

Incorporating Public Speaking into a Senior-Level Engineering Course—Steven Schrock

Project Summary

Small changes to existing assignments and minor amendments to a civil engineering course result in significant improvement in students' presentation skills.

BACKGROUND

I teach CE 582, Highway Engineering. This is an upper-level design elective taken by students who are in the general civil engineering track. The students enrolled are typically seniors within one or two semesters of graduation, although juniors and graduate students may enroll, as well. CE 582 is meant to prepare students for professional careers at state departments of transportation, city traffic engineering departments, or at private consulting firms that perform transportation engineering services. Prerequisites of the course are in surveying, hydrology, and soil mechanics. (See syllabus.)

This course is the only undergraduate course in transportation engineering offered at KU. As such, it contains all of the components of an engineering design course, such as learning and using the computer-aided drafting software package MicroStation. However, students also must be taught highway engineering fundamental principles before they can get to the design project. Specifically, course goals include to:

1. Develop an appreciation of highway engineering as a profession.
2. Develop an appreciation for the planning, design, and operation of highways.
3. Introduce skills of current software used by highway agencies.
4. Develop teamwork skills among students.
5. Foster a professional attitude.
6. Help students develop their written and oral communication skills.

The vast amount and nature of the material pose an interesting time dilemma for structuring the course: How do I balance the time I spend teaching both the fundamentals and the design-specific content? In addition, these two portions of the course seem to have different default approaches to student learning. Students are typically exposed to engineering fundamentals by listening to lecture material and working through computational homework problems. By contrast, learning design project material requires practicing technical writing and presentation. Students typically have varied levels of proficiency in these skills, depending on their previous coursework or work experiences.

Because most of the students are close to completing their undergraduate programs, I believe that it is also one of my duties to begin to prepare students for the expectations of a professional career and employment. One of the skills I consider extremely important for engineers is the ability to effectively communicate technical material in an oral presentation. In fact, the Accreditation Board for Engineering and Technology (ABET) evaluates the KU Department of Engineering on the following criteria:

1. The ability to use techniques, skills, and modern engineering tools necessary for engineering practice.
2. The ability to identify, formulate, and solve engineering problems.
3. The ability to work in a team.
4. The ability to communicate both orally and in the written word.
5. The ability to understand the social and political impacts of engineering decisions.

When I taught this course in 2006, I required students to work in groups to complete a project design for the Lawrence bypass. Each group worked on the same problem but generated different solutions. Their final assessment was a group presentation made to a board of professional engineers. The students were asked to present their project as if they were proposing their design to potential employers. Although a few groups performed well, overall I was disappointed in the quality of the presentations. Their engineering proposals were of extremely high quality, but in general, PowerPoint slides and the public speaking skills were low to mid-quality.

My teaching goal in 2007 was to effectively help students improve their technical presentation skills without sacrificing their learning of the conceptual and technical fundamentals of highway engineering. In short, I wanted to add presentation skills to my curriculum without losing any of the content I normally cover. Specifically, the skills I aimed to help students develop included:

- Effectively conveying information on PowerPoint slides.
- Eliminating physical distractions while publicly speaking.
- Being prepared to defend design decisions orally (articulately and convincingly).

IMPLEMENTATION

Overview of final project and teaching plan

As in 2006, the goal of the final project was to have students work in teams to solve a real engineering design problem, and present their design to a panel of professional engineers. There were two assessment components. One was the oral presentation to the panel of professional engineers. The other was a written report that described the decision-making process student groups underwent during the design process. The project-written and presentation components together—was worth 20% of their final grade. All students in a group received the same grade. (See Project Description.)

For the oral presentation, I assess students on their ability to stand in front of an expert panel of professional engineers, present their design project, defend their design decisions, and in essence, convince the panel that their proposed design will be an efficient and effective improvement for the public good. Ideally, I would like the students to talk about their project with confidence and good public speaking techniques, have effective PowerPoint slides, and have a strong knowledge-base for answering tough questions from an audience or panel.

During the fall of 2007, I changed several aspects of my course in an effort to improve my students' public speaking abilities. Specifically, my teaching goal was to better scaffold the final presentation to increase the quality of the final project; to do so, I aimed to make my expectations for high-level performance clear through a series of practice assignments. Because I didn't want to sacrifice engineering content or course time, many of the changes were amendments to assignments I used previously, only I required students to spend some extra time outside of class developing their presentation skills. Thus, I didn't alter the number of assignments from previous semesters; I just enhanced existing assignments to include dimensions of public presentation. My goal with these small assignments was to have students gradually build their skill sets and, over time, internalize the traits associated with high performance. If students could identify for themselves the characteristics of high-level work and also how to achieve it, I expected they would integrate their knowledge across the semester and achieve a high level of performance on the final project.

Improving presentation skills for the final project

First, on an early homework assignment, I asked students to provide me details about their public speaking background. In particular, I asked them to reflect on their experiences preparing and giving presentations out of the context of a classroom, as well as evaluate their performance and comfort in those presentations. This survey stemmed from frustration I experienced during fall 2006 when I incorrectly assumed that because all students had completed the required speech and communications course, that they would have the tools to be effective public speakers. I hoped that by assessing their prior knowledge and their comfort levels, I could better respond to the needs of individual class members.

Next, I shared with students a video titled “Talking Science” (See http://wrigley.usc.edu/spotlight/talkingscience_video.html.) that humorously illustrates the right

and wrong ways to give a professional (science) presentation. While the video was an exaggerated look at what speakers can do wrong, I found that watching it opened a dialogue among my students. Indeed, relative to my having lectured on the same topic by enumerating lists of no-no's (e.g., gum-chewing, etc., as I had the previous semester), the video invoked responses and spurred discussion among the students that ultimately covered the same material I would have covered in a lecture.

To teach visual presentation skills, I chose to amend existing assignments so that I could build the PowerPoint skills without students having to go out and research new topics or add other work that the students would see as "more for the sake of more." For example, on one homework assignment I required students to present their problem solutions as PowerPoint slides. I then selected slides that demonstrated various levels of performance and showed them to the students (the author remained anonymous), encouraging discussion regarding the strong and weak aspects of each. (See Levels of Work Examples.) In addition, I selected slides from the final presentations from 2006 and had students assess those, as well. By the end of the class session, they seemed to have a strong sense for what makes a good visual presentation with PowerPoint.

Finally, I gave extra credit for students attending transportation-related presentations outside of our class environment. In addition to having them summarize the content of the presentation, I also asked them to evaluate the speakers for their presentation skills. I hoped this would help them internalize and ultimately adopt the public speaking skills they found effective as audience-members. About half of the class opted to do this extra credit assignment.

The final presentations: Nuts and bolts

To designate groups, I gave the students position announcements (See Position Announcements) that described specific roles that a member would play in the group. For example, one of the positions was for Team Leader, whose tasks—among other things—included emailing me with an update each week describing the progress of his or her group. Once students prioritized their preferred position, I designated the Team Leaders, provided them the information on student requests for positions, and had them assign members to their teams based on student preferences. This way, students were not forced into any particular team role and could choose a position that capitalized on their strengths.

I made it clear from the beginning that students in the same group would all receive the same grade. My justification for this is that in professional engineering environments, a product reflects the work of a design team, regardless of the distribution of input among members. Thus, the group grade reflects real-life work scenarios.

For the fall 2007 class, I developed explicit grading criteria (see Grading Criteria and Grading Notes) to evaluate their design presentations, and I shared this with the students early in the semester so they could see what traits comprised a superior performance. Further, as a class we developed expectations for the deliverables (i.e. design sheets). While these traits weren't formally included in a rubric, the fact that the students themselves determined the nature and quality of acceptable work made the expectations clear to everyone.

I believe that one of the most crucial aspects of project preparation is devoting class time to addressing student questions and issues. Each class period I devoted the last 5-10 minutes to discussing the class project; at this time I answered questions and checked in on the students' progress. I also reserved several lectures as "open" lectures (see Syllabus). Because the project is different each year and students encounter different topical challenges, as a class we periodically rearranged the syllabus so that I could teach the material they needed to complete their project designs. In this way, students identified what they needed to know to solve problems, prioritized it, and took some responsibility in re-ordering the class material.

Final presentations took place in November 2007. The committee of professional engineers was comprised of nine registered professional engineers:

- Two transportation engineering faculty from the CEAE department at KU (same two as in 2006)
- One graduate research assistant for the class (same as in 2006)
- Three managing engineers from the Road Design Bureau of KDOT (same three as in 2006)
- Two engineers from Kansas City area engineering consulting firms
- The assistant director of public works for the City of Lawrence

After each presentation, the presenting group fielded questions from the panel. In addition, each panel member provided written comments (see Evaluation Form).

STUDENT PERFORMANCE

When I surveyed the class to assess prior experience with public speaking, many students in my fall 2007 class expressed apprehension at the idea of a public presentation. This reinforced my desire to implement scaffolding activities to build students' skills—and therefore confidence—for their final projects.

I introduced students to quality slide-making by having them create PowerPoint slides as their format for handing in a typical homework assignment. The quality of slides I received varied widely, and I was able to select slides that would be graded A, B, C, or D and compare them during a class lecture. I asked students to pick out the positive and negative aspects of each slide (see Levels of Quality-Example-Consented).

The extra credit assignments did not elicit as much reflection on speaker performance as I'd hoped. However, students who attended the extra seminars and made an effort to describe the strengths of the speaker were given full credit for their effort. (For examples, see Extra Credit 1 and Extra Credit 2.)

The quality of student presentations in both 2006 and 2007 were very high. In the end, I gave all student groups an A grade. The most marked improvement I observed in my 2007 class compared to 2006 was in the quality of the PowerPoint slides. (For examples, see Final Project 1 and Final Project 2.) The feedback from outside panel members attests to the strong presentation skills demonstrated by individual students, as well as the collective effort of the group (see Panel Feedback).

REFLECTIONS

Making a number of small changes to improve presentation skills paid off; overall my 2007 students were better public speakers, and their visual presentations, in particular, improved markedly. Consequently, I plan to retain the additions I made to my course (i.e. the video and the PowerPoint assignment).

Given the high quality of class discussions following the “Talking Science” video, I was disappointed that students did not respond to the extra credit assignment with as many in-depth observations as I’d hoped. My sense was that students seemed to feel uncomfortable criticizing the speakers. Next time I teach the course, I will create a rubric (or use the same rubric I use to grade their presentations) for students to use when assessing the speakers; this way, student discomfort can be alleviated because they can assess the quality of the presentation using objective criteria. Similarly, I would like to have students watch a video of one of the student presentations from the previous year and have them grade it using my rubric. Using these rubrics before they make their own presentations will hopefully help students more effectively internalize the qualities of excellent oral presentation. To maximize the efficacy of the rubrics as teaching and grading tools, I hope to incorporate the traits described in the Grading Notes in future rubrics.

One reason why I saw more dramatic improvement in the visual presentation skills compared to the oral presentation skills may be that students were able to practice their PowerPoint skills in the small assignments during the semester. By contrast, although I’d had students critique (as a class discussion) the “Talking Science” video, I did not create additional opportunities for them to practice their oral communication skills. In the future, I hope to devise a way to incorporate practice speeches into the semester.

Still, overall I was impressed how just a few small changes could improve student presentations. I think the combination of a few assignments explicitly devoted to improving presentations—along with an overall awareness by students of the importance I placed on good presentation skills—helped students internalize the characteristics of high quality work. Importantly, I do not feel that any content was sacrificed, largely because I did not create more work; rather, I accentuated the presentation dimensions of existing assignments. Furthermore, I was able to emphasize to students the importance of public speaking to their professional success beyond graduation by devoting class-time to skill-building, as well as having professional panelists critique their performance.

We currently have a proposal pending with the departmental curriculum committee that would add a required junior-level introduction to transportation engineering course. If this course becomes part of the curriculum, it will cover some basic material that CE 582 currently covers. Consequently, I would be able to spend less time in CE 582 covering introductory material. My hope is that I will be able to go into more depth on the material that remains, including spending more time on preparing students for making formal presentations.