Aspects of Professional Engineering Practice, Ethics and Technical Writing in an Engineering Course

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Abstract

The topics of professional engineering practice, ethics, and technical writing in an undergraduate engineering course are reviewed. A method for offering an engineering course including these topics is presented. Several aspects on course delivery (type of final exam, assignment submissions, resubmissions, and grading) can have an affect on course performance and student learning which are discussed.

1 Introduction

Curriculum development and improving new ways of teaching courses to engineering students is of growing concern. Reviews on research and development in engineering curriculum and instruction inform us that there has been considerable growth in publication on the topic [1]. The past several decades have focused considerably on technology, design, and computers in engineering, most probably to the detriment of soft skills such as ethics, communication, and assessment, for example.

Studies to determine the skill sets required by graduate engineers on entering industry have raised several concerns [2-4]. From these studies, graduate engineers are known to spend a large portion of time using their communication skills (written, oral). However, do they learn these skills sufficiently before or after graduating? They are also known to receive good foundation skills in fundamental engineering, science, and computer skills, but sometimes lack enough experience in knowing how to apply these skills in practice. Moreover, these studies have influenced the engineering accreditation process in commonwealth countries. As a result, many revisions to engineering curricula are expected and underway. Consequently, the Canadian Engineering Accreditation Board (CEAB) has moved towards

defining specific skill and evidence of student learning outcomes. The ways and means of achieving these skills and student learning outcomes has been left to each institution (college, university) to decide. In this context for example, effective teaching in engineering education can be performed through problem-based or project-based learning [5]. Thus, many engineering schools are trying to find a sense of balance in these approaches.

The literature on technical communication education is extensive and mature owing to the growth and development of technical writing [6]. In many schools technical writing began as a service course to various departments and faculties. The natural progression for some was to evolve into technical communication disciplines. As a disciplinary model for higher education, technical communication offers many benefits. They can advance research interests, promote a pedagogical connection to alumni, industry, and the like. The downside is that they exist with some perceived conflict of interest associated across English-to-Education-to-Engineering faculties. They may have issues with hiring transplanted English teachers, writing centre models, application and use of other qualified individuals (students, faculty etc.). One review paper suggests that undergraduate and graduate writing courses should concentrate more on summary and paraphrase skills [7]. Another approach suggests that technical writing in engineering should emphasize term papers, laboratory write-up, small group (3-4 student) capstone design reports and oral presentations with access to a writing consultant [8]. Engineering information literacy and communication has also been addressed using integrated technology and four teaching modules. This teaching approach involves the following items: professional practice module; communication tutorial module; computing module; graphics module (drawing by hand, computer-aided software drawing); and a group project involving team work [9].

Developing new courses that combines several objectives and topics can be a challenge for any instructor. One such challenge involved the need for an undergraduate engineering course to be offered that satisfied the Canadian Engineering Accreditation Board (CEAB) requirement for including course materials on professional engineering practice and ethics combined with a faculty of engineering's interest in including some technical writing for engineering students. In spite of the fact that students entering university should have already learned the basics of reading and writing, we continue to find students that require additional work on these skills. This paper will address various ways of creating and offering a course that addresses these objectives.

2 Professional Engineering Practice and Ethics

Professional practice exams (PPE) exist in all Canadian provinces that regulate and control professional engineering. This is usually a two part exam with part A on professional engineering ethics and part B on engineering law. The recommended text for part A is well known as Canadian Professional Engineering and Geoscience Practice and Ethics by G. C. Andrews [10]. The textbook is a comprehensive structured guide and reference for engineers and geoscientists on various aspects of professional licensing, regulation, professional practice, ethics, environmental issues, exam preparation etc. The text includes many definitions, facts, issues, case studies, and questions, some with suggested answers. It can be straight forward and easy to teach using the power point slides recommended.

Reviews on professional engineering practice and the skills learned by engineering students and new graduates indicate that several key defining skills (i.e. practical application, theoretical understanding, creativity, innovation, and technical breadth) and enabling skills (i.e. communication, team-working, and business skills) play an important role [11] [12]. The required communication skills include reading, writing, listening and speaking.

3 Technical Writing

Technical writing is all about communicating technical information in a written form that is clear, understandable, and with appropriate use of the English language, grammar, punctuation etc. There are many ways of accomplishing this activity. For example, three approaches previously described include: the transplanted "English" teacher, the

communication course as a cornerstone, and creating a partnership - the synergy between engineering and communication design in i.e. capstone design courses [13]. A review of these approaches seems to conclude that there is no single, best solution, but rather a variety of ways to go about teaching technical writing. However, for the purpose of offering technical writing combined with engineering ethics, in this engineering course example, a reference textbook (Making Sense: A Student's Guide to Research and Writing, by M. Northey and J. Jewinski [14]) was chosen to help the students. Also, since many of the engineering students in this course could only reasonably afford one textbook, some paraphrased notes from several key chapters were created from the reference textbook to help the students.

4 Course Outline

A course outline or syllabus was created which included five key chapters on technical writing and communication from the reference textbook, followed by all of the chapters from the course textbook on professional practice and ethics. This material was presented over the course of thirty three lectures in one semester. The course required some technical writing assignments (resume, technical summaries, term paper). Several key case studies from the course textbook were chosen as assignments that required the submission of short technical summaries (500 words) by each of the engineering students followed by a longer term paper (1500 words) on a topic involving some engineering ethics issues. A final exam was set with two parts, the first part including short answer questions to definitions, regulations, and professional practice information, followed by some long answer essay questions requiring the students to read a case study and prepare an essay in response to several ethical questions and issues.

5 Delivering the Course

The five chapters on technical writing were presented first, followed by eighteen chapters on professional practice and ethics. Since these were large classes (i.e. 100 to 230 students) each lecture could only afford time for power point presentation and some questions. Fortunately, at Memorial University we have a very competent writing centre which can help students with difficulties in writing. The director of the writing centre also participated by giving the class some lecture time on paraphrasing along with recommending several ideas. One idea was to use resubmissions of assignments to improve the

engineering students' technical writing by rewriting and remarking assignments (with the student benefitting from the higher of two graded assignments). Another idea was to use graduate teaching assistants from the faculty of arts in the marking process of the assignments and term paper coordinated by the writing centre. Both ideas were implemented in the first year the course was offered. However, in subsequent years the resubmission of assignments was abandoned due to a lack of resources (i.e. time and people to mark so many assignments). The lack of resubmissions of assignments also increased the need for weak students to go and find help more often at the writing centre. This concept of course delivery played a major role in how a university utilizes its resources and to whom it may benefit i.e. students, teaching assistants, instructors, writing centre resources, administrators etc.

6 Results and Discussion

In general, the students are more enthusiastic writing course assignments that are relevant to learning the course material (i.e. summarizing case studies on ethical issues), benefitting themselves (i.e. improving writing skills, learning how to create a better resume [4]), and improving their grades (i.e. rewriting assignments and resubmitting them for higher grades). With this in mind, the engineering student performance in this course the first year it was offered resulted in a grade average that was considerably above average and typical for a complimentary studies course. Since this course is classified as a complimentary studies course, as opposed to the regular technical courses in engineering, these results were expected. Perhaps the enthusiasm and resources behind the first time offering of a course can account for some of this success. However, after the first year offering, the instructor changed for one year due to a sabbatical leave and a different instructor was installed. Some changes occurred in the course offering. First, the resubmission of assignments was dropped, and second the final exam format changed. The final exam changed from a written two part format exam (i.e. combination of short answer format, followed by case study long essay answer format in the first year) to a multiple choice exam in the second year. These changes resulted in about the same grade average for the first two years of course offering. It was in the third year offering of the course that the original instructor was reinstalled. For the third year offering of the course the first year format was used minus the resubmission of assignments. This led to a drop in grade average of

about 5%, in spite of the course grade average still being higher than that for regular technical courses in engineering. Reflecting on these results it appears that several variables (i.e. changing course instructors, marking policy, exam format) can affect the performance in course grade average. However, it is more difficult to measure the affect of learning (i.e. professional engineering practice, ethics, and technical writing) on just looking at grades and course delivery [2-5]. Especially the aspect of technical writing, because it often requires practice in writing, rewriting, evaluation (student, marker) and may not be suitable for large size classes. For example, how much professional engineering practice, ethics and technical writing skills were learned using these formats. It can be argued that the effect of "rewriting and resubmitting assignments" increased learning by about 5% in terms of grade point average in this particular complimentary studies engineering course. Although university policies were followed in this course example, the university has special committees (i.e. Committee on Undergraduate Studies (CUGS)) that evaluate student performance in courses including grade averages and additional statistical information, and they generally consider grade averages and grade statistics as a leading indicator of performance.

7 Conclusions

Several major topics such as professional engineering practice, ethics and technical writing can be included in an undergraduate engineering course. When offering a course of this nature, the type of course delivery (i.e. type of final exam, assignment submissions, resubmissions, grading policy) can affect course performance when measured in terms of grade average. Student learning appears to be more difficult to quantify and measure by using grade average.

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9 References

- [1] J. Heywood, "Epilogue," *Engineering Education: Research and Development in Curriculum and Instruction*, IEEE, 2005, pp. 461-464.
- [2] J.E. Sharp, "Work in Progress: Alumni Mentoring of Engineers in a Technical Communication Course,"

34th ASEE/IEEE Frontiers in Education Conference, IEEE, 2004, pp. F2F-11 to F2F-12.

[3] J.D. Lang, S. Cruise, F.D. McVey, J. McMasters, "Industry Expectations of New Engineers: A Survey to Assist Curriculum Designers," *Journal of Engineering Education*, 88, (1), 1999, 43-51.

[4] D.R. Woods, R.M. Felder, A. Rugarcia, J.E. Stice, "The Future of Engineering Education III. Developing Critical Skills," *Chemical Engineering Education*, 34 (2), 2000, 1-20.

[5] J.E. Mills, D.F. Treagust, "Engineering Education – is Problem-Based or Project-Based Learning the Answer?," *Australian Journal of Engineering Education*, 2003, 1-16, (online).

[6] K. Staples, "Technical Communication from 1950-1998: Where are we Now?," *Technical Communication Quarterly*, 9, (2), (Spring), 1999, 153-164.

[7] S. Jenkins, M.K. Jordan, P.O. Weiland, "The Role of Writing in Graduate Engineering Education: A Survey of Faculty Beliefs and Practices," *English for Specific Purposes*, 12, 1993, 51-67.

[8] D.K. Ludlow, K.H. Schulz, Writing Across the Chemical Engineering Curriculum at the University of North Dakota, *Journal of Engineering Education*, 83, (April), 1994, 161-168.

[9] D. Messer, P. Kelly, J. Poirier, "Engineering Information Literacy and Communication," *Proceedings of the Twelfth International Conference on Learning*, Granada, Spain, 2005, pp. 1-15.

[10] G.C. Andrews, *Canadian Professional Engineering and Geoscience Practice and Ethics*, Fourth Edition, Nelson Education Ltd., Toronto, 2009.

[11] A. Roncin, "What's in an Iron Ring?," *Proceedings of the Canadian Engineering Education Association (CEEA) – First Annual Conference, 2010*, pp. 1-5.

[12] A. Hsiao, "Nanomaterials in Newfoundland: Designing a Lab Kit for Grades 9-12 to Bridge the Gap Between Science and Engineering," *Proceedings of The Canadian Engineering Education Association (CEEA) – First Annual Conference, 2010*, pp. 1-6.

[13] A. Parker, "Preparing Engineering Students for the Communication Exigencies of the Profession: Exploring the Future of Technical Communication in Engineering Education," *Proceedings of the Canadian Engineering Education Association (CEEA) – First Annual Conference, 2010*, pp. 1-5.

[14] M. Northey, J. Jewinski, *Making Sense: A Student's Guide to Research and Writing*, Second Edition, Oxford University Press, 2007.