AC 2008-1150: SENIOR DESIGN WRITING – IT'S ABOUT TEAMWORK, COMMUNICATIONS AND LIFELONG LEARNING

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Senior Design Writing – It's About Teamwork, Communications and Lifelong Learning

Abstract

Writing is both the conveyance of information to others and, even more importantly, a process that clarifies thoughts and ideas. It is a means of communication between people, making it an integral part of the teamwork process. It is a vehicle for addressing issues that clearly demonstrates continuous and life-long learning. A focus on writing in its various forms is an integral tool for demonstrating our graduates are practicing and have achieved some of the key ABET-driven program outcomes.

The writing communication requirements of our Electrical Engineering Senior Design sequence are specifically designed to give students experience in both team and individual communication covering a wide range of styles. The assignments naturally serve to propel the project, but also involve and demonstrate important aspects of team cooperation and lifelong learning. The intent is to assure personal and professional growth on the part of the students as engineers, team players, and societal members, in conformance to the program outcomes and to enhance their future success as prescribed by the program objectives.

Our writing communication requirements have been developed over many years of teaching hundreds of senior electrical engineering students. The normal expectations of three major team reports are guided by specific clearly communicated content and style requirements. But there are numerous other writing tasks as well, all intended to parallel business and industry requirements. They focus on providing evidence of individual contributions and range from engineering notebook entries to bi-weekly "elevator" style reports – very short succinct reports that demonstrate the progress made in the latest time interval. Finally, in conjunction with our "trade-show"-style Senior Design Show in May of each year, each team must create a poster with a primary pictorial emphasis to highlight their design. This is part of a poster competition that takes place the same day.

Background

Much has been written about the essentials of writing requirements in various curricula settings and career preparations.[1-3] Surveys repeatedly have demonstrated both the shortcomings of graduates in their ability to write and the demands of the workplace for improved performance.[2] However, what has been stated with insufficient clarity is what is the specific purpose of writing, and, therefore, how can one more effectively address this issue in a curriculum?

We, like other programs, have both lofty and practical intents with our writing requirements. They are to enlarge and enrich the mind, to capture nuances as well as grand and complex concepts and to convincingly demonstrate achievements. The challenge becomes one of having students see writing as an integral part of their work as engineers, or their engineering practice.

This still leaves the question "What is the purpose of writing?" Writing both conveys information to others and, most importantly, is a process that clarifies ideas. Writing is thinking. Or, as more aptly articulated by Peter Elbow, "Think of writing then not as a way to transmit a message but as a way to grow and cook a message. Writing is a way to end up thinking something you couldn't have started out thinking."[4] Information is conveyed to both to the writer and to those who will read the information. Writing clarifies information. How many times have we had ideas in our minds, being somewhat convinced of the logic and importance of the ideas? But upon giving a concrete form to those ideas, via the process of choosing specific words and patterns of expression, we find the gaps and lack of force that thinking alone often fails to identify. Writing has tremendous potential variety, each format serving specific purposes. Yet the ultimate intent is to convey a message, ranging from precise clarity to intentional ambiguity.

A central intent of the MSOE Electrical Engineering program and curriculum is to instill the importance of professional skills, in addition to the normally expected technical skills. Communication, with an emphasis on writing, culminates in the capstone senior design experience. While the nominal purpose of the three quarter course sequence is to teach the process of design, the project itself is the vehicle used to bring "to life" the design process and to develop the integral role that professional skills, in particular writing, play in the successful execution of the chosen project. While a capstone senior design course generally contains exercises in meeting a customer's needs, solving problems, and using engineering skills, our students' experiences range well beyond that. Our written communications requirements have been honed throughout years of teaching this three-course (9-month) sequence to hundreds of Senior Electrical Engineering students. The decision was made to require students to produce certain specific written works, both as individuals and as team members. Beyond enhancing their communications skills, these assignments further expand their abilities in the realms of teamwork and lifelong learning. As a result, they grow in several ways – as engineers, team players, and societal members.

Writing as an Active Editing Process

Writing is a process of engaging "mental gears," connecting thought to expressions. Writing is a combination of creativity and critical thinking skills. Elbow tells us to think of the writing process as a brainstorming session. When one is generating new and creative ideas, this may not be the best time to be overly critical. There are no bad ideas – initially. "You can't get the good ones [ideas] and the fruitful interaction among the odd ones unless you welcome the terrible ones. Besides, you don't really know which ideas are good or terrible until later…To be critical you have to be doubting, detached, uninvested in the idea to be criticized; to come up with fresh ideas you have to invest yourself and to be believing."[5]

The use of the computer with its associated unlimited ability to perform editing has dramatically changed writing from a practical perspective. A traditional writing problem is termed "writer's block." Technology now allows students to conveniently experiment with their writing so that the investment of effort, aside from the thought process, in false starts is fairly trivial. Students should know and practice writing by being willing (in the worst case) to do a "brain dump" of whatever their thoughts are on a topic. The process of editing allows the organization of what

otherwise might be random strands into some degree of coherence. The essential nature of editing requires that writing must be considered as a multiple step process. Peter Elbow, in his book, *Writing without Teachers*[5], talks about writing as process.

The issue of engineering students wanting to provide "everything" with the intent of being complete needs to be addressed in the practice of writing. Some of the authors have at times light-heartedly suggested to students to cut their verbiage in half. But which half should be removed and which half kept? Therein lies the dilemma. Students must make judgments of what is important and what is supportive of or further elaborates on what is truly important. And that is something that requires practice and awareness.

Merging Communications and Senior Design

We must also ask how does the discussed role of writing translate to engineering practice? In an article on technical coordination in engineering practice, Trevelyan concludes that "effective coordination relies on a hierarchy of many other fundamental and interpersonal skills such as preparing instructions for technical work,…interpersonal verbal and non-verbal communication, written communication (verbal and visual), selecting appropriate communication strategies…."[2] Trevelyan reports that engineers may refer to some duties as "'not real engineering' work, or 'all that administrative stuff'."[2] In a study that examined writing and speaking instruction for engineering students, student feedback suggested that the communication instruction interfered with their "real work." Some student comments:

- "Half the time was spent doing the work, the other half…was spent documenting the work."
- "When will we get to do the real work of design? We can't do it because we're working on our presentation.."
- "Let us do more real work."[3]

We are thus faced with a certain challenge. How do we inspire the students to effectively communicate ideas while not overburdening them with numerous repetitive assignments? Furthermore, how can we do this while satisfying our own program objectives and accreditation requirements? The answer comes in having a wide variety of *types* of assignments, and tying them, when possible, to accreditation criteria. That is, while the typical "long team report" is a necessity, it is not sufficient. To make communications lively and effective, other assignment types are used: memoranda, posters, design reviews, "lab chats," trade show presentation, Gantt chart, and the milestone table. This variety has served to keep the students engaged and has lessened their feeling that they must do "yet another report." The specifics of these assignments and their relationship to accreditation criteria are presented below.

Relevant ABET Engineering Accreditation Commission (EAC) Criteria

As will be explained, the wide range of writing and research assignments of our electrical engineering senior design courses fit well with current ABET EAC criteria, specifically "Criterion 3. Program Outcomes":

d) an ability to function on multi-disciplinary teams
g) an ability to communicate effectively
i) a recognition of the need for, and an ability to engage in life-long learning

The assignments were not necessarily created solely to satisfy the above. Rather, assignments appropriate to engineering team design were found to fit the above. This relationship between our capstone design requirements and ABET requirements is, therefore, harmonious.

The Writing and Research Assignments

The assignments fall into certain categories, but sometimes span across them as well. To organize the discussion, the ABET Criterion 3 topics shown above will be used as a structure. Clearly, other qualities of the capstone design course help to satisfy the Criterion, but only the specific writing and research assignments will be discussed below.

Criterion 3d – an ability to function on multidisciplinary teams

In her paper on student perceptions of collaborative writing, Nelson[6] references a number of sources reporting that "engineering and technology professionals spend an average of one-third of their time writing, and most write as members of a team." Nelson goes on to report the findings of several sources which state that collaboration builds such skills as interactivity, teamwork, and negotiation, promotes growth and increases the confidence of writers, and helps build community. Nelson shares her own experience as a science writer for NASA. "I observed that many of the most successful writers sought multiple reviews of their work from their colleagues, and many actively sought mentoring from writers they perceived to be more expert."

For the Senior Design Capstone project three major team reports are required. In the first quarter, the Feasibility Study demonstrates problem definition, research accomplishments, identification of the customer and of his/her needs and wants, ideation of solution possibilities, development of specifications, and a recommendation to management of a particular solution approach. The winter and spring quarters require extensive preliminary design and final design reports, detailing the exact design, and including test plans and results. These three reports require significant team cooperation to produce – defining tasks, assigning work, meeting deadlines, agreeing on technical aspects, integrating ideas, and managing the writing project. The quality of the reports typically improves as the quarters progress, with the teams meshing better and polishing their writing skills. It is important that each team report have a formal "editor" – the person who not only proofreads the report, but ensures that the tone and style of the writing is consistent. When this is not employed, the authors have often observed an abrupt "jump" in tone from one chapter to the next.

Formal presentations are required at the end of the fall and winter quarters. For these, the team must cooperate extensively, as the grading rubric insists on it. The team is allowed 20 minutes in fall and 50 minutes in winter for their presentation. They must allow time for questions and answers, and each team member is only allowed to speak once (no jumping back and forth between speakers is allowed). Thus, they must divide the material equitably, the negotiations for which provide a valuable team experience. The written aspect of the presentation generally takes the form of a PowerPoint presentation, with handouts.

Other demonstrations of successful team functioning span other criteria and are discussed in the following sections.

Criterion 3g – an ability to communicate effectively

What does it mean to be an effective communicator? Is it simply the ability to carefully choose one's words, to know the language of a professional community? The ability to analyze an audience and to assess their information needs? All these, and more, are important components of effective communication. "Effectiveness is concerned with successfully communicating information, ideas, and meaning to others. It also includes persuasion."[7] While both these observations come from scholars of interpersonal communication, we can certainly extend the definitions to the world of written communication. Both oral and written communications are, after all, forms of verbal communication.

> "As opposed to the transience of spoken language, writing has a lasting, permanent quality about it. Written language is less redundant, more planned. Meaning and shades of meaning are conveyed by carefully chosen and placed words. Meaning can be modified by deleting, editing, and otherwise changing the written words…In written language, the presence of the receiver is not required, and the constraints of time and space are removed. Given these factors, writing can be more analytical than oral communication."[8]

The writing assignments for senior design provide opportunities for students to practice and develop their written communication skills as well as critical thinking skills.

The reports and formal presentations presented in section "Criterion 3g" comprise several major communications experiences. Beyond that are a variety of non-classical assignments, all intended to parallel those from business and industry.

A significant one is the individual engineering notebook. Growth as an individual is evident through the notebooks because they include that person's research, experimental results, and other accomplishments. This work is self-driven and ranges beyond the student's coursework, thus providing an exposure to the value of life-long learning experiences.

Each student is required to write memoranda in the proper format, ranging from a "management methods and style" treatise by the team leader, to individual bibliography lists by each student. Other memos include documentation of the choice of team leader, a "press release"-style project description, and the results of applying several ideation methods to solve the problem.

Either weekly or bi-weekly the team meets with the advisor, and must submit and discuss a milestone memorandum. This requires each student to account for "past progress promised," "actual progress achieved," and "future progress promised." Any lack of progress promised must be accounted for, and the impact on the project scheduling, via a Gantt Chart, must be explained.

An important document is the list of specifications. This is created early in the design process, but plays a significant role at the end when the team must create a "compliance test" document,

showing how certain experiments verify the specifications. The final compliance test is performed in the presence of the professor, and is driven by the documentation.

Finally, in conjunction with our "trade-show"-style Senior Design Show in May of each year, a poster must be created by the team to highlight their design. This is part of a poster competition that takes place the same day. At this show, visitors from on and off campus talk to the teams about their design. Students are judged on their ability to communicate well.

Criterion 3i – a recognition of the need for, and an ability to engage in life-long learning

In their paper, Assessing Readiness for Self-Directed Learning, Litzinger, et al.[9] reference Flammer[10]. Flammer identified two components of life-long learning: motivation and ability. Motivation was divided into "won't do" and "will do" practices. Ability practices were labeled as "can do" and "can't do." A successful life-long learner then is one who "will do" and one who "can do." Litzinger, et al. also cite Candy[11] whose paper on self-directed learning summarized the characteristics of the self-directed learner into two areas: personal attributes and skills.

> *"Will do" Attributes*: curious/motivated, methodical/disciplined, logical/analytical, reflective/self-aware, flexible, interdependent/interpersonally competent, persistent/responsible, venturesome/creative, confident, independent/self-sufficient.
>
> *"Can do" Skills:* have highly developed information seeking and retrieval skills, have knowledge about and skill at the learning process, develop and use criteria for evaluating (critical thinking).

The students' "will do" and "can do" attributes and skills become evident in their interaction with teammates and their advisor, as well as in their engineering notebook. The engineering notebook relates to lifelong and self-directed learning. This medium documents the student's work beyond any formal classes.

Specific items documented:

- **Research.** They must research the problem, determining whether it is worth solving. Additionally, they must determine who their customer is, and what the customer's requirements are. Interviews, surveys, and first-hand observation are valued here. The research must discover the state-of-the-art of the technology, and what impact that has on possible solutions and their feasibility. Competing solutions and products must be discovered and documented. Finally, a simple patent search must be conducted, not only to determine interference possibilities, but also to give clues to possible solution approaches. This research activity clearly fits the "can do" skill of *information seeking and retrieval skills.*

- **Individual Work.** The students must document all original work in the notebook. This will show study and learning beyond that of a formal course. Their resources may include textbooks, but more typically include Internet, library and personal interview

resources. The team must develop both customer and design specifications and document them fully. Test plans must be written and carried out, especially with regards to the year-end Compliance Test, which compares their solution to their specifications. Again, one can place this individual work under the label "will do" attributes of *logical/analytical* and *independent/self-sufficient.* This individual work also corresponds to the "can do" skills of *develop and use criteria for evaluating thinking (critical thinking).*

- **Progress/Achievement.** Less technical, but nevertheless required for completeness, is the documentation of a natural progression of learning, successes and failures. Required in the notebook is a summary of individual learning over the quarter, with references to specific pages in the notebook that demonstrate the learning and related successes. At the end of the notebook is a tally sheet showing the topic worked on every day, the hours invested, and total hours accumulated on the project. As students reflect on the work accomplished during the project, they are exhibiting a number of characteristics identified in Guglielmino's Self-directed Learning Readiness Scale (SDLRS)[12]:
  - Self-concept as an effective learner,
  - Initiative and independence in learning,
  - Informed acceptance of responsibility for one's learning,
  - The ability to use basic study skills and problem-solving skills.

Assessment Process Changes

As the understanding of the ABET criteria has become more well defined, our EE program, perhaps as many other programs, has shifted in how it addresses meeting of the criteria. Specifically, the earlier responses were in the context of addressing course outcomes. The inherent assumption was that if course outcomes that mapped onto program outcomes were met then the program outcome was automatically met. While there is a significant amount of logic to that argument, there is also a considerable danger that a myopic view of the assessment process develops, and that a narrow focus on course level activities results in missing the bigger picture of what the characteristics are of the graduates. Are they as well prepared for the intended career paths, defined by the program objectives, as the program's faculty believe they are prepared? The ABET assessment process is a top-down process whose central concern is the career paths of the graduates of the program. Everything, such as both the program outcomes and the curriculum details are for the purpose of supporting the career paths as defined by the program objectives.

A shift occurred in the process of how we address meeting the program outcomes. The shift was to focus directly on meeting a rubric of achievement defined in terms of the program outcomes. The shift was away from indirectly assessing meeting program outcomes via a narrow analysis of course outcomes. Hence, the formal assessment process focuses on program outcomes and an informal assessment process runs in the background for the routine improvements and changes associated with the curriculum.

An interesting side benefit is that this shift in the process has the promise of being a less laborious, a more sparse process than the old indirect process. With the old process there was a

tendency to take more data with a just-in-case mentality in order to assure that the mapping of the course assessment adequately proved meeting the program outcomes. An additional benefit, but more data is needed to demonstrate it, is potentially greater uniformity in judging student performance since all instructors are using the same rubric. Any discussion of significant performance differences between classes allows a common focus on how the rubrics are applied and results in a "norming" of the data.

Assessment Data

Tables 1-3 show assessment data taken to directly measure compliance in meeting specific program outcomes. The student performance was judged to be in one of three categories, Adequate, Marginal, and Inadequate. This judgment was made at the end of the three-quarter set of courses that comprise our Senior Design series. The number of students that fall into the Inadequate category, expressed as a percentage, is compared to a threshold. If the threshold is crossed, corrective action is required. In the old process the grading was not done specific to the ABET criteria. Rather, grading was done and grades were assigned on an ongoing basis for report writing, presentations, etc. For senior design the focus has shifted away from individual assignments to applying professional judgment to a composite of activities. One key factor that advocates for the process change is that specific grades can and often do involve other factors, such as being handed in late and formatting, where those factors may not necessarily be used for assessing the program outcome.

Tables 1-3 show data for two recent years. The data of Table 1 and 2 are for the two individual instructors teaching senior design in 2006-07, and the data of Table 3 is for the combined senior design class of the same instructors for the prior year of 2005-06.

	Program Outcomes Assessment Results: EE-407, EE-408, EE-409 Course Series				
	4 – realize and evaluate designs	6 – design and select components and processes	7 – serve on a design team	8 – understand engineering as a professional pursuit	10 – write technical reports and make technical presentations
A	**12**	**13**	**10**	**10**	**14**
M	**1**	**2**	**5**	**5**	**2**
I	**3**	**1**	**1**	**1**	**0**
A	**75%**	**81%**	**63%**	**63%**	**88%**
M	**6%**	**13%**	**31%**	**31%**	**13%**
I	**19%**	**6%**	**6%**	**6%**	**0%**

Table 1. 2006-07 Electrical Engineering Senior Design – S. Williams Student Group

	Program Outcomes Assessment Results: EE-407, EE-408, EE-409 Course Series				
	4 – realize and evaluate designs	6 – design and select components and processes	7 – serve on a design team	8 – understand engineering as a professional pursuit	10 – write technical reports and make technical presentations
A	**12**	**15**	**16**	**14**	**15**
M	**7**	**2**	**0**	**3**	**3**
I	**0**	**2**	**3**	**2**	**1**
A	**63%**	**79%**	**84%**	**74%**	**79%**
M	**37%**	**11%**	**0%**	**16%**	**16%**
I	**0%**	**11%**	**16%**	**11%**	**5%**

Table 2. 2006-07 Electrical Engineering Senior Design – S. Reyer Student Group

	Program Outcomes Assessment Results: EE-407, EE-408, EE-409 Course Series				
	4 – realize and evaluate designs	6 – design and select components and processes	7 – serve on a design team	8 – understand engineering as a professional pursuit	10 – write technical reports and make technical presentations
A	**23**	**29**	**19**	**20**	**32**
M	**10**	**7**	**15**	**15**	**4**
I	**3**	**0**	**2**	**1**	**0**
A	**64%**	**81%**	**53%**	**56%**	**89%**
M	**28%**	**19%**	**42%**	**42%**	**11%**
I	**8%**	**0%**	**6%**	**3%**	**0%**

Table 3. 2005-06 Electrical Engineering Senior Design – Combined Student Groups

The assessment data of Tables 1-3 also allows for discerning some of the nuances typical of student performance in a class. Example instructor comments were:

- "Most students do a good job. However, others are either lacking talent or are not engaged in the process. The less-talented ones are sometimes placed by their teams in a less-challenging area of design. Or, they sometimes are simply not the best designers."
- "Certain students see that they can be less-engaged, and still earn a mediocre (but acceptable to them) grade based on their own poor individual performance coupled with their higher team portion of the grade. This is the nature of the grading policy which mirrors an industry team situation."
- "In the future we can strive to have design tasks better associated with individual student talents, and to engage the less-involved students – having them give targeted reports during team meetings with the professor, as an example."

While most students perform in the Adequate category, the percentage of Marginal and Inadequate performers is a concern. Assessment shows that the levels across section and instructor are not significantly different moving from the 2005-06 year to the 2006-07 year. During the second assessment period, certain adjustments were made in how team meetings were run, and the way in which individual students were expected to perform during the team meeting. The percentage of students performing Adequately in category 7, serve on a design team, increased from 53% to 74% across both sections from the first to the second assessment period. However, the changes have not significantly altered writing and other communication performance. Future years afford the opportunity to experiment with different methods being used to engage individual students in varied communications tasks.

Summary

In the 9-month-long Electrical Engineering Capstone Senior Design course sequence, students have many new experiences. The dynamics of working in a team, closely with three other teammates, mimics the business and industry world. While the Senior Design professors inherently know the value of the associated assignments, the variation in the tasks serves to both meet ABET criteria and to keep the students engaged. The variety keeps things fresh, while meeting our own program requirements. The students move beyond thinking and writing as separate activities to a new mode where "writing is thinking."

Bibliography

1. Beer, D.F., editor, "Writing and Speaking in the Technology Professions: A Practical Guide," Wiley-IEEE Press, 2003.
2. Trevelyan, J, "Technical Coordination in Engineering Practice," *Journal of Engineering Education*, vol. 96, no. 3, July 2007, pp. 191-204.
3. Daniels, D.P., et al., "Challenges in Learning Communication Skills in Chemical Engineering," *Communication Education*, vol.52, no.1, January, 2003.
4. Elbow, P., "Writing Without Teachers," Oxford University Press, 1973, p. 8.
5. Elbow, P., "Writing With Power," Oxford University Press, 1981, pp. 8-9.
6. Nelson, S., "Engineering and Technology Student Perceptions of Collaborative Writing Practices," *IEEE Transactions on Professional Communication,* vol. 46, no. 4 December, 2003.
7. Griffin, E., "A First Look at Communication Theory," 6th ed., McGraw Hill, 2006
8. Ferris, S., "The Effects of Computers on Traditional Writing," The *Journal of Electronic Publishing*, vol. 8, issue 1, University of Michigan Press.
9. Litzinger, T, et al., "Assessing Readiness for Self-Directed Learning," *Proc. 2003 ASEE Annual Conference and Exposition*, June 2003.
10. Flammer, G.H., "Undergraduate Foundations for Lifelong Learning," *Proc. 1978 ASEE Annual Conference, University of British Columbia, 1978.*
11. Candy, P., "Self-Direction for Lifelong Learning: A Comprehensive Guide to Theory and Practice," Jossey Bass, 1991.
12. Guglielmino, L., "Development of Self-Directed Learning Readiness Scale," University of Georgia, 1977.

Additional Resources

Farr, J., et al., "Using A Systematic Engineering Design Process to Conduct Undergraduate Engineering Management Capstone Projects," *Journal of Engineering Education*, vol. 90, no. 2, 2001.

Doty, R., and Williams, S., "A Practice-Based Senior Design Experience," *Proc. 2002 ASEE Annual Conf. and Exposition*, June, 2002.

Wikoff, K., Friauf, J., Tran, H., Reyer, S., Petersen, O., "Evaluating the Communication Component of an Engineering Curriculum: A Case Study," *Proc. 2004 ASEE Annual Conf. and Exposition*, Salt Lake City, UT, June, 2004.

Williams, S., Reyer, S., Petersen, O., "Senior Design as a Transition from Academia to Industry," *Proc. 2005 ASEE Annual Conf. and Exposition*, Portland, OR, June, 2005.

Wolfe, J., "The Role of Writing in Effective Team Projects: Students and Professionals Differ," Proc. *Frontiers in Education Annual Conference, 2005.*

Krause, S., "How Will This Improve Student Writing?: Reflections on an Exploratory Study of Online and Off-Line Texts," *Computer-Mediated Communication Magazine*, vol. 2, no 5, May 1, 1995, pp. 10 – 18.

Bazerman, C., "A Response to Anthony Fleury's 'Liberal Education and Communication Against the Disciplines': A View from the World of Writing," *Communication Education*, vol. 54, no. 1, January 2005, pp. 86-91.