Improving Audience Analysis of Real-World Clients in Industrial Engineering Senior Design

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Abstract

Since ABET requirements have increased, more colleges and universities are focused on enhancing students' communication skills. At Georgia Tech, workforce interviews conducted with industrial engineers, supervisors and senior executives have been used to conceptualize the engineering audience and develop audience analysis instruction. The instruction has been used with five semesters of Senior Design students working with real-world clients. Our team will share the instructional tool and demonstrate how it improves students' awareness of audience and their ability to research audience information. Student and faculty experience and instructional results will be presented.

I. Introduction

Partly because of the recent Accreditation Board for Engineering and Technology (ABET 2000)[1] criteria, communication skills have become more important to engineering undergraduates than ever before.[2] In this paper we will explore one part of the communication skills needed by practicing Industrial Engineers: the communication problem-solving needed to conceptualize the engineering audience. This problem-solving is one part of the engineering problem-solving and focuses on identifying and understanding the engineering audience. The instruction is based on interviews conducted with industrial engineers, supervisors, and senior executives of organizations who employ many industrial engineers. The information these professionals provided was used to build instruction for undergraduates in Senior Design. It has been used for five semesters; four semesters were part of a two-semester Senior Design course and the most recent semester was a one-semester course.

In this paper we look in depth at the data from the one-semester course and discuss major conclusions based on our experience using the instruction. The instruction is expected to be useful as a starting point for undergraduates in courses other than Senior Design and in other engineering disciplines.

II. The Instructional Context: Senior Design

The Senior Design course we worked with involved real-life engineering projects with real clients. Students started the semester with a five- or six-person team and a rough idea of a project that had already been discussed with company contacts and approved by the Director of Undergraduate Studies. Examples of the seven projects include:

1. designing the template for Standard Operational Procedures for a home décor company
2. working to ameliorate the on-time record of the local train system
3. suggesting alternative approaches to reduce the shrinkage of the inside walls of jets, for a jet manufacturer
4. enhancing the efficiency of the distribution system, for a delivery organization.

In this Senior Design course, instruction on conceptualizing audience included three guides to be described in detail below. The instruction was integrated into the course as follows:

1. Early in the semester, a tutorial is given on conceptualizing the engineering audience. The tutorial includes students' filling out the audience conceptualization guides, individually and then in teams.
2. Before mid-semester client presentations, the students again fill out the guides, working as teams.
3. Before the final client presentations, the students fill out the guides a third time as teams.

III. Highlights of the Literature

There are many facets of engineering communication problem-solving. First, there is the idea of demographic audience analysis. Second, there is a wide range of ideas about what information is needed about the engineering audience. Third, different approaches are suggested for collecting information about the audience, and fourth, the roles of various audience members have been identified. Finally, the process of communication problem-solving is defined as continuous. These points will be described below.

The focus of this literature review was prominent and current textbooks. The eleven textbooks gave a good picture of the field. They were reviewed to check their descriptions of audience analysis, or conceptualizing the engineering audience. Several textbooks defined the concept of "demographic audience analysis." The elements of the analysis included age, gender, racial/ethnic background, job title, group membership, social status, and economic status[3 4 5 6]. These characteristics are included in what is considered the most basic type of analysis.

This concept is greatly expanded in discussions of other information the engineering presenter needs to know about his or her audience. This includes:

1) "The psychological needs of the listeners"[7] Lehman and Dufrene refer to Maslow's hierarchy of psychological needs[8], such as safety or security needs, for example, financial security. Higher-level needs become prominent as lower-level needs are fulfilled. Examples of higher-level needs include social needs such as the feeling of belonging to a group and esteem needs such as recognition from others.

2) The audience members' needs, expectations, values, and attitudes toward the presenter and the topic [9] [10] [11] [12]
3) What the audience does and does not know[13] [14] which includes background knowledge about the topic as well as particular expertise and education
4) Which individuals make the decisions .[15]

So there are many audience characteristics that are relevant to giving an engineering presentation. There are also a variety of sources and approaches for gathering this information. These include gathering data from the speaker himself or herself; from other people; from documents; by conducting a survey; and by searching the web or other publicly accessible business files.

The speaker can "take inventory of [the] audiences by thinking about who will receive the communication directly from [them]." [16] It also covers "asking yourself what your audience does know and what it doesn't know"[17].

Other people that can be contacted for audience information include "[the] person who gave you the assignment, the group leaders, or a group member"[18], "other friends or business contacts that might have valuable information",[19] and other "colleagues who ha[ve] presented to the same[audience]."[20] It is recommended that presenters consult with their audience as they prepare their communication [21] [22].

Documents, such as other presentations given to the same audience, can provide valuable information to the presenter, if they are available. Surveys or "needs assessments" can also be conducted. For example, interviews or questionnaires may be used to find out what the audience need[s] or want[s],or what problems they may have" [23]. And, finally, the web or any public business records can be searched for additional audience information [24]. As you can see from the great variety of audience characteristics and suggested modes of collecting information about them, "effective speakers spend a great deal of time analyzing their audiences"[25].

Several of the textbooks describe the different roles audience members may play. For example, Lay & Wahlstrom[26] cover the following roles:

1) transmitters, who receive messages and direct them to the appropriate person,
2) decision-makers and action-takers,
3) advisors, who offer guidance to decision-makers,
4) learners, and
5) implementers, or individuals executives put in charge of implementation.

The final major point covered in the textbooks identifies audience analysis as a continuous process. "Thinking about audience is not something you do at one point in the production of a communication and never again; rather, considering audience is an ongoing activity for good technical communication."[27]

IV. The Instruction

The three parts of the instruction are available on the website www.isye.gatech.edu/communication, under Audience Analysis. They will also shared during the presentation. In the tutorial given early in the semester, students learn to use the three guides. The first guide contains Key Client Contact information. For each key contact, the students are asked to identify, on their own, the person's name and role. Students compare their answers to their team-mates', and usually only a small number of the groups report that all of their members' answers agreed. Examples of the roles are reviewed orally, with examples including job titles such as "senior engineer" and roles such as "the main decision-maker with regard to our project" or "the person who directs us to other company people for help with questions". Often many more students respond with job titles than roles, and discussion focuses on the usefulness to the team of the two types of answers: clearly the "role" information is more useful to the group in planning its presentation.

The second guide focuses on Significant Client Expectations. Students are asked to fill out two of these if they have more than one significant client. For each contact, the person's name was recorded, and then

1) A description is given, for
   --"What does this significant person understand the problem to be?"
   --"What does the significant person expect you to do?"
   --"What does the significant person value most?"

Table 1 below includes examples from the student team working on a more efficient distribution system for a delivery organization. These answers were given early in the semester.

Table 1. Examples of Significant Client Expectations (Descriptions)

Question	Answer
What does this significant person understand the problem to be?	"General inefficiency is present in current system of scheduling"
What do they expect you to do?	"Identify the inefficiencies, develop countermeasures. Implement?"
What do they value most?	"Reduced cost of labor"

2) "What makes you think so?" was then recorded, for the same three questions:
   --what the significant person understands as the problem
   --what the significant person expects, and
   --what the person values.

Examples of answers for the same team, early in the semester, are shown in Table 2 below.

Table 2. Examples of Significant Client Expectations ("What makes you think so?")

Question	Answer
What does this significant person understand the problem to be?	"Initial client meeting, person Y plans to refer us to a conveyance group leader for scheduling details."
What do they expect you to do?	"Initial client meeting"
What do they value most?	N/A

3) "How confident are you?" was answered on a five-point Likert scale with 1 being low, 3 being medium, and 5 being high. This applies to all three questions shown above. For example, the same team reported a confidence level, at the start of the semester, of "5" for "What does the significant person understand the problem to be?", "4" for "What do they expect you to do?, and "5" for "What do they value most?.

4) "What could you do to be more sure?" was then answered for each of the three questions. For example, this team's answer was "more meetings".

The third guide, Audience Background, focuses on the following information for up to three contacts in the audience:

1) "What is the person's authority level?" For example, the same team, early in the semester, responded "no subordinates".

2) "What does the person know about the project?" The student team answered, "General awareness of a problem. Has done little to no investigation into the issue."

3) "In terms of engineering expertise, is the person's background technical or non-technical?" This question was sometimes answered as "both" or "mixed." In this particular case, the team answered "technical."

As mentioned earlier, all three guides are based on the information deemed important by practicing industrial engineers, supervisors, and senior executives. Besides being used in an introductory tutorial, the students fill out the guides with their team members and submit them before the mid-semester client presentation and before the final client presentation.

V. Why this Instruction is a Contribution

This instruction is a contribution because, first, it is built directly from input by practicing professionals. As discussed in detail in earlier papers[28 29 30 3132], this results in instruction with higher content validity—or instruction more likely to include what it claims to include, such as audience conceptualization for workforce engineering audiences. Also, students are more likely to apply the skills they learn in class to their jobs when the context of the instruction is the workplace.

Second, the instruction is conceived of as part of the engineering problem-solving task. In addition to solving problems such as which data to collect and which model to use, there is the problem of conceptualizing the engineering audience.

Third, the instruction builds on the key concept of audience conceptualization as continuous. This concept was mentioned earlier in the literature highlights. For example, over time, the individuals in the audience change their perspective and their background knowledge.

VI. Major Conclusions Learned from this Experience

We learned four major things from using the instructional guides in Senior Design classes. First of all, contrary to what we might expect, the students' confidence in reading their audiences did not always increase as the project moved along. For example, the confidence of some teams started out and stayed high until the end of the project--when it decreased. Second, several key audience characteristics changed as the students worked with their client on their project. The number of contacts can change—in one case, an initial single contact expanded to four contacts, including a financial officer; then at the end of the project only three contacts were listed, with the financial officer being omitted. Also, the students' classification of their audience as technical or non-technical can change. Contacts who are classified as both technical and non-technical can later be denoted technical; clients originally identified as technical can be changed to non-technical. And, the students' analysis of the background knowledge of the audience members is often modified, becoming more detailed as the project moves along. For example, in one project, the audience member's background knowledge (that is, what the person knows about the project) was "everything, or at least where to find the information and from whom". Other examples are shown in Table 3 below.

Table 3. Students' Answers to "What does the Person Know about the Project?"

	Early in the Semester	Late in the Semester
Example 1	"everything, or at least where to find the information and from whom"	"Person Z probably knows more about the project than anyone else at Company A since he has been there working on these ideas for the longest as the Project Manager. If he doesn't have or know the information we need, he knows which department and who we need to contact to get it."
Example 2	"General awareness of a problem. Has done little to no investigation into the issue"	"Knows all the details from how we collected data to how we are analyzing it. She has helped us a lot along the way."
Example 3	"Everything that needs to be done. Goal of project."	"Objectives, resource availability, and the needs of upper management"

As you can see from Table 3, the information provided by the students becomes more detailed as the project moves along.

The third major conclusion we drew from the experience of using the instruction concerned situations where the students' confidence was high. The answers to the question "What makes you think so?" included certain types of communication behaviors. The behaviors were precise and operational and were learned through the ongoing communication occurring in the engineering project. Key characteristics of the communication behaviors were: 1) it was direct, as in direct conversations in groups or one-on-one; 2) it was concrete, such as being available in writing; 3) it was repeated for clarity—it happened over and over again. Table 4 gives more examples of communication with the three characteristics.

Table 4. Communication Situation with High Team Confidence

Characteristic	Communication
Direct	--he/she told me --he has directly expressed his interest in this --he has directly communicated to us <u>Future options:</u> --ask him directly --speak with him in person when we need clarification --we could ask person x what he thinks the problem is
Concrete	--she gave us past surveys --she gave us in writing…
Repeated for Clarity	--we have reviewed it over and over --this has been our project scope for the entire term and we have confirmed this through several meetings --we have discussed these expectations several times with the client <u>Future options:</u> --discuss the client's expectations again --review information again—maybe she would like more from us in addition --repeat back our understanding of the problem

As you can see from Table 4, the students' responses included many examples that were direct, concrete, and repeated for clarity.

Fourth, the implications we have learned for future teaching include regular review and problem-solving discussion, before each client presentation, as soon as the student team has filled out their audience guides. For example, in one case a team reported a very low confidence level with their second significant contact. The information about this situation appears in Table 5.

Table 5. Communication Situation with Low Team Confidence

	What does this Significant Person Understand the Problem to Be?	What does this Significant Person Expect You to Do?	What does this Significant Person Value Most?
Description	He feels there really isn't a problem	We think that he feels that we are going to cut jobs	Not sure
What makes you think so?	The attitude he portrays	The impression he gives us through the interaction we have with him	Lack of communication
Confidence Level	3 (medium)	2	1 (low)

You can see from Table 5 that the descriptions given by the students are nebulous: "he feels that…", "we think that he feels…" And the student answers to the question, "What makes you think so?" are indirect: "the attitude…", "the impression he gives…" In this case, the contact person was with the union, and the students had no experience in working with unions. Discussion about how to get direct and concrete evidence would have been helpful, along with a review of the particular union's orientation. Through the semester the team did receive assistance from their faculty advisor and their primary client contact. The information available from the audience guides would have added to those discussions. So the guides should be filled out at regular intervals and reviewed soon after that, prior to interaction with the client.

The final conclusion we drew from our experience was: workforce interaction and ongoing engineering problem-solving is essential for students to learn the skills of conceptualizing their audience. The engineering problem, anchored in workforce experience, led to several approaches that enabled the students to gather and check their audience information. The approaches included trial-and-error, communication in several media (email, phone and in-person), and both in groups or one-on-one.

VII. Future Work

In the future, the communication instruction will continue to be modified as needed, according to both faculty and student input. Data collection will continue as more students use the instruction. Information will be collected from workforce professionals, for example, to clarify the definition of "technical audience member" and "non-technical audience member." Specific exercises and curriculum will be developed and used as part of class or as part of the Communication Lab activities supporting the course[33]. Formal assessment will be developed to evaluate the students' learning, and the students' responses to the guides will be compared with information collected at the same time from the clients. The instruction on conceptualizing engineering audiences will be expanded for use in other courses and other engineering disciplines.

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X. Biographical Information

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Dr. Norback is the Director of Workforce and Academic Communication in Industrial and Systems Engineering and a faculty member at Georgia Tech. Before arriving at Tech five years ago, she headed her own firm, the Center for Skills Enhancement. She conducted research and curriculum development on basic and communication skills for the U.S. Department of Lab, the National Skill Standards Board, and a number of universities. Since 2000, her research has focused on workforce communication skills needed by practicing engineers. She has also co-taught Senior Design and Technical Communication, coordinated the activities in the Communication Lab and co-authored the communication instruction for undergraduate engineers. She has authored a textbook chapter and eight articles as well, and Dr. Norback has presented at INFORMS, ASEE, and the American Association for the Advancement of Science.

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Dr. McNair is the Associate Director of the Communication Program in the School of Literature, Communications, and Culture and a faculty member at Georgia Tech. She teaches a variety of communication courses and has done research and curriculum development for SRA/McGraw Hill and for a number of universities. Dr. McNair has also assisted in the workplace communication research and has co-authored the workforce communication instruction for engineering undergraduates. She has published several articles in the field and presented at ASEE and the American Association for the Advancement of Science.

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Dr. Forehand was Director of Research Program Planning and Development at Education Testing Service until February 2000. Dr. Forehand teaches and consults in the areas of research design and workplace communication. His research emphasizes curriculum innovation and evaluation. As a consultant to Georgia Tech, he has assisted in the workplace communication research and co-authored the communication instruction for engineering undergraduates.