
AC 2012-4526: A WORKSHOP TO IMPROVE COMMUNICATION SKILLS FOR TEACHING ASSISTANTS

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A Workshop to Improve Communication Skills for Teaching Assistants

Abstract

In engineering departments where teaching assistants (TAs) often lead recitation sessions and hold “office hours” in tutoring centers, it is important that these TAs can clearly communicate new, discipline-specific, technical information to other students who have a technical background, but lack expertise in the topic at hand. In order to address this need, a 5 hour teaching workshop for TA candidates at RIT has been developed, with the intention of giving students the skills they need to be able to teach other students. The initial results of the workshop are favorable. Out of the seventeen prior attendees, students on average felt that each of the five sessions was helpful (minimum score 4.18/5), and all students agreed or strongly agreed that they would recommend the workshop to other students. We hypothesize that participation in this workshop will improve the communication skills of students working as TAs in engineering departments. This informational paper presents an overview of the workshop, along with student feedback to date and future plans that will enable testing of the hypothesis.

Background

This paper discusses a Teaching Workshop that was developed to enhance college-level students’ communication and teaching skills, so that students would be prepared enough to gain the benefits of teaching others about engineering. In engineering departments where teaching assistants (TAs) often lead recitation sessions and hold “office hours” in tutoring centers, it is important that these TAs can clearly communicate new, discipline-specific, technical information to other students who have a technical background, but lack expertise in the topic at hand. The same can be said for any engineering student who will be required to communicate on technical topics after graduation. ASME’s “Vision 2030: Creating the Future of Mechanical Engineering Education”, cites the results of a survey of over 1000 engineering managers as pointing to communication as an area where engineering graduates need improvement.¹ At the same time, Felder and Brent report that learning through teaching is highly effective in enhancing student learning.²⁻³ Similarly, RIT students working as lab instructors on-campus or participating in teaching activities off-campus report that they viewed teaching experience as a valuable part of their college careers.⁴ However, in order to teach, we must first prepare our students to communicate their ideas clearly.

Within the mechanical engineering curriculum at RIT there has been past work done to strengthen the communication abilities of engineering students. Namely, a team-based presentation project has evolved within an advanced thermodynamics course as a way to introduce upper-level engineering students to an engineering outreach opportunity while also strengthening communication skills and deepening engineering knowledge.⁵⁻⁶ Formative assessment results based on student opinion data after completing the team-based presentation project during the spring quarter of 2006 and fall of 2010 are included in Table 1 with a student respondent sample size of 13 and 6, respectively. Students made a strong connection between the project and promoting their creativity, communication abilities, teamwork skills, and self-

assessment abilities while strengthening their self-reported knowledge of and interest in Thermodynamics.

Table 1. Student Opinions Regarding Team-Based Presentation Project⁵⁻⁶

Question <i>*Scale: 1 = unsatisfactory; 2 = marginal; 3 = satisfactory; 4 = above average; 5 = excellent</i>	Average Rating (2006, n=13)	Average Rating (2010, n=6)
<i>Through my involvement with the ME680 Team Presentation....</i>		
1. I enhanced my creativity through the creation of a relevant and appropriate presentation.	3.9	4.3
2. I used a design process to create a presentation with my audience in mind.	3.9	n/a
2a. I improved my design skills by using a systematic design process in creating the presentation.	n/a	3.6
2b. I designed the presentation with my audience in mind.	n/a	4.5
3. I enhanced my creativity by creating an activity to stimulate audience interest and involvement.	3.8	4.5 (slight edit)
4. I improved my self-assessment skills by completing a self-assessment based on my presentation.	3.7	4.3
5. I applied and strengthened my Thermodynamic knowledge through teaching others.	4.2	4.5
6. I have improved my communication effectiveness by written, verbal, and/or graphical means.	4.5	5.0
7. I have improved my teamwork abilities.	4.3	4.5
8. I have improved my understanding of contemporary issues associated with the field of mechanical engineers.	4.5	n/a

The workshop presented in this paper has been developed as part of The TEAK Project, which was initiated at RIT in 2007 as a means to combine engineering outreach to middle school students with educational opportunities for college-level engineering students. The outreach portion of The TEAK Project is focused on the development of hardware kits and lesson plans that can be easily transported to local classrooms to support engineering instruction. The hardware and documentation have been developed entirely by engineering students. The portion of the project aimed at college-level engineering students and providing opportunities for them to learn and practice professional skills is focused on training students to teach engineering, and giving them opportunities to teach. This has been accomplished primarily through the development and offering of a new TEAK-TA Teaching Workshop targeted at engineering students who will be working as teachers of engineering in RIT classrooms and labs, at various outreach activities on and around campus, or in developing instructional materials. This TEAK-TA Teaching Workshop is the focus of the present paper. The workshop has been offered four times in its current form, to a total of 17 students. Participants include student members of capstone design teams, students interested in volunteering at outreach programs, and full-time co-operative education students doing extensive teaching and curriculum development for engineering outreach programs on campus. During the Spring of 2012, the workshop is being offered for the first time as a one-credit course to a larger group of students

TEAK-TA Teaching Workshop Content

The TEAK-TA Teaching Workshop currently consists of five sessions, with more planned for Spring 2012. The first four sessions are instructional, and the fifth is a microteaching exercise, where each workshop participant delivers a 15 minute lesson to the class, and receives constructive feedback. Each session is approximately one hour long, and begins with an overview of the session learning outcomes. The sessions are highly interactive, with several opportunities for the students to stop and consider how to apply the material being discussed to their own microteaching activity. Sessions and their outcomes are shown in Table 2.

Table 2. Session Descriptions for TEAK-TA Teaching Workshop

Session	A student completing this session will (be able to)...
1. Know your Audience	Be aware of The TEAK Project, determine your most likely audience, learn some techniques for setting the stage in your classroom.
2. Lecture and Questioning Techniques	Plan a session that keeps your students focused on the class or lab, be able to pose good questions to the class or lab, apply techniques learned in the workshop to your planned teaching activity.
3. Managing Hands-on Activities	Recognize potential difficulties that may arise in a lab, think about how to time activities appropriately, discuss ways to help students learn from mistakes in a safe hands-on environment.
4. Classroom Assessment Techniques	Recognize the value of assessment and evaluation, learn how to help students learn through assessment, apply techniques learned in the workshop to your planned teaching activity.
5. Microteaching Session with peer Observation	Design and deliver a short lesson on an engineering topic, provide constructive feedback to other student teachers, receive constructive feedback on your own teaching, reflect on how you can use the feedback you receive to improve your teaching.

The first one-hour session begins with an introduction to The TEAK Project and motivation for the overall workshop. Participants are given time during the session to consider what topic they would like to address for their 15 minute microteaching exercise, as well as who their target audience will be. Depending on the workshop participants, the target audience may range from elementary school students (for participants who will be teaching at summer camps or outreach programs) to college students (for participants who are or plan to work as Teaching Assistants at RIT). Participant-centered workshop activities include:

- A discussion of how the workshop instructor set the stage for the session, and what expectations the class read into this. The participants then individually consider what expectations they want to set for their own session, and the class discusses how these expectations can be set.
- A discussion of the importance of knowing your audience, and how casual use of unfamiliar terms can be confusing. The participants then individually develop a list of terms that will be unfamiliar to their target audiences.

The second one-hour session includes a review of Bloom's Taxonomy, which is used in RIT's College of Engineering to guide development of course learning outcomes for ABET reporting.

Different ways of posing questions are presented for different Bloom's levels, and the class is asked a variety of questions using different Bloom's levels to illustrate some basic differences (e.g., "Can someone tell me the definition of a Knowledge question?" vs. "Can someone give me an example of a Knowledge question?"). Different techniques for maintaining student interest are discussed and the participants brainstorm ways to hold interest in their microteaching exercise. Participant-centered workshop activities include:

- Participants individually develop 1-2 knowledge or comprehension questions for their workshop sessions, then share the questions within groups.
- Participants individually develop 1-2 application or analysis questions for their workshop sessions, then share the questions within groups.

The third one-hour session is focused on the workshop participants' completion of an existing hands-on activity. The activity is typically one pulled from a TEAK outreach kit, because they are designed to be portable and should be very simple for college engineering students. This leaves the emphasis on completing the hands-on work, rather than learning new engineering concepts. Participant-centered workshop activities include:

- Each individual participant reads the activity instructions and develops a list of potential stumbling blocks, as well as an estimate for how long they think the activity will take to complete. As a class, gather everyone's input and come up with a master list.
- Participants then complete the hands-on activity individually; they are timed, and are asked to note any new difficulties that arise.
- When everyone is done, individuals share the new problems that were not apparent from reading the directions, and the class suggests ways to prevent or handle these problems.
- The range of times to complete the activity are posted, and the session closes with a discussion of what to do with students or groups who finish work early, or who are not done with an activity when time is called.

During the fourth one-hour session, participants are introduced to a variety of assessment techniques that can be used in the classroom, mostly from *Classroom Assessment Techniques*⁷. The workshop instructor reviews Traffic Lights (green=go ahead, yellow=slow down, red=stop), the One-Sentence Summary (summarize the day's topic in one sentence), Partner Progress (pair up with a partner and exchange questions or concerns about the class), and the Summary Swap (write down a one-sentence summary, then exchange summaries with a partner and add or edit as to supplement the partner's statement). Participant-centered workshop activities include:

- Complete one of the CATs presented in the workshop. This also gives the instructor feedback on that particular lesson.
- Consider which of the CATs presented could best be incorporated into their microteaching exercise, and discuss this within groups.

During the final session, each workshop participant has fifteen minutes to deliver a mock lesson on a topic of his or her choosing. The lesson is delivered in a typical RIT classroom, which is equipped with a whiteboard, presenter's podium, and audio/visual laptop projection capabilities. The "instructors" are responsible for preparing the lesson and any supplemental materials required for the lesson (presentations, handouts, audio/video materials, etc.). The audience is told what group they are to represent (e.g., an engineering college lab section or a group of sixth-graders at engineering camp) and they also complete a peer feedback form that goes back to the

presenter. This form, adapted from the U.S. Military Academy's T⁴E evaluation form⁸, is used as a tool to objectively provide critical feedback to the presenter, and also to give the workshop development team information on potential problem areas that could be the focus of new workshops. In addition, each presenter's session is video-recorded. At the end of the day, participants receive copies of their feedback and a DVD of their microteaching session. The final assignment is for each participant to review the feedback, watch the DVD, and write and submit a one-page reflection that discusses the strengths and weaknesses of his or her own session, as well as any other observations from the video.

Workshop Assessment

The primary means of assessing the workshop to date is a post-workshop survey that provides feedback on the workshop content and activities. This survey is administered at the end of Session 5, and consists of a series of questions scored on a scale of 1-5, where 1=Strongly Disagree and 5=Strongly Agree:

- Sessions 1-4 (Instructional Sessions)
 - The information in this session was new to me.
 - The information in this session was helpful to me.
- Session 5 (Microteaching Activity)
 - It was helpful for me to observe and critique other students' teaching.
 - It will be helpful for me to see myself teaching after the recorded session.
- Overall Workshop
 - This workshop will help me improve my teaching in the future.
 - I would recommend this workshop to other students before they begin work as instructors.

Participants are also provided space to enter open-ended comments related to each individual session, as well as for the overall workshop.

Additional data is extracted from co-op evaluation forms, when participants enroll in the workshop as part of their employment requirements. All RIT engineering students complete a series of co-op experiences, after which the students complete a common evaluation form. The responses to two questions from this co-op evaluation form are collected:

- "Please assess the extent to which your work experience provided you with the opportunity to accomplish the items below." (1-5, where 1=Minimal/Poor, 5=Extensive/Excellent)
 - Communicate Effectively (written)
 - Communicate Effectively (oral)
- "My employer/supervisor provided a work experience that was educationally meaningful and challenged my abilities" (1-5, where 1=Strongly Disagree, 5=Strongly Agree)

This data is not in direct support of workshop assessment, but is helpful in supporting the idea that students on teaching-intensive work assignments are gaining opportunities to practice effective communication in a meaningful way. The responses from students who completed the TEAK-TA Workshop as part of a teaching-intensive experience will be compared with the

general mechanical engineering student population. To date, these teaching-intensive co-op experiences have all been for students focused on engineering instruction as part of outreach programs, either with The TEAK Project or with RIT's Women in Engineering organization (WE@RIT).

Workshop Results to Date

To date, workshop results are in the form of post-workshop surveys completed by the students (Table 3). Results indicate that students participating in the workshop found the workshop to be helpful, even if they were not as likely to indicate that the information was new to them. One student participating in the workshop indicated in open-ended comments that he did not actually hear *anything* new during the workshop, but that this was the first time he had seen the information presented together in a way that made sense and was relevant to his job as a TA. In general, students also found the workshop to be valuable enough to recommend it to others.

Table 3: Post-workshop Evaluation Survey Responses

Question	n	Average score (1=Strongly Disagree, 5=Strongly Agree)
Session 1: new information	17	3.29
Session 1: helpful	17	4.18
Session 2: new information	17	3.59
Session 2: helpful	17	4.41
Session 3: new information	17	4.18
Session 3: helpful	17	4.71
Session 4: new information	17	3.76
Session 4: helpful	17	4.53
Session 5: helpful to observe	9	4.67
Session 5: helpful to receive feedback	9	4.78
Overall workshop: helpful	13	4.62
Overall workshop: would recommend to others	13	4.62

Results collected from co-op reports is presented in Table 4. While the teaching workshop only constitutes a small part of the co-op experience, it is important to note that students whose co-op was strongly teaching-related were more likely than their peers to respond that their co-op provided the opportunity to practice effective communication. At the same time, students on teaching-related co-ops rated their experience as being equally challenging and meaningful. This is not a direct reflection on the teaching workshop, but an indication that students view teaching experience as a good way to practice their written and oral communication skills.

Table 4: Co-op Evaluation Form Feedback

Question	Opportunity (teaching co-op, n=10)	Opportunity (all co-ops, n=1,354)
Communicate effectively (written)	4	3.57
Communicate effectively (oral)	4.5	3.9
Meaningful, challenging work experience?	4.4	4.23

Future Plans for Teaching Workshop

During the 2011-12 academic year, this workshop will be expanded and offered as a one-credit elective course to mechanical engineering students who are interested in working as TAs in the mechanical engineering department, in addition to students who will be working on teaching-intensive co-ops during Summer 2012. Two key improvements in assessment are planned, in order to support testing of the hypothesis that this teaching workshop helps to improve students' communication skills. The first is incorporation of two recorded teaching activities during the course. The first is a brief 5-minute session on an engineering topic, and the second is the same 15-minute microteaching session currently included. This will allow (1) a before-and-after comparison of each student's communication skills and (2) an opportunity for students to give and receive feedback early in the term and use what they observe to improve their communication. Students will be graded on *completion* of the 5-minute session and *quality* of the 15-minute session, including their response to any feedback they received on their 5-minute session. The second assessment-related improvement is an update to the peer evaluation form, in order to make it more constructive and easier to complete quickly. The same form will be used for grading.

Since the workshop is now being offered as a one-credit (10 hour) course, new content is also being added. Additional content relative to TAs, such as writing and working sample problems, grading, and using the campus course management system, will be integrated. Table 5 describes the new sessions that will be added to the original five sessions described in Table 2 above.

Table 5. Additional material developed for 10-Week Course

Sessions	A student completing this session will (be able to)...
Managing Problem Solving Sessions	Understand the advantages and disadvantages of different types of recitation sessions and how class size and year level affect success, observe, then develop and run a sample recitation session.
Creating Exams, Homework, Quizzes, Multiple Choice Questions	Understand the six levels of Bloom's as it relates to engineering, understand strategies to assess student mastery of the material relative to Bloom's level taxonomy, be able to identify Bloom's level for questions on an exam
Grading, Annotation, Rubrics	Understand the difference between grades intended for student motivation versus student assessment, recognize appropriate grading schemes and professor annotation of graded work, create a grading rubric for exam, quiz and homework problems, grade papers using the rubric.
Course Management Software and Best Practices	Demonstrate ability to use the course management system and be able to explain best practices for maintaining accurate student records.

Different methods of running problem solving sessions will be discussed that range from fully structured to completely open-ended. The fully structured type of session involves assigning the attendees a problem in which the TA knows the solution ahead of time, but does not solve the

problem on the board. Instead the attendees solve the problem in small groups with help as needed from the TA. The mid-structured range involves attendees asking questions only on assigned homework problems. In this case, TAs are responsible for understanding a larger range of problems, but have the answers ahead of time. The unstructured recitation involves attendees asking questions of any nature, not involving homework, and the attendees expect the TA to answer the question. In this case, the TA must have a very good understanding of the material but can guide the direction and determine the extent of the solution. The completely unstructured session is when the attendees ask any type of question, other than homework and the attendees are expected to answer for each other. In this case, the TA acts as a facilitator only and does not necessarily answer any technical questions. But instead the TA works to involve the students in the process. We will discuss the advantages and disadvantages of each session from the attendees point of view and from the TAs point of view. We will discuss different ways to prepare for each session, and the different techniques for managing each session. For example, involving attendees to help answer questions when the TA does not know the answer; referring to course notes and text books, rather than recreating additional notes on the board, when to carry a solution to the end with numbers and when to stop strategically mid-way through; and how to handle attendees who are quiet, unengaged or disruptive.

Bloom's Taxonomy as it applies to engineering will be described and sample example exam questions will be provided for each Bloom's level. We will discuss how to create an exam to include specific course learning objectives, how to measure specific Bloom's levels with multiple choice questions, and how to estimate level of difficulty and time required for each problem. We will also discuss how to reduce the time required while maintaining the difficulty level of the question relative to Bloom's. Students will then be asked to create a 90 minute exam for a core mechanical engineering science core course of their choice. They will be asked to include all six levels in the assessment and estimate the time required for each problem.

Grading strategies will be presented in terms of graded items that could be used for motivation versus graded items that are more appropriate for assessment of learning. We will also discuss grading rubrics and how they provide benefit in terms of improved time management and maintaining grade consistency, both within a class and between classes. Students will write solutions and create a grading rubric for homework problems and for their sample exam. In addition, we will provide them with sample rubrics from actual exam and homework problems, and discuss how to handle special cases in which the student's solution deviates from the rubric.

Finally, we will discuss overall course management and demonstrate the use of the course management software. We will discuss how to organize and manage content on the website, set up the grade book, including extra credit and weighting of different graded items, how to import and export grades, and strategies for maintaining accuracy.

Summary

A successful workshop has been developed to improve the communication skills of engineering students planning to work in a teaching capacity, with an emphasis on classroom communication. Students who have participated in the workshop have found the information helpful, even if it is not new, and students who have participated in the workshop as part of a

teaching-based co-op indicate that their communication skills are generally enhanced by the co-op. Future offerings of the workshop will include additional topics specifically relevant to TAs, and the workshop will be offered for credit.

Acknowledgements

Support for the TEAK Project is provided by the National Science Foundation's Course, Curriculum, and Laboratory Improvement (CCLI) program under Award No. 0737462. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the National Science Foundation.

The authors would like to acknowledge the support of Sarah Cass, an Instructional Design Consultant in RIT's Teaching and Learning Services department, for her assistance in the development of the TEAK-TA Teaching Workshop.

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