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Take a Stand: Speaking about RF Safety

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1. Motivation

Tell your students at the beginning of the semester that they need to prepare a speech and deliver it before an off-campus audience, and they will not exactly be leaping out of their seats with joy. Remind them a week in advance that their speech is coming up, and you will inevitably have a student or two in your office nearly in hives about speaking in public. Get even closer, and students will start asking if there are makeup assignments for assignments that are missed....

Engineers are notorious for not liking to speak in public. Engineers are engineers because they love the technical aspects of their work, and while it is often very important that they explain that work, the importance or significance of it, etc., to a non-technical audience, this is often one of the things they uniformly dread. Engineers who speak well and communicate effectively become highly successful in their careers. Those who do not are destined to work for those who do. At the University of Utah, we are experimenting with methods to improve students' writing and speaking skills throughout the curriculum. This paper describes one such assignment designed to teach two specific speaking skills: the ability to organize a presentation (introduction, three main points, conclusion), and to adapt presentation information for a diverse, non-technical audience. The class chosen, "Introduction to Electromagnetics," is a large (88 student) required class, taught in a traditional classroom setting. The methods used here allowed immediate feedback for each student in spite of the large numbers of students, and address ways to effectively integrate speaking assignments into large engineering classes.

Students create a three-minute oral presentation for a non-technical impromptu audience concerning radio-frequency safety

issues that affect everyone, such as, "Are cell phones safe?" and "Is it dangerous to live near high-voltage power lines?" The timing of the assignment near a holiday break offers opportunities for the students to present these speeches to their non-technical family members and receive feedback. This serves the dual purposes of relieving the anxiety surrounding public speaking, and teaching engineers about the sorts of questions that a candid, non-technical audience will have. As a positive side effect, it communicates to the students' families the nature and application of the technical information their son/daughter/spouse is learning, thus demonstrating the return on their investment, and generating potentially recruitment-oriented discussions among the engineering students and their younger relatives.

2. Class Experience

Students in ECE 3300: "Introduction to Electromagnetics" learn basic electromagnetics at the junior (third-year) level. Near the end of the semester, coordinated with our four-day Thanksgiving vacation, they were given three reference papers on radio-frequency (RF) safety, and asked to read them and formulate their own opinion on whether or not power lines or cell phones are safe:

- M. C. T Huynh and W. Stutzman, "A Review of Radiation Effects on Human Operators of Handheld Radios," *Microwave Journal*, June 2004, pp. 22-42.
- K. R. Foster and J. Moulder, "Are Cell Phones Safe?," *IEEE Spectrum*, 37, 8, August 2000, pp. 23-28.
- J. R. Ashley, "Are Power Lines Unsafe?," *IEEE Spectrum*, 37, 7, July 2000, pp. 21.

In class, a communication PhD student from the University of Utah CLEAR Center (which focuses on teaching writing and speaking for engineers) [2] presented material summarized below on impromptu speaking and audience adjustment.

3. Teaching Materials

Organization of an impromptu speech (or any speech, for that matter) was introduced with some public-speaking mathematics in a fifteen-minute mini-lecture presentation at the beginning of a regular EM lecture. This was done by the communication student, but would be suitable for use by the regular professor. Three equations were written on the board: $9 \times 1 = 0$, $6 \times 2 = \text{maybe } 1$, $3 \times 3 = 3$, and the students were asked to guess the answers, which, of course, were 9, 12, and 9. They were amused at being told they were incorrect, and listened well when the communication student explained that nine ideas explained once means the audience will not remember anything. Six topics explained twice means the audience may remember one item. Three items explained three times means the audience will remember all three major points of the speech. The students were then encouraged to "Tell them what you are going to tell them (introduction). Tell them (body). Tell them what you told them (conclusion)."

Three major points about impromptu speaking were included:

- $3 \times 3 = 3$
- Choose a catchy (visual or personal story) introduction and bring up the example again in the conclusion.
- Adapt your presentation to your audience.

For audience adjustment, the example of "Have you ever had to buy a gift for someone you don't know very well?" was used. Methods to understand as much about that person, and what that person would want from the gift, were discussed. Some methods of adapting to the audience included:

- Choosing a catchy introduction that includes a familiar example of interest to the audience (such as flying a kite under a power line when talking with an elementary-school class). This was tied to the conclusion at the end of the presentation.
- WIIFM: What's in it for me? (No, it's not a radio station.) Be sure you know what your audience wants to get from your presentation. Why should they listen to you?
- Think about what the audience knows/doesn't know (avoid jargon and excessive technical information), what their experience is, what they do on a day-to-day basis.
- Gain credibility by explaining your expertise, and being direct and forthright in your speaking and body language.

At the end of the mini-lecture, the professor asked the students:

- List the three main points.
- How did the introduction tie to the conclusion?
- How did the speaker engage the audience?

4. Additional Written information on Impromptu Speaking was Provided [1]

4.1 Step One: Prepare to Speak

You don't have to start speaking the minute you have been asked to. Take a deep breath, rise from your chair, and walk to the front of the room to the lectern. Use this time to gather and organize your thoughts.

4.2 Step Two: Determine Your Purpose

Try to develop one or two points as you walk to the lectern to begin speaking. Think about what point or points you want to make. Because you will have a very limited amount of time in which to prepare and speak, focus on one issue that you know well and can adequately address. Avoid complex issues or ideas about which you have limited knowledge.

4.3 Step Three: Support Your Purpose

Support your purpose with examples, narratives, or other supporting evidence. Regardless of the type of evidence you choose, you want to provide specific details for your audience so that you justify your position or purpose.

4.4 Step Four: Prepare the Introduction

Develop an introduction. A brief sentence will suffice in an impromptu presentation. You might refer to the event at which you are speaking, or to another comment that has recently been made.

4.5 Step Five: Prepare the Conclusion

Finally, conclude the presentation. One of the most common mistakes in this method of delivery is that the conclusion often rambles. Follow the guidelines below for an effective ending (be brief, clear, and memorable). You want to come to a definite stop. Simply restate your point or points, and end with a memorable thought or a call to action.

Here are some additional considerations that will help you prepare for impromptu presentations:

- Don't rush

Take your time before you start speak. Make sure your thoughts are clearly laid out in your mind before you begin speaking. Also, speak slowly, and don't rush through the presentation.

- Don't apologize

Start your presentation with your introduction. Avoid statements such as, "You'll have to forgive me, I had little time to prepare today." Your audience will know this and they will not be expecting a masterpiece.

- Focus on the topic

Keep the focus of your presentation on the topic at hand. Remember your purpose and don't stray from it. It is also important that you avoid any negative remarks. Keep your mind on your subject matter and keep negative thoughts at bay.

- Be brief

Remember, this is a brief presentation. Try to stay focused and avoid rambling. You don't have to say everything that you know about a particular topic. Choose your purpose, state your point or points, provide support, and then conclude.

- Foresee situations

If at all possible, try to anticipate those situations in which you may be called on to speak. From experience, you may know that you will have to report on your division's progress at certain staff meetings. Plan in advance what you would like to say if the situation presents itself.

5. Students Were Then Given the Following Assignment:

ECE 3300 RF Safety Assignment

5.1 Objective

In this assignment, you will read and learn about some politically prominent RF safety concerns, including cell phones, power lines, and similar consumer issues.

You will create a three-minute speech for a non-technical audience, and present it to your family and/or friends over the Thanksgiving holiday. Write down the questions that your audience(s) ask(s). The student with the most questions will get a prize at the first class after break. (This means the more people to whom you give your presentation, the better, and the more engaged your audience is, the better. HINT: find the most vociferous uncle you have, because he will have a good debate and lots of questions for you!)

When you return, we will have a debate. We will divide into groups of five to whom you will give your speech. The only thing is, you won't know until three minutes before your presentation *who* your audience is: your peers, a CEO, a venture capitalist, your professor, grandparents, a young niece, a newspaper reporter, or an attorney intending to sue your company.

5.2 Today

Read the following papers and choose one to discuss with your family.

Prepare a three-minute speech, and write down at least three questions that your audience asked (prize given for most questions). (The prize was a box of "Whoppers," specifically meant to be a stupid pun: "Sounds like most of your questions were real 'Whoppers'.")

Come to class prepared to give a three-minute speech to an unknown audience on your topic.

6. Non-Technical Audience Questions

After the holiday, the students returned with lists of questions obtained from non-technical audience members. Some had as many as 15 questions. The student with the most questions from the non-technical (mostly family members) audience read his/her questions, which actually sparked a quick and interesting set of additional questions from the class. They included:

- How much time would it take for a cell phone to heat up tissue significantly?
- Why do they test on rats? "Do they make small phones?"
- Does my hairdryer cause cancer?
- What is the difference between fields that can hurt you and help you?
- Does it matter how far the cell phone is from the station?
- Would it matter how long you use the phone?
- Is a hands-free unit better? If you are using a hands-free set, doesn't it put the waves into your ear and closer to your brain?
- Would older cell phones be worse, they are much bigger?
- Does it matter if the person is fat?
- If cell phones transmit microwaves, doesn't it seem like they would slowly cook your brain?
- Is there a regulation for how much power a cell phone can transmit?
- From a 16-year-old sister: So, am I going to get cancer?
- Will TV make me blind or give me cancer? How about computer screens?

7. In-Class Experience

The lecture class of 88 students divided into groups of five to deliver these speeches to one another. They were "huddled" in chairs near the rest of the group, in full hearing/visual contact with the rest of the class (i.e., it was pretty noisy). Each student had three minutes to adapt their talks to the following audiences. The audience and experience were taken from a current zoning battle over power lines through a residential neighborhood in a nearby town. Most students were familiar with the town but not the battle.

List of audiences (written on the board one at a time, in this order, to reflect an unfolding real-life scenario). The notes in parentheses were just given orally.

- A lawyer trying to sue the company. (These students were specifically reminded and encouraged to have a strong introduction for their talk.

- A CEO who needs immediate information to handle this issue. (These students were specifically reminded to have three main points in the body of their presentation and to be sure that the points were effectively communicated ($3 \times 3 = 3$).
- A 10-year-old doing a class report that will be presented at the zoning meeting. (This assignment was actually given to all fifth graders in this town.) (The engineering students were reminded to avoid technical jargon and excessive technical detail.)
- A grandparent or concerned parent, or the PTA (Parent Teacher's Association) President. (Students were encouraged to find compelling examples to convince this audience.)
- A politician (mayor or other) who needs to make a decision and is concerned about public perception (votes). (Students were encouraged to have a particularly good conclusion that summarized three main points.)
- A peer (another engineer) whom you need to have "on the same page" with so that you can both agree and support the same side of the issue (your job depends on it). (Students were encouraged to summarize their technical information and fully justify their personal opinion on this issue.)

Each student presented their three-minute speech (one student in each group speaking simultaneously – i.e., noisy), followed by a one-and-one-half-minute oral-feedback period for each student. When the speakers were stopped, and the feedback was ready to begin, the professor would help focus each feedback period on a different aspect of speaking ("Comment on this speaker's introduction." "What were the three main points, and how many times did the speaker tell them to you?" "Did the conclusion relate to the introduction?" "How did the speaker adapt to the audience?"). This helped to focus the feedback on the speaking skills we were specifically addressing in this assignment. The feedback and presentations were clearly collegial, fun, sometimes silly; however, the informal setting and small groups allowed a lot of personal feedback in an honest, collegial setting. Interesting comments overheard by the professor (such as "Gee man, your body language looks like a used car salesman, and I don't believe anything you said") were passed on to the class (although in this case, I simply asked, "How did the body language of your colleague work or not work to make you believe what they had to say?"). Students nearly always caught holes in the organization of the speeches ("You told them what you were going to tell them, told them, but you forgot to tell them what you told them"). The professor can also ask, "Specifically, how did the student adapt the speech to the audience, and what methods worked well?" Each student also did a written feedback sheet for each person in the group (Figure 1). The feedback sheet served two purposes: providing feedback to the student doing the presentation, and reminding students of what a model presentation looks like.

8. Observations

Pre- and post-tests were administered to assess the effectiveness of this short lecture for teaching this abbreviated speaking skill set. The two sets of students were self-selected for the pre-test, and selected by proximity to the professor for the post-test. The two sets of speeches were video taped and compared. There was a clear, observable difference in the improvement of speech organization after the lecture. These students have had not prior,

Speech Critique Form

Your Name: _____ Class: _____

Speaker's Name: _____

E: Excellent VG: Very good G: Good P: Poor

Introduction ~15%

Lead with attention getter [creativity a plus]	E VG G P
Preview main points	E VG G P
Clearly state Purpose	E VG G P

Body: content/arrangement ~30%

Employ logical organizational pattern/ Simple org. pattern	E VG G P
Define jargon-use appropriate level of language	E VG G P
Numerically Rich/Specific Examples	E VG G P
Results Oriented /	E VG G P

Conclusion ~15%

Restate Main Ideas	E VG G P
Create sense of completeness	E VG G P

Supporting Media ~20%

Appropriate, strongly supported presentation/ Visually Interesting	E VG G P
Handled well	E VG G P

Delivery: Without mastering delivery
content loses its effectiveness ~20%

Eye contact [<25% / <=50% / 70% / 80% / 90%]	E VG G P
Reading Speech [-intro. -body -conclusion]	E VG G P
Vocal energy and variety exhibited	E VG G P
Extemporaneous/Conversational Tone/Professional	E VG G P
Circle: looking at board too much/ Back turned to Audience	E VG G P
Rate [fast] [slow]	E VG G P
Volume [loud] [soft]	E VG G P
Vocal Fillers [like/umm/uh/you know/okay/other]	E VG G P
Distracting movement [swaying/bobbing/bouncing]	E VG G P
Gestures and movement emphasize main points, appeared intentional	E VG G P

Time limit not met [Under Time] [Over Time] Time: _____

The Best Aspect of this Presentation is:

Figure 1. The speech critique form.

formal coursework in public speaking within the University of Utah's Electrical and Computer Engineering program. Over 90% of the students in the class responded that they had learned at least one important thing for preparing future presentations.

9. Conclusion

This activity demonstrated that even in a large, traditional lecture-style class, peer feedback can be used to provide instant

feedback on oral-communication skills. It provided a pragmatic template for impromptu speaking situations that are common in the engineering workplace. It demonstrated the practical application to humanity of students' newly acquired theoretical know-how by reinforcing to the engineering student the importance of RF signals for the non-engineering world, thus accomplishing the professor's goals of training well-rounded and competent engineers. It mimicked reality in that safety concerns are always ripe topics for conversation among the public and the expert engineer. It provided a forum that increased students' interest in, participation in, and, therefore, understanding of, RF safety. More than half of the students had gone to additional Web sites, beyond what was required, to learn more about the topic. If they had simply been assigned to read the articles and discuss them in class the next day, it is unlikely their level of interest would have been as high.

This speaking assignment also formally teaches impromptu speaking skills, specifically, basic speech organization and adaptation to the audience. It also communicates to the families what an engineer does ("infiltration"), and may encourage younger family members to ask more questions (future recruiting).

Perhaps the most serious limitation of how this assignment was conducted is that it does not provide another opportunity for students to practice and improve the oral-communication skills on which they received peer feedback (although they may have received some feedback from their families). Within our curriculum, this will be handled by incorporating similar short speaking assignments into all three required courses taught in the same semester. For the first course experience, students will have plenty of time (several days or weeks) to prepare. For the second experience, students will have overnight, such as this holiday assignment. For the third experience, they will have to adapt their presentation "on-the-fly," such as this in-class assignment.

It must also be realized that a single experience like this in class is not going to make a radical difference in how our students speak. Within our curriculum, we are providing multiple speaking experiences each semester (from freshmen through seniors), each accompanied by formal training in public speaking, focused on a different aspect of good oral communication. Thus, by the end of the program students will have been exposed to the full range of

formal speaking education, practiced it over a period of time, and applied it directly within their education.

Another limitation of this assignment is that it would be difficult or impossible to grade. Credit was given for (required) attendance in the class, which, of course, had the drawback that some students could not attend for legitimate reasons. These students were allowed to make it up by attending another technical lecture (a seminar or the like) within the department.

Perhaps the most personal limitation of this method is that the professor has to instill a sense of necessity to the assignment. It cannot be "passed out" in class, like a regular assignment, and be expected to work. The professor must give the assignment credibility with examples of comments from alumni, specific examples where engineers have needed to speak well or wished they spoke better, etc. The professor must then accept an unusual noisy, playful chaos when the presentations are done in class.

This assignment was quite popular among the students, was a fun and potentially more effective method for teaching RF safety than a traditional lecture format, and was (from pre-and-post observation) quite effective in teaching the students the rudiments of speech organization and audience adaptation.

10. References and Web Resources

1. M. Morgan, *Presentational Speaking: Theory and Practice*, New York, McGraw-Hill Publishing, 2003, p. 116-117.
2. University of Utah CLEAR Center, <http://www.coe.utah.edu/clear>.
3. ECE 3300: Introduction to Electromagnetics, <http://www.ece.utah.edu/~ece3300>.
4. This assignment online (go down to November 29): <http://www.ece.utah.edu/~ece3300/LECTURE/lecture.html>
5. Dr. Cynthia Furse home page: <http://www.ece.utah.edu/~cfurse>.

