Individual Communication Requirements in Capstone

Richard Bannerot
University of Houston

This paper describes how students' technical communication abilities, focusing on individual abilities, are assessed in a two-semester capstone course. Detailed scheduling and grading information is also provided.

Keywords: Communication, Assessment, Individual, Team

Corresponding Author: Richard Bannerot, rbb@uh.edu

The ABET General Criterion 3g requires engineering programs to demonstrate that each student has the ability to communicate effectively. Industry has complained for some time that engineering graduates have poor communication skills[1]. Engineering programs have responded over the years by introducing requirements for the use of communication skills in engineering courses[2-6]. In our BSME program, student outcome assessments related to communications are collected in six courses: technical communications[7,8] , sophomore design[9], measurements lab, senior lab, and (the former, one-semester) capstone[10]. This paper describes how student communication effectiveness is documented and assessed in our current, two-semester capstone.

The two-semester, capstone is offered once a year beginning in the fall. Teams of four (to the extent possible) complete projects either submitted by external clients, developed by the faculty, proposed by the students themselves or provided by design competitions as listed in Table 1 for the past year.

Table 1: 2013-14 Projects

External Sponsor: ExxonMobil: Sand Screen Design; Superior Energy: Disappearing Packer Setting Device; NOV: Hydraulic Control Mechanism; Cameron: Gas Pipeline Monitoring System; Cameron: Subsea Light Structures; Westbrook: Robot Assistant**;** NASA: Asteroid Mining; UH: Parking Lot Monitor.
Instructor: 2 can crushers, 2 rebar tying devices; Reynolds experiment; cube placer, solar still
Student: Grill design; one-wheel "Segway", solid mechanics demo, fruit juicer; child's change maker
Competitions: 2 cars, 4 teams for Shell Eco-Marathon

Expectations are that the teams justify and select a design from at least three documented and illustrated concepts, complete a detailed design, submit drawings, and order parts in the fall and complete fabrication and testing in the spring before a formal validation process at the end of the spring. The progress of the design process is reported to the class and the instructor in a variety of documents submitted and presentations made by individuals (in the fall) and by the team (in the spring). This paper focuses on the requirements and progression of the documents that are the responsibility of individuals (addressing the ABET requirement that each student must demonstrate the ability to communicate effectively). The team documents are used to demonstrate that the students can work effectively in teams (ABET General Criterion 3d).

The following is a list of the communication requirements for the two-semester capstone. The schedules for the submission of these communication requirements are shown in Tables 2 and 3, generic schedules for the course which assumes a total of 24 teams (as was the case for the 2013-4 year academic).

Fall Team Document Requirements:
A "mini-proposal" (a bid for the team's first choice for a project) and two "mini-mini-proposals" (bids for the team's second and third choices) are due near the end of the third week after the instructor has met for 20 minutes with each team during class time (8 to 11 AM Mondays and Wednesdays) to discuss the team's questions about the projects offered and their ideas for their own projects. Of course, teams can (and do) schedule additional meetings outside the class time. Projects are assigned by the end of the third week. During the fourth and fifth weeks teams again meet individually with the instructor to discuss their assigned projects and at those meetings provide a "draft" of their version of the: statement of work, the deliverables, and the validation requirements. This "draft" is revised and resubmitted as many times as the team desires and serves as the basis for the formal documents to follow.

Table 2: Generic Fall Schedule for ME Capstone I

Lectures will start at 9 or 10 AM as noted. **Student presentations** will begin at 8 AM and 9:30 AM unless otherwise noted. **Work** is due at the beginning of class or meeting unless otherwise noted. The class will be divided into teams consisting of four students (to the extent possible) designated as A, B, C or D. These letters will designate what type and when students will prepare reports. The teams will be combined into 4-team cohorts for the purpose of the presentations. Students need attend only the cohort meetings in which their team is presenting.

Monday	Wednesday
Week 1	Week1
Lecture (9 AM): Introduction: Syllabus, Course Organization, Gantt Charts, Milestones/Tasks, Deliverables/Validation, Project Descriptions	**Lecture (9 AM): Introduction (cont.):** Continue project descriptions. Discuss mini-proposals and project selection process. **Form Teams**
Week 2	Week 2
NO CLASS: LABOR DAY	Team Meetings with Instructor 8 to 11 AM: 20 minutes with each team: 1 to 9. Teams should be prepared to indicate interests and ask questions.
Week 3	Week 3
Team Meetings with Instructor 8 to 11 AM: 20 minutes with each team: 10 to 18. Teams should be prepared to indicate interests and ask questions	Team Meetings with Instructor 8 to 10 AM: 20 minutes with each team: 19 to 24. Teams should be prepared to indicate interests and ask questions **Lecture (10 AM): Statement of Work (SOW) & Proposals** **Mini-proposals due by noon Thursday** Projects assigned by 5 PM Friday
Week 4	Week 4
Team Meetings with instructor 8 to 11 AM: 20 minutes with each team: Teams 1 to 8. Be prepared to discuss assigned project. **Bring draft SOW, Deliverables and Validation**	Team Meetings with instructor 8 to 11 AM: 20 minutes with each team: Teams 9 to 16. Be prepared to discuss assigned project. **Bring draft SOW, Deliverables and Validation**
Week 5	Week 5
Team Meetings with instructor 8 to 11 AM: 20 minutes with each team: Teams 17 to 24. Be prepared to discuss assigned project. **Bring draft SOW, Deliverables and Validation**	**Lecture (10 AM): Progress Reports** **Submit revised SOW, Deliverables and Validation**
Week 6	Week 6
NO CLASS	Proposal: Oral (A) and Written (D) – Cohorts I & II
Week 7	Week 7
Proposal: Oral (A) and Written (D) – Cohorts III & IV	Proposal: Oral (A) and Written (D) – Cohorts V & VI
Week 8	Week 8
NO CLASS	Progress Report I: Oral (B) and Written (C) – Cohorts I & II
Week 9	Week 9
Progress Report I: Oral (B) and Written (C) – Cohorts III & IV	Progress Report I: Oral (B) and Written (C) – Cohorts V & VI
Week 10	Week 10
NO CLASS	Progress Report II: Oral (D) and Written (A) – Cohorts II & I
Week11	Week 11
Progress Report II: Oral (D) and Written (A) – Cohorts IV& III	Progress Report II: Oral (D) and Written (A) – Cohorts VI & V
Week12	Week 12
NO CLASS	Design Review: Oral (C) and Written (B) – Cohorts II & I
Week 13	Week 13
Design Review: Oral (C) and Written (B) – Cohorts IV & III	Design Review: Oral (C) and Written (B) – Cohorts VI & V
Week 14	Week 14
NO CLASS	**NO CLASS - THANKSGIVING HOLIDAY**
Week 15	Week 15
NO CLASS	**NO CLASS** - Written Design Review
Week 16	Week 16
	FRIDAY 8 TO 11: FINAL EXAM

Table 3: Generic Spring Schedule for ME Capstone II

Lectures will start at 9 or 10 AM as noted. **Team presentations** will begin at 8 AM. **Work** is due at the beginning of class or meeting. Cohorts consist of six teams and presentations last 20 minutes plus Q &A.

Monday	Wednesday
Week 1	Week1
NO CLASS - by 12N Tuesday mail to rbb@uh.edu a list of milestones and tasks for spring, the associated Gantt Chart and expected spring deliverables and validation	30-minute team meetings with instructor – Teams 19 to 24; Teams should be prepared to discuss spring plan, deliverables and validation
Week 2	Week 2
NO CLASS: MLK DAY	30-minute team meetings with instructor – Teams 13 to 18; Teams should be prepared to discuss spring plan, deliverables and validation
Week 3	Week 3
30-minute team meetings with instructor – Teams 7 to 12; Teams should be prepared to discuss spring plan, deliverables and validation	30-minute team meetings with instructor – Teams 1 to 6; Teams should be prepared to discuss spring plan, deliverables and validation
Week 4	Week 4
LECTURE: TEAM PROGRESS REPORTS (BEGIN AT 9 AM)	NO CLASS
Week 5	Week 5
Team Progress Reports: Oral and Written for Teams 19 to 24. Oral Reports: 20 minutes	Team Progress Reports: Oral and Written for Teams 13 to 18. Oral Reports: 20 minutes
Week 6	Week 6
Team Progress Reports: Oral and Written for Teams 7 to 12. Oral Reports: 20 minutes	Team Progress Reports: Oral and Written for Teams 1 to 6 Oral Reports: 20 minutes
Week 7	Week 7
20-minute team meetings with instructor – Teams 17 to 24; Teams should be prepared to discuss updates on deliverables and validation	20-minute team meetings with instructor – Teams 9 to 16; Teams should be prepared to discuss updates on deliverables and validation
Week 8	Week 8
20-minute team meetings with instructor – Teams 1 to 8; Teams should be prepared to discuss updates on deliverables and validation	NO CLASS
Week 9	Week 9
NO CLASS – SPRING BREAK	**NO CLASS – SPRING BREAK**
Week 10	Week 10
NO CLASS	**NO CLASS**
Week11	Week 11
NO CLASS	**LECTURE (9 AM): POSTERS, EXTENDED ABSTRACTS, FINAL REPORTS**
Week12	Week 12
NO CLASS	**NO CLASS**
Week 13	Week 13
NO CLASS – set up posters in engineering commons (D-building) by 12 N Tuesday	Poster review and grading 8 to 11 AM. All team members expected to attend
Week 14	Week 14
Team Final Presentations – schedule to be determined	Team Final Presentations – schedule to be determined
Week 15	Week 15
Team Final Presentations – schedule to be determined	Team Final Presentations – schedule to be determined
Week 16	Week 16
NO CLASS – TEAM FINAL WRITTEN REPORT AND EXTENDED ABSTRACT DUE BY 12N	FRIDAY 8 TO 11: FINAL EXAM

Fall Individual Communication Requirements:

Each team member is assigned a letter: A, B, C, or D that determines which of the following oral and written reports he or she is responsible for during the semester. The class meets in cohorts of four teams each for the presentations. The individual "stake" in the quality of the individual report is 10% of the presenter's course grade for an oral report and 15% of the writer's course grade for a written report. The team grade is also influenced by the grades its team members receive. Sixteen per cent of the team grade is based on the average grade for the four individual presentations and 28% of the team grade is based on the average grade for the four individual written reports. The obvious expectation (or hope) is, of course, that while one person is responsible for a report, all team members have a stake in his or her success and will therefore help in the gathering of information, in proof reading and in critiquing practice presentations.

The idea behind this sequence of reports is that improvement is expected in both the writing (as "corrected" written reports are returned) and presenting (as talks are critiqued immediately after completion) as the year progresses. The series of individual reports in the fall will, of course, lead to a "recycling" of material which is acceptable as long as it is corrected and improved based on the previous comments. (Copies of all previous reports are resubmitted as appendices of current reports). Also, the number of topics and the amount of material increases with each report (based on seven to eight pages of detailed instructions for each report). The presentations are graded according to a rubric that is provided ahead of time to the students. About 60% of the grade for the presentation is based on content. Specific instructions are given, and most students score well for content. About 40% of the grade is based on timing (ten minutes plus or minus 1 minute), quality of visuals, and overall speaking quality (e.g., preparation, knowledge, annoying gestures or sounds, and engagement with the audience, etc.). Students usually score between 20% and 35% to 38% of the 40%. A total score of 95% is an "A" and 100% is an "A+".) The outlines for the written Proposal, Progress Reports I and II and the Design Review are not shown here due to space limitations, but each report contains material not present in the previous reports. Even the two progress reports are different. Fifth-five percent of the individual fall grade is based on the team grade. The remaining 45% includes a mock FE exam (mathematics, economics, statics, and thermodynamics I), prepared by the instructor, or students may chose to use their performance on the actual FE exam.

Spring Requirements:

In the spring, a progress report, final report, poster and extended abstract are prepared by the team as indicated in Table 3. Forty percent of the team grade is based on the "validation" of the project. Eighty per cent of the individual grade is the team grade (a peer evaluation is conducted which could result in a reduction of an individual's grade); the remainder is based on a second mock FE exam (dynamics, solid mechanics, fluid mechanics and thermodynamics II).

In conclusion, the requirement of individual presentations and written assignments near the end of the BSME program provides a better assessment of the actual graduates, rather than an assessment in earlier classes where a significant number of the students may not actually graduate. In addition, one of the benefits of this "continuous improvement" process is that the quality of the Final Reports and Presentations in the spring has greatly improved over previous years when there were fewer, less formal communication assignments.

References

1. Jeffrey Donnell, et. altera, "Why Industry Says that our Engineering Graduates Have Poor Communication Skills - What the Literature Says", AC 2011-1503, Proceedings of the 2011 ASEE Annual Conference and Exposition, June 26-29, 2011, Vancouver, BC Canada.
2. William K. Durfee, et altera, "A Writing Program for Mechanical Engineering", AC 2011-1200, Proceedings of the 2011 ASEE Annual Conference and Exposition, June 26-29, 2011, Vancouver, BC Canada.
3. Kristen Eichhorn, et altera, "Infusing Communication Skills into an Engineering Curriculum" AC 2010-218, Proceedings of the 2010 ASEE Annual Conference and Exposition, June 20-23, 2010, Louisville, KY.
4. Julia Williams, et. altera, "Communication Pedagogy in the Engineering Classroom: A Report on Faculty Practice and Perceptions," AC 2009-1610, Proceedings of the 2009 ASEE Annual Conference and Exposition, June 14-17, 2009, Austin, TX.
5. Ronda Young, et. altera, "Assessing Writing in a Comprehensive Design Experience Course," AC 2009-629, Proceedings of the 2009 ASEE Annual Conference and Exposition, June 14-17, 2009, Austin, TX.
6. Caroline Carville, et altera, "Integrating Writing into Technical Courses: Steps toward Integrating Communication in the Engineering Classroom" Session 1416, Proceedings of the 2002 ASEE Annual Conference and Exposition, June 16-19, 2002, Montreal, ON, Canada.
7. Chad Wilson, et altera, "Advances in Technical Communications in the Cullen College of Engineering at the University of Houston," paper F2D1, Proceedings of the 2005 Annual Conference of the ASEE Gulf Southwest Section, March 23-25, 2005, Corpus Christi, TX
8. Chad Wilson and Richard Bannerot, "Creating a Comprehensive Communications-Across-the-Curriculum Program in the Cullen College of Engineering" AC 2006-1978**,** Proceedings of the 2006 ASEE Annual Conference and Exposition, June 18-21, 2006, Chicago, IL.
9. Richard Bannerot, et. altera, "Integrating Technical Communications into an Early Design Course", IMECE2005-79556 presented at 2005 ASME IMECE, Orlando, FL, November 5-11, 2005.
10. Jenna Terry, et altera, "A Just-in-Time Model for Teaching Technical Communications and the Use of Grading Rubrics in a Multidisciplinary Capstone Design Course," AC 2004-491, Proceedings of the 2004 ASEE Annual Conference and Exposition, June 20-23, 2004, Salt Lake City, UT.