
AC 2011-1350: IMPROVING THE PUBLIC COMMUNICATION SKILLS OF GRADUATE STUDENTS

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Improving the Public Communication Skills of Graduate Students

Introduction

More and more engineers have found themselves in the situation of communicating their technical work directly with the public. This might include press briefings, customer interactions, or government hearings. Often the engineer who is involved in these communications are graduate level (M.S. or Ph.D.) engineers. We have undertaken a set of classroom exercises whose goal is to improve the communication abilities of graduate students when communicating with the public.

Several authors ^{1,2,3,4} have noted the importance of engineers having strong public communication skills. Loftstrom ⁵ suggests that subject matter experts (SME) should have media training as a prerequisite to their interaction with the public. Dulin ⁶ proposes ways in which undergraduate and graduate programs can prepare their students for public communications. Colorado School of Mines ⁷ has even developed a public affairs curriculum for engineering undergraduates to address this issue.

This paper continues with a brief description of the course and students involved in this activity. Next, the actual assignments are discussed, including the grading rubric. Student feedback and assessment will then be presented. The paper concludes with lessons learned.

The Course and Students

The public communication course assignments (“Hot or Not”) were made in a graduate level course in heat conduction. The course met three times a week for 50 minutes and covered the standard topics in heat conduction: physical nature of heat conduction and thermal conductivity; derivation of the heat conduction equation; one-dimensional, steady heat conduction; composite walls and fins; two-dimensional; steady heat conduction; separation of variables method; transient heat conduction; Laplace transform methods; Green’s function; and numerical method. The course goals were stated as:

1. To understand the physical nature of heat conduction and thermal conductivity
2. To formulate a mathematical model for a heat conduction problem
3. To solve the mathematical representation of heat conduction problems
4. To calculate the performance of the heat conduction system using the mathematical solution

The course learning objectives are given in Figure 1. It should be noted that the public communication learning was not listed as a course learning objective. This is because these objectives are “owned” by all of the faculty that teach this course; and since this was a pilot program, it was not appropriate for the instructor of the course to simply add it to the course learning objectives.

The course had an enrollment of 19 students. Eleven of the students were at the M.S. and eight were doctoral students. Ten students had undergraduate degrees from U.S. institutions, while nine students were international students.

The course grade was based on homework (15%), two hour exams (20% each), and a final exam (45%). The “Hot or Hot” assignments were included in the homework total and the three assignments accounted for about 25% of the homework total.

ME 812
Conductive Heat Transfer
Course Learning Objectives

1. Students understand the connection between thermodynamics and heat transfer.
2. Students understand the conductive heat transfer on the microscopic scale.
3. Students can derive a differential heat conduction equation for different geometries.
4. Students can solve the differential heat conduction equation in one dimension for different geometries.
5. Students can apply the thermal circuit model.
6. Students can obtain a solution to the fin equation for different and varying cross-sectional area.
7. Students can use the separation of variable technique to solve steady, multidimensional heat conduction problems.
8. Students can use a variety of different mathematical methods to solve one dimensional transient heat conduction problems.
9. Students can transform the differential heat conduction equation into a finite difference representation.
10. Students can apply Duhamel’s theorem.
11. Students understand the use of Greens functions in solving heat conduction problems
12. Students understand the application of finite element analysis to solve heat conduction problems.
13. Students can formulate a heat conduction problem in anisotropic solids

Figure 1. Course Learning Objectives

“Hot or Not” Assignments

The “Hot or Not” assignments asked the students to explain in a 500 word essay a mystery of heat transfer and to do it at the level of a nontechnical, educated person. Three such assignments were made and included the mysteries of:

- Why does metal feel cold?
- Ice or water and ice to cool a champagne magnum?
- How does water freeze when the ambient temperature is above freezing?

The three assignments are provided in Figs. 2-4.

The assignments are graded by the director of communication for the Department of Mechanical Engineering, who has years of experience in teaching and editing technical communication but is not formally educated in a technical field. The assignments are graded with a rubric that includes:

- Correctness of Explanation (20%)
- Clarity of Explanation (30%)
- Brevity of Explanation (5%)
- Technical Level of Explanation (15%)
- English Usage (30%)

The grader is provided with an explanation of the mystery by the course instructor, and often a discussion is held between the two to further clarify the explanation. The students are given 2 weeks to complete the assignment and the course instructor addresses the assignment at least twice during lecture time.

Student Feedback and Assessment

Student feedback was collected at the end of the course using the form shown in Fig. 5. The results of the first three “Hot or Not” questions are shown in Fig. 6. It is clear that four students in the class did not find the assignments useful in their learning. However, most of the class felt that their learning was enhanced by the assignments. Fifteen of the students responded with a 3.0 or higher. Except for one student, the class felt that they could confidently explain a technical issue to a non-technical person. As shown in Table 1, the student interest level was highest for the Touch of Sense of Temperature assignment. This was the only hands-on demonstration assignment, which may explain its popularity. Finally, all of the students who responded (17 out of 19) felt that the assignments should be continued in the next offering of the course.

Table 1. Student Interest Level

“Hot or Not” Assignment	Average
#1 Touch of Sense for Temperature	3.61
#2 Water or Not: Cooling a Bottle of Champagne	3.28
#3 Black Ice	3.5

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Conductive Heat Transfer

Hot or Not ?

Assignment #1 Due Monday, September 13

The "Hot or Not?" assignments are intended to: (1) develop a real world intuition for heat transfer and (2) develop a public communication style for technical information.

Assignment: Write a 500 word essay explain the physical phenomena described below. The explanation should be easily understood by an educated, non-technical person (e.g., Craig Gunn).

Phenomena: Touch of Sense for Temperature

At the front of the room are six blocks made of different materials. By touching these blocks, rank them from 1 to 6 in order of increasing temperature and record your ranking below:

Block	Temperature Ranking
1	
2	
3	
4	
5	
6	

When the temperature of these blocks is measured with a thermocouple, it is found that they are all at the same temperature.

Why is the human sense of touch fooled by temperature?

Figure 2. Hot or Not Assignment #1

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Conductive Heat Transfer
Hot or Not ?
Assignment #2 Due Monday, November 1

The "Hot or Not?" assignments are intended to: (1) develop a real world intuition for heat transfer and (2) develop a public communication style for technical information.

Assignment: Write a 500 word essay explain the physical phenomena described below. The explanation should be easily understood by an educated, non-technical person (e.g., Craig Gumm).

Phenomena: Water or Not: Cooling a Bottle of Champagne

One of your research team colleagues has just passed his/her Ph.D. Comprehensive Exam. To celebrate this achievement you have brought in a magnum of champagne. Unfortunately, you did not have chance to chill it. You place the bottle in a bucket and add ice. Should you add water to the bucket?

What are the heat transfer implications?

Figure 3. Hot or Not Assignment #2

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Conductive Heat Transfer
Hot or Not ?
Assignment #3 Due Friday, December 10

The "Hot or Not?" assignments are intended to: (1) develop a real world intuition for heat transfer and (2) develop a public communication style for technical information.

Assignment: Write a 500 word essay explain the physical phenomena described below. The explanation should be easily understood by an educated, non-technical person (e.g., Craig Gunn).

Phenomena: Black Ice

A phenomenon occurs in Southern California in the winter time called black ice. A thin layer of ice will appear overnight on asphalt highways. This normally occurs on clear, cold nights, but the ambient air temperature is still above freezing.

How and why does this happen?

Figure 4. Hot or Not Assignment #3

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Conductive Heat Transfer
Course Survey

Using the MSU grading scale, 0.0-4.0, evaluate your mastery of the following topics:

Kinetic theory of gas model for thermal conductivity: ____

One dimensional, steady heat conduction: ____

Fins: ____

Bessel functions: ____

Separation of variable method: ____

Laplace transforms: ____

Legendre polynomials: ____

Finite difference method: ____

Green's functions: ____

Quasilinearization: ____

Similarity solutions: ____

The following questions pertain to the Hot or Not assignments. Again, use the MSU grading scale, 0.0-4.0, in your response.

Level of technical learning from these assignments: ____

Level of improvement of communication skills: ____

Confidence in explaining a technical topic to a nontechnical person: ____

Your interest level for the Hot or Not topics:

Touch of Sense for Temperature: ____

Water or Not: Cooling a Bottle of Champagne: ____

Black Ice: ____

Should the Hot or Not assignments be included the next time the course is taught?

Yes: ____

No: ____

Please share any other comments you have about the course:

Figure 5. Course Survey

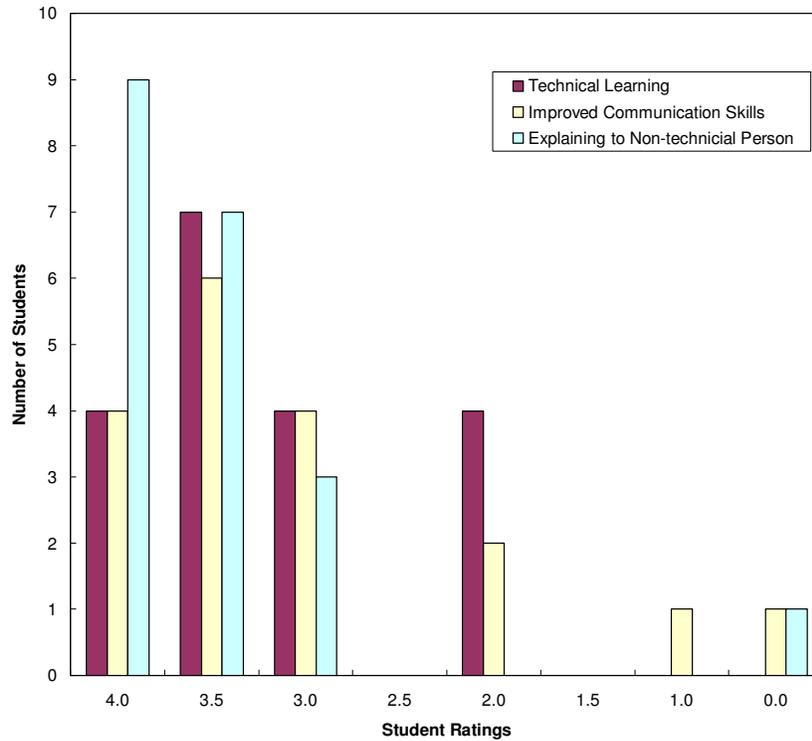


Figure 6. Course Survey Results

From a perspective of assessment, assignment grades are used. Figure 7 shows the grades for Assignments 2 and 3. Unfortunately, due to a communication problem between the instructor and the assignment grader, the scores for the first assignment were not recorded. For Assignment #2 the grades are excellent. It is interesting to note that the grades for Assignment #3 fall off from Assignment #2, probably due to the end-of-the-semester disease. The greatest room for improvement was observed to be in the technical level of the essays. They were somewhat higher than they should have been.

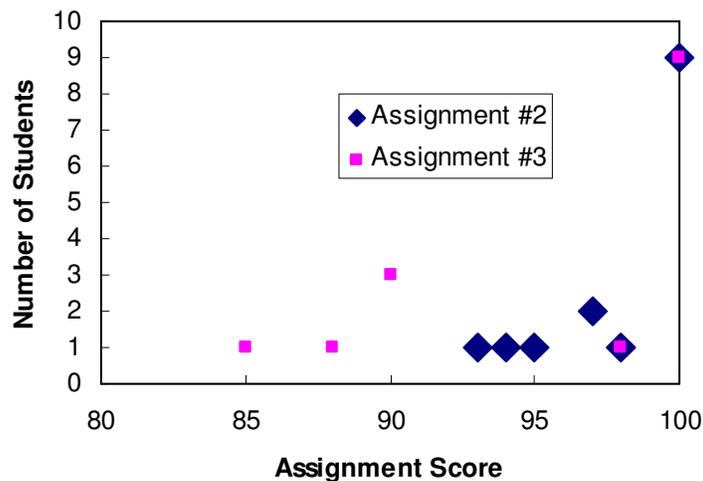


Figure 7. Assignment Grades

Lessons Learned

- Most students enjoyed the “Hot or Not” assignments and they felt that they improved their public communication skills.
- The hand-on assignment was the most popular. It was also the assignment that was tied the closest to the course topics.
- The addition of oral presentations should be included to further enhance the public communication goal.
- No direct instruction on public communication was provided, rather feedback from the graded assignments was used to facilitate students’ learning about public communication of technical information.

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