrium....”

Dr. Digital’s students are diligently taking notes, quickly copying the material on each slide before he advances to the next one. And he is making great time. Across the hall, Dr. Digital’s colleague, Dr. Chalk, is also teaching her students how to solve two-dimensional equilibrium problems. A die-hard traditionalist, she is using the chalkboard rather than PowerPoint.

**Dr. Chalk:** “Let’s begin the problem solution by drawing a free body diagram. Start by sketching the outline of the body itself, isolated from its surroundings—like this.”

Dr. Chalk draws the body on the chalkboard and then pauses, steps away from the board, and allows her students enough time to do the same in their notes.

**Dr. Chalk:** “What should I draw next, Pat?”

**Pat:** “Ahh...the x-y axes?”

**Dr. Chalk:** “Good! Let’s add the x-y coordinate axis system.”

Dr. Chalk draws the x-y axes and pauses again as the students do the same.

**Dr. Chalk:** “What forces act on this body, Jamie?”

**Jamie:** “Reactions?”

**Dr. Chalk:** “Yes, some of the forces are reactions. What sort of reactions should I draw at this pin support?”

**Jamie:** “x and y forces.”

**Dr. Chalk:** “Right, an unknown force in the x direction...let’s call it \( F_x \), ...and an unknown force in the y direction... \( F_y \). Everybody, give it a try.”

Obviously, Dr. Digital’s presentation of the free body diagram takes considerably less time than Dr. Chalk’s step-by-step approach. But speed is not the objective here; and, at the end of the day, Dr. Chalk’s students will be able to draw better free body diagrams—in their notes and on subsequent homework assignments and exams. Some of Dr. Digital’s students, when confronted with the entire free body diagram, found its complexity overwhelming. During the brief time it was displayed on the screen, they were unable to take it all in. Dr. Chalk’s students saw each new element of the drawing as a separate entity and thus could draw it more accurately and could better understand its relationship to the whole. And by asking questions, Dr. Chalk caused her students to actually think about these relationships, rather than just mindlessly copying the diagram.

Another aspect of Dr. Chalk’s class is worthy of note: her use of the chalkboard added flexibility and spontaneity to her class. For example, in response to the professor’s questions, Pat might have suggested adding dimensions, rather than drawing the x-y coordinate axes. Jamie might have responded with “applied loads” rather than “reactions.” These answers would have been perfectly correct, and Dr. Chalk could have accepted them and constructed the diagram accordingly. Once the diagram was complete, Dr. Chalk could have asked the students to decide which equilibrium equation to solve first. She could accept their answer, whatever it was, and then lead the class through that particular solution methodology. After the fact, she might engage the entire class in an assessment of the problem-solving strategy, and perhaps explore alternatives (“Was summing forces in the y-direction really the most efficient way to start this problem solution?”). Dr. Digital could not have done the same thing, because his chosen problem-solving strategy was “hard-wired” into the PowerPoint presentation before the class ever began.

The most critical difference between these two classes is that Dr. Chalk’s students could take ownership of the problem-solving process, while Dr. Digital’s students could not. In Dr. Digital’s class, the instructor was the sole source of information. He created the PowerPoint presentation and transmitted it to the students, who had little choice but to receive it. In Dr. Chalk’s class, the students were the principal source of information. The instructor elicited that information through questioning, and she used the chalkboard to affirm or clarify and, ultimately, to record their contributions. Though the chalkboard is seldom associated with student-centered learning, Dr. Chalk’s class was undeniably student-centered (Fig. 1). And the chalkboard facilitated her students’ engagement in the learning process in a way that the Dr. Digital’s PowerPoint presentation could not have done.
Dr. Digital is not convinced. "My students really love the bright colors and animations in my PowerPoint presentations," he argues. Yes, there is a certain "cool factor" associated with all new technologies. But it will wear off quickly. Try doing a Google search on the phrase "death by PowerPoint." You'll get over 1,500 hits.

"I have poor handwriting," Dr. Digital says. Practice writing legibly. It's a learned skill, just like any other learned skill.

"I don't like chalk dust." Getting dirty is part of the professional culture of civil engineering. Learn to love it, in the same way that geotechnical engineers love soil.

"What about those occasions when I want to show a digital photograph, or display a Web page, or demonstrate the use of a software package to my students?" These are clear cases where computer projection is the right tool for the job. Use it.

"What about interactive whiteboards?" In case you haven't seen one yet, an interactive whiteboard looks pretty much like a standard whiteboard, except that the user interacts directly with a computer screen image projected onto the surface of the board. The user can touch the whiteboard to control computer functions, use a dry-erase pen to annotate notes and diagrams on the board, and then capture the display as a digital image. Interactive whiteboards are rapidly gaining in popularity, no doubt because of their exceptionally high "cool factor." From a pedagogical perspective, the interactive features of the device represent a significant improvement over PowerPoint slides projected on a plain screen.

Indeed, the device provides almost all of the capabilities of a conventional chalkboard, at a cost only about ten times as high (not including the cost of the computer, projector, and a replacement whiteboard after the original has become functionally obsolete in a few years). Use an interactive whiteboard if you can afford one. As for me, I’ll take chalk and slate, and I’ll use the leftover cash to buy instructional technology that my students can really interact with—ropes, pulleys, K'nex construction toys, flexible styrofoam beams, and the like.

Conclusion

The chalkboard's bad reputation derives from its erroneous association with a justifiably discredited mode of teaching—the non-interactive lecture. But just as it is possible to lecture with high-tech tools, it is very possible to use the low-tech chalkboard to enhance the effectiveness of interactive, student-centered modes of instruction. Josiah Bumstead knew what he was talking about.

Of course, to gain the greatest possible benefit from any tool, you’ve got to know how to use it effectively. In the next issue of JPI, we’ll provide some practical tips for getting the most from your chalkboard.

References


