

Integrating Writing into the Engineering Curriculum Or How to Build a Dog House

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Abstract

This paper compares a seven step engineering design process to the process of writing a paper, providing a reasonable approach for an engineering student to write a good paper. This process can be applied to all types of written documents that engineers are required to write.

Introduction

Engineering graduates of all disciplines should be technically competent in their discipline and be good communicators of their creative ideas to solve societal needs, to invent new processing techniques, to reduce wasteful use of resources, to express their ethical concerns about products, and to inform the public on issues of mutual concern.

From the National Academy of Engineering's "The Engineer of 2020", the attributes of the 21st century engineer include the following:

As always, good engineering will require good communication.... We envision a world where communication is enabled by an ability to listen effectively as well as to communicate through oral, visual, and written mechanisms. Modern advances in technology will necessitate the effective use of virtual communication tools. The increasingly imperative for accountability will necessitate an ability to communicate convincingly and to shape the opinions and attitudes of other engineers and the public.¹

Under ABET's Accreditation Criteria for Engineering Programs², Criterion 3 Program Outcomes states in letter (g) "an ability to communicate effectively".

These two statements from national organizations indicate the importance of teaching effective communication in engineering programs. Writing and publishing effective papers, reports, surveys, and proposals are just one of the many outcomes of engineering programs in this country. How can engineering educators help in this area of education so vital in today's society? This paper shares one way to do this.

Messiah College's Approach

At Messiah College the Bachelor of Science in Engineering (BSE) degree requires 131-132 semester hours to graduate. Of those hours 41-42 credits are in General Education to include History, Literature, Language, Philosophy, Religion, Ethics/World Views/Pluralism, Physical Fitness, Oral Communications and several other courses to be discussed. In the General

Education Program all students are required to take a writing course in the first semester called First Year Seminar (FYS) as well as two other writing courses, one in the student's major and one in another General Education course of the student's choosing. Several faculty in the Department of Engineering offer FYS courses such as "The Impact of Invention on Society" and "C.S. Lewis: The Shadowlands and Space Trilogy" and several other faculty offer Science, Technology and World (STW) writing courses in "Exploring Electrical Technology" and "Appropriate Technology". The FYS courses are limited to 18 students while the STW writing courses are limited to 25. The Engineering major's writing requirement is covered in two seminar courses instead of one. Engineering Seminar I discusses various articles and readings from two books culminating in the student's essay, "What is Good Engineering?". Writing principles are reviewed and interventions in various phases of their essay are performed. In Engineering Seminar II, practical aspects such as job searching, resume writing, graduate schools, and financial planning are discussed with the course reviewing writing principles and doing interventions again, culminating in a second paper on the student's vocational vision.

Writing is a Process!

To help teach writing in the Engineering seminars, the process of writing papers is compared to the engineering design process which the engineering majors were introduced to in the Introduction of Engineering course in their first year at Messiah College. This review of the engineering design process with the writing process seems to help many students in writing the major essays in the seminar courses.

The table below compares the basic steps of designing, building, and testing an engineering project with developing and writing a paper for a grade in a course but this approach to writing documents is useful for any form of writing by an engineer.

7 Basic Steps in the Engineering Design Process	7 Basic Steps in Writing a Paper
1] Idea – "Let's build a Dog House"	1] Assignments, creative thoughts, free writes
2] Design – get plans, specifications	2] Basic Format - Intro (Thesis), Body (3points), Conclusion
3] Materials – wood, nails, paint	3] Words! Use of Dictionary & Thesaurus are helpful
4] Tools – saw, hammer, ruler, paint brush	4] Mind, Library, research, word processor, writer's reference
5] Build – according to plan, sometimes Iterative	5] Drafts- usually iterative
6] Test – does dog want to live in it?	6] Peer evaluations, Writing Center, other interventions
7] Communicate – Put name on it! "Fido"	7] Turn into professor, send to publisher, receive money from client

A few comments expand each of the steps mentioned above;

Under step 1), one should ask questions like, What kind of dog house? For a small or large dog? Square or round? For areas with lots of snow or rain? Clarity on what is expected is essential to initiating a good design. Paper ideas usually come from the instructor of a course, following specific topics or suggestions in the assignment.

Under step 2), designs can come from pre-existing schematics, design as you go, or specifications. Design of the paper format may include the standard way of writing a paper (developing a thesis, supporting the thesis in the body, and having a strong conclusion), or a more creative way of interviewing and documenting an expert on the assigned topic, writing a poem, or another format. In industry, clients may require specified formats for reports, proposals, specifications, and manuals.

Under step 3), materials could be wood, bricks, ice (igloos!), cloth for the walls; nails, screws, pegs to hold materials together. In writing, words are the key building blocks. Putting them together in specific creative ways can make an interesting paper. Dictionaries and thesauruses are helpful sources of words. Reading literature, periodicals, books, and poems can give useful examples of how to choose and compose words into interesting and meaningful ways of expressing student's ideas.

Under step 4), tools like saws, hammers, rulers, and paint brushes are necessary to complete the dog house. Likewise, the use of your mind, the college library, researching the internet, use of writers' references, and the word processor are key tools for writing great papers. The use of the periodical index "Engineering Village" to find reference articles has been stressed in Messiah's engineering program.

Under step 5), building the dog house according to the plan or schematic is essential. Often iterations are necessary to complete the design or make it better; for example, making the opening of the dog house bigger or putting shingles on the roof to improve weathering. In writing papers, authors seldom go through one draft of a paper before turning it in. Several iterations are necessary to get the right words to say what you want to say in a powerful and interesting way. Word processing software is a great tool to shift words, paragraphs, check spelling, and changing fonts. For the "old timers" reading this paper, do you remember the days of typewriters and onion skin paper?

Under step 6), as the builder completes the dog house, he/she would desire to see if the dog would like to live in it. If not, one would try to improve the dog house to allow the dog to live comfortably in it (e.g., vent the roof so during hot days air circulates). Before one turns a paper into the course's instructor, there could be several interventions made to improve the paper. In-class peer reviews or dorm mates' reviews from basic grammatical checks to preventing misunderstandings and improving clarity can be done and improvements made before turning a paper in. Many schools offer on-campus writing centers where other students (usually good paper writers) review papers for clarity, coherence, and effectiveness and give feedback to the inquiring student.

In the final step 7,) one would communicate that the dog house is completed and the dog likes it by the builder putting the dog's name on it. In the writing process, the student is turning the paper into a course instructor for grade, or sending it out for publication, receiving money for it (free-lance writer), fulfilling a job requirement as in a newspaper reporter, or a consultant turning in a client's report. This step of effectively communicating the end product is an essential part of the engineering design process as well as in writing a paper.

After going through an explanation of this comparison of processes using visual aids such as schematics, hammers, wood, and nails and actually building a scaled-down dog house, this final statement is made: **If you don't like the end results (grades!), CHANGE YOUR PROCESS!** If something in this writing process is not working correctly (i.e., poor choice of words, lack of coherence, getting a poor grade) for the student, the student now has a process to go back through and put in appropriate changes to affect the outcome (i.e., grade). Some students learn quickly to change their process to improve their writing skills, some learn the 'hard' way!

Conclusion

This approach to writing has been used in both engineering and non-engineering classes with good success. Students have responded positively in using the steps in the process, especially in developing a good thesis statement to follow in writing the paper and in the draft stage of a paper by requesting more peer/instructor interventions earlier in the writing process.

Effective written communication is a necessity in today's complex and constantly changing society. Engineers are not excluded from writing good reports, specifications, assembly manuals, and evaluations. As educators in the engineering curriculum, we must help our students recognize the need to become good communicators and show them how! Comparing the engineering design process to the writing process is one approach which has been found to be useful in developing writing skills of students in engineering programs.

Bibliography

[1] The Engineer of 2020, National Academy of Engineering, The National Academies Press, Washington, DC, 2004, page 55.

[2] Engineering Accreditation Commission, Accreditation Board for Engineering and Technology (ABET), Criteria for Accrediting Engineering Programs, Effective for Evaluations During the 2010-11 Accreditation Cycle, Baltimore, MD, 2009, page 3.