Teaching Engineering Communication to First Year Engineering Students

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Abstract

At the University of British Columbia Okanagan School of Engineering (SOE), first year engineering students take a 3-credit course in Engineering Communication. Designed to replace the traditional 3-credits of English taken by other first year students, APSC 176 introduces students to the fundamentals of engineering communication, with a strong emphasis on written communication.

The paper is describes the types of assignments given to first year students, the techniques used to encourage meaningful revision of written assignments, and the methods used to evaluate written assignments.

Particular attention will be paid to a two-week first term design project (such as the assignment, supplemental materials including exercises, and marking guidelines). It should be noted that the design is entirely conceptual - students are not required to develop a prototype, but rather to work with a team to develop (and subsequently, explain and market) a concept in response to an RFP.

1. Introduction

When the University of British Columbia began the newest engineering school in Canada, they decided to offer a full program of engineering courses to first year engineering students in place of service courses traditionally taught by departments of Mathematics, Physics and Chemistry. The School of Engineering offers the following courses to its first year engineering students: Engineering Fundamentals (engineering metaskills), Introduction to Electrical and Computer Engineering (electricity and programming), Engineering Analysis I and II (differential and integral calculus), Engineering Mechanics (statics, dynamics, and algebra), Matter and Energy (physical chemistry and thermodynamics), and Engineering Communication. The School of Engineering will offer three specializations: civil, electrical, and mechanical engineering.

Most students at the University of British Columbia Okanagan take six credits of English. Most take an excellent introductory course, "Strategies for University Writing" (English 112) followed by 3 additional credits in English. ENGL 112 is described in the UBC Okanagan Calendar as the "Study and application of the principles of university-level discourse, with emphasis on expository and persuasive writing. Essays and exercises are required" [1].

When the School of Engineering developed its first slate of courses for September 2005, the Senate approved a 3-credit Engineering One course in engineering communication. Despite the difference in name, students persist in referring to the course as "English." They are right in a sense, in that Engineering Communication, or APSC 176, was designed to replace English 112, which is required of all engineering students at UBC Vancouver. Engineering One students are wrong, however, in supposing an equivalency in content, as the course was not designed to replicate English 112.

In fact, at the beginning of every session, at least one student asks, on behalf of his or her peers, "Are we going to have to read Shakespeare?" Of course, students in English 112 do not study Shakespeare either. However, the question reveals the priorities and concerns of the typical engineering student - concerns with utility and professionalism.

APSC 176 recognizes engineering students' priorities and concerns, identified by Richard Felder et al as the desire for "deductive presentation - (Just tell me exactly what I need to know for the test, not one word more or less)" [2]. It is important to recognize and respect the desire for deductive instruction for what it is - not laziness or a lack of intellectual curiosity, but rather a bent for practical applications and a suspicion of what students see as vague or poorly designed classroom - or workplace - assignments. This concern with the immediate and applicable can be used to engage students in meaningful communication activities that prepare them for university studies and professional practice.

Felder et al, in “The Future of Engineering Education,” published in the journal Chemical Engineering
Education (2000), notes that while engineering students tend to yearn for deductive instruction, inductive instruction, combined with clearly articulated and relevant instructional objectives, yields better outcomes. Felder et al list seven recommendations for engineering education, and although the recommendations are made with technical engineering subjects in mind, all the recommendations are equally applicable to practice in APSC 176.

The following list is based on a summary of Felder's recommendations. Delivery of APSC 176 includes (1) frequent and overt statements regarding the importance of communication in engineering studies and practice. Learning objectives are (1) articulated clearly to students, and connected to larger issues and themes in engineering education and practice. (In addition, where possible, assignments are related to the ethical principals that underpin many engineering decisions, whether in the realm of communication, design, or professionalism.) Concrete information (3) is balanced by in-class applications (which incorporate both (4.5) active and cooperative learning); testing (6) is rigorous and heavily weighted. Instructors convey their concern (2) about students' learning through the carefully monitored revision process. Finally, collaboration between other Engineering One faculty members contributes to our students' sense of the importance of mastering good communication skills [2]. Of particular importance have been attempts to link APSC 176 with in our 6-credit introduction to the profession of engineering, APSC 170.

APSC 176 does not merely offer Engineering One students English 112 with readings on topics deemed to be of interest to engineering students. Rather, APSC 176 seeks to accomplish two purposes: to prepare the student for university writing and to introduce the student to the rich and challenging world of engineering communication. The UBC O Calendar description reads “Written and oral presentations, formal and informal. Purpose, audience, content, format, and tone are studied, as are team-based report writings and presentations” [3].

2. APSC 176: logistics and challenges

The original course outline for APSC 201 was prepared by Erin Robb, presently a sessional lecturer in the Centre for Professional Development at UBC Vancouver Faculty of Applied Science. When it was first delivered at UBC Okanagan School of Engineering, APSC 176 enrolled only 60 students, split into three sections of 20 students. In the second year of the program, APSC 176 sections were kept at approximately 20 students. In September 2007, with 140 students projected, a second full time instructor has been hired. Sections will continue to be capped at 20 students, with the two full time instructors responsible for delivering all sections. A steady state of 180 first year students is anticipated, at which time the two instructors will each teach four sections of approximately 22-23 students.

APSC 176 is taught in the fall, with a second year communication course, APSC 201 (Technical Writing), being taught in the spring.

All sections of APSC 176 have a common syllabi, assignments, and expectations. The goal is that all students have, as much as possible, a similar classroom experience. To that end, assignments and materials have been developed, and will continue to be developed, for the use of both instructors.

2.1 Challenges

One of the challenges has been inclusion of weak writers, both ESL students and others. UBC Okanagan does not require language screening for entering students who have studied for four years in Canadian high schools [3]. In 2006, of the 100 students enrolled in APSC 176, over 10% experienced varying levels of difficulty communicating in English. Additional students, for whom English was a first language, also had difficulty with university level written English. Sixteen students ended the term with an average of 60% or under, with three of these students failing. In addition, four failing students withdrew. These numbers suggest that 20% of the full cohort of students have difficulty with English communication. Given the importance of effective written communication to student success in the university and the workplace, these outcomes are not satisfactory.

A second challenge has been finding a balance between the need to teach students to write and work in a team environment with the students’ need to do their own writing. While it is important that students learn how to write as part of a team, in order to ensure that they develop their own writing ability, and in order to provide a fair assessment of their ability, students must also have ample opportunities to write independently.

A third challenge has been devising assignments that reflect the communication needs of engineering students. A related concern has been to encourage and facilitate meaningful revision balanced with the need to assess students’ ability to write clear, concise, well-organized documents independently under time constraints.
2.2 Responding to These Challenges

To respond to these challenges, APSC 176 seeks to incorporate early identification of and intervention with weak writers, and to facilitate teamwork while requiring individual writing. To respond to the third challenge, students write papers that require extensive, guided revision. Finally, APSC 176 requires students to write an in-class diagnostic (no marks); an in-class argument response paper (10%); an in-class persuasive design proposal (10%); and a final exam (40%). No revision is permitted. Students must pass the final in order to pass the course.

Specific assignments have been developed in response to these challenges.

3. APSC 176 assignments

Low stakes and high stakes assignments are written both in and out of class, with and without revision. Over the course of the term, students complete approximately 27 pages written outside class, as well as two written examinations and two in-class documents. In addition, students frequently submit brief documents written in class. These brief documents are often but not always submitted electronically for prompt feedback (using the Word comment feature) and email.

3.1 The diagnostic

The first assignment in APSC 176 is an in-class "diagnostic." Students are given a reading, and asked to write a short two-paragraph response to a question. They are required to show their understanding of the source in their response but also to develop their own argument. The reading is taken from a source such as Technology Review. An example is the editorial "The Alternative" (July/August 2006) [4]. The question asked is "Does technology harm or help society?"

Students are required to respond to (and not merely to summarize) a reading in order to encourage them to develop and express their own ideas. It is hoped that they will not be able to rely on stock phrases and simple sentences that may have enabled them to navigate other writing situations. Furthermore, while some of the weaker students can express themselves fairly well at a rudimentary level, they may not be able to read at a university level or speed. The diagnostic is intended to find our weakest students.

Instructors are given a simple rubric to use in marking the students' responses. The areas looked at are organization, content, and grammar and spelling. Instructors are urged to mark the diagnostics quickly (they must be returned in the class after they were written), and to fail rather than pass marginal writers. After making comments and noting specific areas in which the student is weak, the instructor makes recommendations regarding actions the student may take.

Students who fail the diagnostic are required to make an appointment with their instructor and, beginning in September 2007, to attend a post mortem at our Learning Centre. They are recommended to attend a series of Communication Labs run in conjunction with the School of Engineering, and through our Learning Centre. The Learning Centre offers peer tutoring and instructional support to undergraduate and graduate students in all disciplines. The School of Engineering has collaborated closely with the Learning Centre to devise programs specifically for SOE students.

3.2 The post-mortem

The post-mortem is a required, one-time event for all students who fail the diagnostic. It is administered by the Learning Centre. The post-mortem is intended to provide a safe environment in which students can begin to reflect on their learning.

Communication instructors give the director of the Learning Centre examples of typical errors found throughout the diagnostics. She then presents these errors to the students, and leads a discussion on common errors and the writing process. Students then work on their own diagnostic with the assistance of peer tutors. They are required to resubmit their diagnostic – and to continue to revise it until it receives a pass.

3.3 The ELogs and the communication labs

The second assignment is a series of ten, one- to two-page "ELogs," or Engineering Logs. Students submit an ELog on an assigned topic, such as readings from Henry Petroski's book, To Engineer Is Human. At times students are required to attend a presentation by a guest speaker and write a response to the speaker's talk, or to conduct additional research and respond to a topic raised in another engineering class.

Each Elog requires the student to use a source, summary, and critical thinking. The ELogs are submitted in a two-pocket portfolio, with the new ELog on the right and previously graded ELogs on the left. Also in the portfolio is an ELog comment sheet, which enables students and instructors to track the student's progress. The ELogs are assigned letter and corresponding number grades according to a series of descriptors given to students at the beginning
of the term. In order to facilitate quick marking and return, number marks correspond to letter grades (A = 85 etc.). Students who fail an ELog can revise it until they pass, but in order to have their revision marked, they must attend a Communication Lab.

3.4 Communication labs

The Communication Labs are being developed by the School of Engineering in conjunction with the UBC Okanagan Learning Centre. Students who receive a poor mark on their ELog (or any Engineering One student who wants to improve his or her written communication skills) can attend this series of workshops. The intention is to provide targeted and timely instruction to the weakest writers, and to encourage students to reflect on their work in a supportive and non-punitive environment. Previous experience has shown that students do not respond well to offers of writing assistance, no matter how free, convenient or needed. Time constraints and fear of being perceived as a poor writer (and previously reinforced confidence that they can't fail "English" because they are so good in their technical courses) have contributed to poor attendance at previous writing workshops. Last year, almost zero Engineering One students attended voluntary workshops. (In contrast, communication workshops offered to Engineering Two students usually attracted over 80% of the class.) Consequently, a high-stakes intervention is being introduced in September 2007. To pass APSC 176, students must pass the final examination. Poor performance on the ELog will be a strong indicator of risk of failure. It is hoped that the combination of incentive and assistance will produce a high rate of return to the Communication Labs.

In future years, it is intended that international graduate students will also attend the labs, providing a further incentive and positive role models to undergraduate students.

Each week, in addition to a brief instructional module on a particular topic (such as the comma, or the fragment, or the thesis) students will work with peer tutors as they work on their next ELog. It is important that students recognize that attendance at the Communication Lab does not add to their workload. On the contrary, attendance at the Communication Lab offers students an efficient and timely method of finishing class prep.

3.4 Rhetorical analysis

The first major paper students written by students in Engineering Communication is the rhetorical analysis. This paper is similar to papers assigned in a traditional English course, although the emphasis is somewhat different.

Most writing in an English course is done for the usual academic audience: the instructor. Students in Engineering Communication learn to adapt their writing for multiple audiences. They learn to revise their writing for specific audiences, such as audiences with different levels of technical knowledge and varying degrees of interest in technical information. It is essential that engineering students be able to express complex technical material clearly to audiences with different levels of technical training.

Students are asked to write a five-page paper in which they compare two articles written on the same subject but for different audiences. To introduce them to the assignment, students are shown a journal article on the effects of a head injury on smoking cessation, and a newspaper article based on the journal article. These are both short articles, but they illustrate clear differences in structure, tone, diction, syntax, and use of figurative language and graphics. Students also read and discuss a series of articles on the Venice MOSE gate project. One article is from the academic journal Civil Engineering [5]; another is from the Journal of Waterway, Port, Coastal, and Ocean Engineering [6]; and a third is from the popular publication, Wired.

Again, students are invited to compare the structure, tone, diction, syntax, and use of figurative language and graphics.

Next, students attend a library-sponsored class, in which they are introduced to the library and the UBC databases. This class concludes with the students locating the articles they will use for their rhetorical analysis.

Students are given worksheets to guide them as they read and analyze the articles they locate. Because sections cap at 20 students, it is efficient to have writing occur during class time, with the instructors moving amongst students assisting and challenging them. Because SOE students all have laptops, and because UBC Okanagan classrooms are wireless enabled, it is plausible to have students email their writings done in class to their instructors. It is efficient and effective for instructors to add comments (using the Word comment feature) to student documents, and return them to the students on the same day.

Summary and paraphrase are introduced in this unit, as is the correct use of quotation. Intentional plagiarism has not been an issue with this paper, which makes it particularly useful for instruction in avoiding unintentional plagiarism (poorly managed paraphrase). The prompt feedback enabled by the electronic
communication features noted above is particularly effective for this exercise. Instructors can identify students who are struggling with the concept of paraphrase and offer prompt assistance in a low-stakes environment.

3.5 Revision and marking overview

Most documents in APSC 176 are submitted and marked in a series of steps. After reading the first draft, instructors respond to the report’s higher order needs in a letter format. Engineering One students have proven to be particularly diligent at implementing instructors' suggestions. A peer review is conducted on the second draft. The final draft is marked according to a rubric (to simplify and speed the process for the instructors, and to encourage consistency in marking standards). These revision techniques, while labour intensive, have resulted in consistent improvement in student writing. Embedded voice commentary will be added in September of 2007, using WebCT. Embedded voice commentary is usefully discussed in Brian Still’s article, “Talking to Students: Embedded Voice Commenting as a Tool for Critiquing Student Writing” [7]. Using WebCT will eliminate many of the technical difficulties Still describes. It is hoped that embedded voice commentary will be helpful to students and instructors alike.

3.6 All writing is public

Students in APSC 176 are clearly and repeatedly told, "All writing is public." Just as in any design class, students are not permitted to hide their design from their peers, but must be prepared to share their travails and triumphs as they master the craft, in this case, of writing. Students know that their writing may be used to assist student learning and that all student documents (or parts of documents) are treated with utmost respect. Sample documents are usually used anonymously and taken from a different class section from that in which discussion occurs. Interspersed with student samples are instructor samples, and many samples are compilations. Students are aware that their instructor may have written the sample document under discussion. A minor practical note is that student documents are printed on coloured paper to facilitate collection at the end of a class period.

3.7 First draft

After the students write their first draft, they are asked to number the paragraphs. They submit it to their instructor, who returns it with detailed comments, typed in the form of a note. These comments are explicit, and focus on high order concerns such as coverage and organization. For example, an instructor might write, "Robin, you have chosen two interesting articles, and they contrast well. I notice that in paragraph three you begin your discussion of diction, but at the same time you begin to discuss syntax. Your reader will be able to follow you better if you separate these topics into two paragraphs."

Instructors are urged to highlight sentences that contain typical grammar errors (such as comma splices), but only one example. Students are expected to locate and correct sentence errors only on their final draft. They are urged to continue to work on grammar errors with a peer tutor, in a communication lab, or with their instructor.

3.7 Second draft and peer review

Students use the instructor’s comments to guide their revision of their first draft. Their second draft is submitted for peer editing. Having the report due shortly after the peer review helps motivate students in the revision process. In the peer editing stage of the writing process, students use a worksheet and prepare written comments for their peer. The worksheet parallels the marking criteria. Students must write (and not verbally discuss) their comments because the peer review is seen as a writing exercise. Students are instructed to evaluate their peer reviewer's comments carefully. The peer reviewer is not an instructor, and could be wrong in his or her comments. Most of the areas the peer reviewer comments on are within a student's range of expertise. The peer reviewer is well able to tell the writer whether or not the writer has named the journal, for example, or whether or not the reader finds any sentences difficult to understand. Students are strongly advised that any changes they make as the result of the peer edit are entirely their own responsibility. They are told, "If you change it, you own it." There have been no problems with students blaming problems on the peer reviewer. The real value of the peer review is for the student to return to his or her own report with fresh eyes after a carefully directed review of a peer's work.

3.8 Final grading

The final grading is done by the instructors, using a rubric (based on criteria similar to those used in the peer review) and a set of descriptors. By this point in the writing process, the instructor's comments are
intended primarily to make sure the student understands the strengths and weaknesses of the report, and why the report has received its mark. There is no need to include detailed comments. It is too late for the student to make changes, and students seem to find it difficult to transfer instructors' comments on one paper to their work on a subsequent paper. This is particularly true in a course with multiple different types of papers.

Another audience for the marking rubric is the peer tutors at the Writing Centre. Instructors are aware of this audience when they write comments. Students take marked reports to the Centre when they are working on their next report. Instructors' comments are helpful to the peer tutors as they seek to understand the writing needs of each tutee.

3.9 Argument and persuasion: the midterm

The midterm ends a unit on structuring an argument. Students study the structure of the classical argument (introduction, thesis, proof, rebuttal, conclusion) and develop arguments using sources and the student's own ideas. Rogerian argumentation is discussed but not assigned. The midterm, like the diagnostic, consists of a reading and a response. Revision is not permitted.

3.10 Engineering failure research report

The engineering failure report was originally written as part of a 6-credit course designed to introduce students to the profession of engineering, Engineering Fundamentals (APSC 170). However, when Engineering Fundamentals was moved from a two-term to a one-term course, it was suggested that the engineering failure report be broken into two components. These are the research report, written in term one in APSC 176, and the failure analysis, written in term two in APSC 170. The research report is intended to instruct students in developing research and writing skills. It is also intended to give students the background information they will need when they prepare their failure analysis in APSC 170 in term two.

3.10.1 Research report

The research report unit comprises a progress report, an annotated bibliography, and a twenty-page team research report. Instructors divide students into teams of three students. Each team selects an engineering failure from a list provided by the instructors. These include, for example, the Titanic, Challenger Space Shuttle, several bridge failures, and so forth.

Students conduct research, with each student required to locate a minimum of six to ten sources (books, articles, chapters, web sites, etc.). After an initial research period, students write an informal progress report, divided into the following sections: Background, Proposed Work Schedule, Research, Problems, and Conclusion. Teams then meet with the instructor to discuss their progress. Under Background, students explain why they chose this particular failure. Under Proposed Work Schedule, students indicate completion dates of their research; report sections (titles of sections are contained in the assignment); figures; annotated bibliography (external due date); drafts of report sections (internal deadline); first draft of full document for peer review (external deadline); final draft of full document for editing; and final submission date (external deadline).

Under Research, students detail how much research has been completed, and note what remains to be done. Under Problems, students comment on any areas of difficulty they are experiencing, whether it is with the topic, research etc. Under Conclusion, students discuss how they are working to overcome problems and obstacles and justify their confidence in their project.

3.10.2 Individual annotated bibliography

Due midway through the research report, the annotated bibliography is intended as a building block towards a literature review, and also to ensure that students are engaged in the research report. Each student provides bibliographic information, a description and evaluation of the source, and a description and evaluation of the source material. The annotated bibliography forces students to complete their research in a timely manner. Instructors are able to identify students whose research is weak, or team members who are not participating fully.

3.10.3 Headings and figures

Students use APA citation format and no more than two levels of headings. They are not required to produce a letter of transmittal or a table of contents. They are, however, required to use at least one figure from each team member, all of which may be imported. They are taught correct format for introducing, captioning, and citing figures. Classroom discussion and exercises encourage students to evaluate about the figures, and all sources, critically. The headings used in the report are Introduction,
Technical Description, The Failure, Design Analysis, and Lessons Learned.

3.10.4 Paraphrase and summary

Correct use of paraphrase and summary is reinforced and required. Extensive classroom discussion and instruction are intended to ensure that all students are able to use sources correctly and ethically. Connections are made between ethical use of sources and ethical engineering practice. Reports are submitted to turnitin.com as a further incentive to encourage correct citation and ethical use of source material.

3.10.5 Revision and marking

Teams submit regular audits of team performance. As in other assignments, draft sections are submitted for commentary, and peer review takes place. However, it is important to note that each student is responsible for his or her own section of the report (comprising five pages, six sources, and one figure). Only the first and last sections (Introduction and Lessons Learned) are written as a team. The student’s grade is based on the team’s sections and the report’s appearance, their individually written section, the annotated bibliography, and the individual progress report.

4. Persuasive design: written proposal and oral team presentation

The Persuasive Design Proposal and Team Presentation are the most unusual aspects of ASPC 176. Together, they comprise the assignment the students enjoy the most. The assignment was originally presented in the course outline, developed by Erin Robb, as an RFP. It is important that Erin Robb be given full recognition for creating the concept of the design proposal as an Engineering One communication assignment.

4.1 Background

In APSC 170, the second term 6-credit Engineering Fundamentals course, students work in teams on a term long design project intended to give them hands-on experience working on an engineering project. Students learn how to work on a team, prepare a GANNT chart, develop and implement a budget, make engineering drawings, use CAD, develop and implement a design, and prepare and make a team presentation to a panel of distinguished engineer judges. They also demonstrate their completed project to the judges. Guests at this event include local dignitaries, university deans and administrators, parents, and fellow students.

In APSC 176, Engineering Communication, and prior to APSC 170, Engineering One students work in teams to propose a design in response to a particular challenge. They are taught the rudiments of engineering description so that they can prepare a written description of their design, and they are required to make a team presentation of their design using a visual. Power point is not permitted. However, the main purpose of the module is to instruct students in the art of written persuasion.

As noted above, APSC 176 replaces English 112. It anticipates, but does not provide a prerequisite for, APSC 201 (Technical Communication). Students must have opportunities to write expository or persuasive essays, and the persuasive design proposal offers such an opportunity. It would, perhaps, be easier to give students more traditional assignments, but students rise enthusiastically to the challenge of producing a design. They are delighted to have the opportunity to argue for the excellence of something they have created. The assignment has been designed to ensure sufficient rigor.

Through this project in particular, Engineering One students discover how hard creativity is. They learn that engineers work in teams because their projects are too complex to be completed by one person. They recognized that technical documents require precise expression and the use of numbers. (Parenthetically, correct use of quantifiable information is not an instinctive aspect of first year writing. On the contrary, students need to be bullied into any form of precise expression.) As part of the module, students make an oral team presentation to their peers. Although they are required to use a visual, they are not marked on either the visual or the oral presentation. This presentation forms the backdrop for second term preparation for their oral presentation at the APSC 170 design award competition.

4.2 Marking creativity?

It is difficult to mark a student’s creativity; nor is it desirable for this assignment. Students are not assessed on the basis of how creative their design is, but rather on the accuracy of their description of the design and the excellence of the arguments they develop in its support. The ability to generate ideas and arguments, both quickly and upon reflection, are key to successful professional engineering practice, and require many of the same mental skills as any other form of creativity.
Students are marked on the basis of individual “proposals” written in class in which they describe and explain their product and develop a persuasive argument "selling" their product. The audience and occasion for the persuasive proposal are given at the time of writing, and part of a student's mark is based on how well he or she has adapted the proposal for its audience.

Prior to writing their persuasive proposals, students make a brief team oral presentation of their product (to their peers, but for an intended audience of middle aged venture capitalists). The team that, according to their peers, makes the best oral presentation receives bonus marks on their written proposal.

### 4.3 Nathaniel Wyeth and pop bottles

Students have no idea how to begin this assignment. They are placed in teams by the instructors, and given an RFP. This is followed by several preliminary assignments. The first involves a simple reading, reprinted in a 2002 issue of *Technology Review* [8], in which students encounter Nathaniel Wyeth, the DuPont engineer who filed the 1973 patent on polyethylene terephthalate, the plastic used in pop bottles. In their teams, students record answers to several questions. The first question involves rhetorical analysis (who is the intended audience and supply proof). Next, they are asked to make as detailed a record of Wyeth's process as possible from the text. They should note the dates contained in the article (Wyeth worked on the project from 1967-1973); they should note that the process began when Wyeth "wondered" why pop was always packaged in glass bottles; they should note that Wyeth did not accept the conventional answer he received; they should observe that he used practical personal experience (he poured pop into an old detergent bottle to see what happened); they should recognize his scientific and technical knowledge; and they should note that Wyeth concluded the process by applying for a patent. Students should recognize Wyeth's curiosity, independence, tenacity, knowledge, and business acumen. Engineers don't work in isolation, and their solutions to problems are intended to be shared and used by the public. The financial motive is recognized.

Next, students are asked to list reasons why creativity and invention are hard. These may include fear of ridicule; lack of technical understanding; the need to conform taught by society; etc. (Students also, later, write an ELog in response to Jason Pontin's 2006 editorial "10 Ways to Think about Innovation," in which he discusses ten common traits of successful innovators [9].)

Finally, students are invited to choose an existing product or technology and "make it smaller, make it stronger, make it do more, make it easier to use, make it cheaper, make it cleaner."

### 4.4 Design proposal using a familiar object

Students are given little class time to come up with ideas for their product, but one of the difficulties of this project is teaching the writing skills the students will need while they are still coming up with their product. Students work on an in-class exercise in which they learn how to write a technical description and prepare a written outline and a persuasive presentation using a familiar object.

Students are shown a sample description and persuasive argument using the paper clip as an example. Then, they are presented with an array of common objects: an eraser, a highlighter, a rubber band, a sticky note, and a lid from a disposable cup, for example. Each team chooses one object, and then prepares a technical description and a persuasive argument in which they attempt to persuade the audience of the excellence of their object. They must produce a formal outline, and teams give 2-minute presentations of their product.

### 4.5 Ethical, logical, persuasive?

Once teams have come up with their own product, they develop an outline for their presentation. They are not allowed to use their outline while they write their in-class proposal, although they are expected to use it for their oral presentation. The outline allows them to submit their reasoning to tests of its logical, ethical, and emotional validity. Using a worksheet, and working as a team, students develop reasons in support of their invention, and then evaluate them. Once they complete their analysis, each student must independently prepare a formal sentence outline for their presentation.

Keeping a good balance between the joys (and irritations) of teamwork and the need for each student to master material is a constant challenge. Engineering students are no less chatty than any other first year students, and firm classroom management is essential to the success of these exercises.

### 4.6 Preparing for the team presentation

Students work briefly in class, but mostly out of class, to prepare for their team presentations. They are urged to be organized, clear, quantitative, effective, and aware of their audience. Students score their peer’s oral
presentations according to a detailed rubric. Humour receives no marks. During the brief in-class presentations using a familiar object, humour is well received and enjoyed by the students. When they present their persuasive design proposal, professionalism takes over, and students have consistently risen to the challenge of showcasing their product for their imagined audience of middle aged venture capitalists.

In Engineering Fundamentals, students receive additional instruction on oral communication, (one lecture and a tutorial assignment), as they prepare for their year-end, adjudicated team design presentations to a panel of distinguished professional engineers. This lecture and tutorial are designed and presented by the communication instructors.

4.7 The individual written proposal and marking scheme

Students write an individual proposal for a specified occasion and audience. These are written in class, and marked by the instructors using a rubric (thesis, description, explanation, reasoning and persuasion, adaptation for audience and occasion, professional tone, quality of writing). As with all written assignments, quality of writing is heavily weighted, and no proposal written below UBC standards can receive a passing grade.

5. The final examination

The final three-hour examination is written during the formal examination period. It consists of a reading and response (using the structure of a formal essay); a short reading followed by paragraph questions; and short questions. The final is worth 40% of the course grade. Students must pass the final in order to pass the course. Instructors team mark the final during a marking meeting.

6. Conclusion

Through new initiatives in APSC 176, specifically the post-mortem and the Communication Labs, it is hoped that the failure rate of APSC 176 can be reduced, but as importantly, that communication skills of weaker but passing, students are also improved. Particularly, it is hoped that the unsatisfactory outcome of students passing APSC 176 with low marks will be reduced. APSC 176, Engineering Communication, continues to evolve. When it was designed so well by Erin Robb, the persuasive design proposal existed only as an RFP. In 2005, the potential connections between Engineering Communication and Engineering Fundamentals (particularly in the areas of ethics, oral communication, and design) were also not fully realized. Through delivering the course, and through working closely with the team delivering Engineering Fundamentals, an exciting and compelling pair of courses is being developed. In these courses, Engineering One students are introduced to many of the challenges they will meet and skills they will use in their professional careers. As Richard Felder et al note [2], the combination of theoretical knowledge and immediate application provides students with a rich and meaningful learning environment.

Communication is not an area where a student can scrape by thinking that he or she will never need to use this material in the workplace. Such thinking is erroneous in all aspects of engineering education, but it is particularly dangerous if applied to studies in communication. Engineering students need to recognize the truth of the statement, "You can have brilliant ideas, but if you can't get them across, your ideas won't get you anywhere." Lee Iacocca is the source of the frequently quoted statement, and it has become an aphorism. It is particularly relevant for an engineer, who must apply the ideas of science for the betterment of society. Engineers must be able not only to design solutions to the problems with which they are presented, but they must be able to communicate their solutions clearly and persuasively. APSC 176 seeks to begin the process of educating engineering students in the art of effective professional communication early in the student’s academic career.

7. References


