Report Writing Skills of Engineering Students

Dr Su-Hie Ting[1]
Universiti Malaysia Sarawak

Associate Professor Dr Syaharom bin Abdullah[2]
Universiti Malaysia Perlis

[1]*shting@cls.unimas.my*
[2]*syaharom@unimap.edu.my*

Abstract

There is some concern that engineering students may only be concerned with technical content, and not with the quality of writing. There is also the issue that engineering writing is so different that only engineering lecturers are in the position to teach them better writing skills. This study examines recommendation reports written by Engineering students at a Malaysian university from the aspects of focus, analysis of data, and language for making recommendations. The data are obtained from reports written by Engineering students enrolled in an English for Professional Communication course which requires students to identify educational or physical conditions needing improvement in the university. The students conduct a study to assess the condition and make recommendations based on their findings. The recommendation reports of the Engineering students are compared with reports of students from the Arts faculties to highlight the distinctiveness of reports produced by Engineering students. The findings suggest that the nature of the engineering discipline is manifested in the precision and substance of the recommendation reports produced by the engineering students. The paper ends with a discussion of the contribution of language educators to the enhancement of writing to meet the needs of the engineering profession.

Keywords: Engineering students, report writing, business communication, recommendation reports

Introduction

Business communication courses are conducted in universities to prepare university students for workplace communication. These business communication courses usually include preparation of resumes and job application letters, various types of letters and reports. For engineers, the reports could be short laboratory reports or longer research or project reports (Ryder, 2002). Some estimate that up to 30% of work-time of professional engineers is engaged in written communication (Blair, n.d.). In engineering, one of the major forms of communication is the technical report written for managers, clients and other engineers, and it is the conventional format for reporting the results of research, investigations, and design projects (Monash

University, 2010). Writing of these technical reports is referred to as technical writing. The rise of technical writing instruction in America and the concomitant refinements and improvements in teaching and materials has led to the current growth and success of technical writing courses (Connors, 1982).

The technical communication of engineers is a growing area of research. Some research has focused on the writing of professional engineers in order to obtain insights for teaching technical writing to would-be engineers. For example, Selzer (1983) investigated the composing process of an experienced engineer in Chicago who spent 80% of his time planning and arranging in a linear process. Others have studied the use of pedagogical approaches such as situated learning and genre to design technical writing course that provide a context in which students acquire rhetorical skills and strategies necessary to integrate into a discipline-specific discourse community (Artemeva, Logie, & St-Martin, 1999). "A culminating paper assignment provides an excellent opportunity to strengthen both self-directed learning and technical communication skills" (Furman & Robinson, 2008). On the basis of interviews with ten business and engineering faculty members, Zhu (2004) concluded that writing instruction would be most effectively provided by content course faculty and writing instructors working together to take account of the unique thought and communication processes of the discipline and the transfer of general writing skills. We argue that to be effective in helping engineering students to develop necessary skills in report writing, it is essential to understand the nature of the students' writing strengths and weaknesses. Hence, it is important to analyse the writing produced by engineering students in order to obtain insights for more focused teaching of report writing skills.

Purpose of Study

This study examined recommendation reports written by Engineering students at a Malaysian university from the aspects of focus, description of results, and language for making recommendations.

The Study

The recommendation reports analysed were written by students enrolled in an English for Professional Purposes communication course at a Malaysian university. The course is an optional course in the university structure of generic courses but the Faculty of Engineering has made the course compulsory for engineering students. The course is taught over a 14-week semester, with two contact hours per week. The modules covered in the course include business etiquette, reports, use of visual aids in oral presentations, job application and interview, writing memorandums and letters, writing formal business letters and handling meetings.

Report writing is one of the modules given more emphasis in the course in the teaching time allocated and the weightage of coursework and final examination evaluation. Reports are broadly divided into two types: informative and analytical. Analytical reports are more difficult to write as they not only convey information but the information needs to be used in order to justify recommendations. In the four weeks allocated for the report writing module, students learn types of reports, drafting of questionnaire to obtain data, analysis of data, writing and editing the draft report, and finally making an oral presentation of the report. The marking criteria for the

recommendation report emphasises preparation of front matter (which includes a letter of transmittal, executive summary and table of contents), introduction, organisation of content in discussion, coherence in analysis of findings, cohesion in development of ideas, relevance and objectivity of conclusion, professional presentation of graphs or tables and other aspects of writing such as mechanics and referencing conventions.

A total of 22 reports were analysed in this study: 11 reports engineering written by 33 engineering students, and 11 reports written by 33 students from Arts faculties. Each report was a group work of two to four students. The reports were collected from four instructors over two semesters. The reports were on educational or physical conditions needing improvement in the university. The students were asked to conduct a small-scale survey to assess the existing conditions pertaining to the identified problem and make recommendations based on their findings. The number of respondents usually ranged from 10 to 40. The survey was merely an exercise in formulating a questionnaire to collect data on a given problem and the emphasis was on the analysis of the data and the reporting of the findings.

The data analysis for this study focused on three aspects of the reports: focus of report, description of results, and language for making recommendations. The method section was not analysed as the preliminary analysis showed that the recount of steps taking in the distribution and collection of questionnaire is fairly uniform across students.

The focus of the report was analysed by checking the objectives of the report. A recommendation report should include the purpose of the survey and how the survey outcomes are evaluated to make a recommendation (see Henson & Means, 1997). Exclusion of either is considered an incomplete statement of objectives. For example, the sample proposals for undergraduate engineering review provided by Penn State University includes both the criteria and evaluation of existing conditions using the criteria to make a recommendation:

> I propose to review the available literature about using Yucca Mountain as a possible repository for spent nuclear fuel. In this review I will achieve the following two goals:
> (1) explain the criteria for a suitable repository of high-level radioactive waste; and
> (2) determine whether Yucca Mountain meets these criteria.
>
> (Taken from http://www.writing.engr.psu.edu/workbooks/proposal.samples.html#samples)

The objectives were also checked against the scope of the questionnaire and results to find out if there is a consistency in the focus.

The next section of the report analysed was the description of results. The analysis of the results section (sometimes labeled findings) took account of whether the main patterns of results were described, whether interpretations of the statistics were provided, and whether there was a reference to tables or figures. The preliminary analysis revealed that some of the students also provided their own conjecture of reasons to explain the findings. Although personal opinions should not feature in a recommendation report, the presence of this characteristic of writing was included in the analysis to find out the prevalence among the reports written by engineering and other students.

Finally, the language of recommendation was analysed. The initial plan was to analyse the recommendations section for the language of recommendation. However, as students also put their recommendations throughout the report, the whole report was read to identify sections of the report where the recommendations appeared. The analysis also presented the directness of the phrases used to make recommendations.

Results and Discussion

This section presents the results of the analysis. The engineering students' reports are labeled as Group E1 to E11, and the arts students' reports are labeled as Group A1 to A11.

1. Focus of the recommendation report

The analysis of the objectives outlined in the 22 reports written by engineering and arts students shows that the engineering students had a greater tendency than Arts students to include both the purpose of the survey and how the survey outcomes are evaluated to make a recommendation.

Table 1. Focus of reports by Engineering and Arts students

Focus of report	Engineering students	Arts students	Total
Objectives include survey	10	9	19
Objectives include recommendation	9	5	14
Questionnaire and results match objectives	7	8	15

Table 1 shows that out of the 11 reports written by engineering students, 10 included the focus of the survey in the statement of the problem and nine included the intention to make a recommendation based on the survey outcomes. However, fewer of the arts students included both: nine included survey objectives and only five included recommendation objectives (Table 1). Examples of reports which include both survey and recommendation objectives are as follows:

Excerpt 1

> The purpose of this report is to investigate the lack of handicap facilities in the Faculty of Engineering. Our focus will be on facilities that are already provided, what necessary facilities are missing, effects of the lack of facilities to handicapped students, and how we can solve the problem. (Group E9)

Excerpt 2

> The purposes are:
> (1) To investigate the factors that caused students of the Faculty of Creative Arts to be not proficient in English language;
> (2) To identify the more successful strategies and techniques they use to master English language; and

(3) To recommend appropriate solutions to improve Faculty of Creative Arts students' proficiency in English. (Group A7)

In both examples, the goals to be accomplished include the investigation of the existing condition pertaining to the problem under study as well as the recommendations to solve the problem. The recommendation objective is usually placed last in the list of objectives. This manner of writing complies with samples of formal reports provided in business communication books, for example, Henson and Means (1997).

Although the engineering students are better in putting in the two-pronged goal of the report, they were similar to the arts students in the coherence of their questionnaire and objectives. Table 1 shows that seven of the engineering students' reports and eight of the arts students' reports were consistent in the focus. There were two problems of inconsistency in the seven remaining reports. One was the inadequate scope of the questionnaire and description of results compared to the scope outlined in the survey objective. For example, the report written by Group A5 claimed to investigate existing facilities for handicapped students in the faculty and to survey whether students were aware of the handicapped students but the questionnaire and description of results dealt with there were sign language symbols in the faculty, whether lecturers should learn sign language, and whether the university should provide Personal Digital Assistant (PDA) for the convenience of the handicapped students. The other problem arose from the absence of the survey objective in the statement of problem as the reports contained only the recommendation objective. Hence, the questionnaire and description of results do not fit the recommendation objective. For the report to be focused, the purpose needs to be clear in the mind of the writer and subsequently clearly worded for the benefit of readers. "In order to meet fundamental workplace writing expectations, a student must be able to at least identify the purpose for writing and effectively use grammar, syntax, and conceptual knowledge to convey and support that purpose" (Rhoulac & Crenshaw, 2006).

The results on the focus of the reports point to the importance of formulating the purpose of the project to encompass both the collection of data and the recommendation, and ensuring that the information presented adequately fulfils the purpose and do not deviate from the purpose of the report. The results also indicate that the engineering students were more aware of the need to include the recommendation objective in the purpose of the report.

2. Description of results in recommendation report

The engineering and arts students were similar in their description of results in the 22 recommendation reports analysed (Table 2). Almost all the reports contained a description of results in the form of frequencies and percentages based on a compilation of data from the questionnaires distributed to other students in the university. Three of the reports were not satisfactory in the description of results because the write-up was sketchy (Groups E1 and E9) and made vague references to "majority of students" and "some students" without any mention of frequencies listed in the table (Group A3). "Conclusions should be supported by specific references to data and results, quoting numerical values, and guiding the reader from facts to conclusions" (University of Connecticut, 2003).

Table 2. Description and interpretation of results in reports by Engineering and Arts students

Results section of report	Engineering students	Arts students	Total
Description of results (frequencies, percentages)	9	10	19
Interpretation of results	7	7	14
Reference to figure or tables	7	9	16

Although the students were able to handle the reporting of results satisfactorily, fewer were able to provide an interpretation of the results. Out of 22 reports analysed, 14 contained a relevant interpretation as follows:

Excerpt 3

> Moreover, all the students also think that disabled toilet is an important facility and it should be provided at FK [Fakulti Kejuruteraan] for mobility disabled persons. They understand the disabled toilet is helpful because there is a handrail provided and the space is bigger where wheelchair is allowed to enter it. There are 68% of the students noticed that most of the disabled toilets at FK has been misused as store but 32% of them were not sure. However, we did find that there are some disabled toilets at FK used as store (see Figure 2 in Appendix 3). This scene happened because there are no mobility disabled persons working or studying at FK. So, *cleaner might think* that it is not important to take good care of the disabled toilet. (Group E3)

To add to the frequencies of students who had or had not noticed disabled toilets at the faculty, Group E3 included their own observation and a possible explanation for the misuse of the disabled toilets. Besides this report, two other groups of arts students also offered likely reasons for the patterns of results obtained using modality such as "They might think …" and "It might be …". In a formal report, personal opinion such as these may not be appropriate and students need to learn how to express these as factual statements. For example, "So *cleaner might think* that it is not important to take good care of the disabled toilet" in Excerpt 3 can be rewritten as "So the cleaners did not take good care of the disabled toilet" to remove the conjecture of the cleaners' thoughts and to focus on the clearly observable outcomes of their actions.

However, the other one-third of the reports stopped at the description of numbers extracted from the table as shown in Excerpt 4:

Excerpt 4

> In our survey, we also inquired on whether they have met or saw handicapped students in the faculty of engineering. Out of 100 respondents, only 73 respondents answered they have, and another said they did not. The 73 respondents said they have met or seen 1 handicapped students in the Faculty of Engineering at most. (Group E10)

This is merely a mechanical transfer of numbers from the table or figure to text, and it does not show processing of the data to generate patterns of results. Based on the findings of this study, the skill to make reasonable interpretations of frequencies and percentages is lacking and needs

to be emphasised in the teaching of report writing. When presenting facts and figures, it is important to make comparison, contrast and similarity (see Kerridge, 1990).

In addition to describing and interpretation major patterns from the information gathered in the survey in text, the students were also required to present the information either as tables or figures. In the data analysis for this study, the results section was checked to find out if the students made references to the tables or figures. For example, "Table 1 shows", "see Table 1" or "(Table 1)". The analysis revealed that 16 out of the 22 reports contained references to the tables or figures (Table 2). The remaining six reports included the illustration in the appendix but did not make any reference to it in the text. Although this is a feature that tends to be stressed in academic writing courses, this is a crucial feature of reports which cannot be neglected in business communication courses. Workplace reports written by engineers usually contain many complicated illustrations and readers cannot be expected to know which table or figure is being referred to in a particular part of the text.

Overall, the findings on the description of results in the recommendation reports show that the engineering students are similar to the arts students in their ability to provide a description of results but many still need to acquire the skill of providing interpretations of the results and making appropriate references to supporting illustrations.

3. Positioning and language of recommendation

Recommendations is an important section of a recommendation report because they provide proposals for the organisation to act on. The recommendations should emerge from the conclusions of the report, and the writer may include a brief persuasive statement before presenting the recommendations clearly listed in numbered or bullet points (Winckel & Hart, 2002). Based on Winckel and Hart's description, it is clear that recommendations should not appear in the introductory or even the results sections of a report. However, the analysis of recommendations in student reports shows that two groups of engineering students and four groups of arts students included recommendations in the introduction and results sections (Table 3). In fact, there were 26 recommendations in these two sections (13 from reports by engineering students and 13 from reports written by arts students). Nonetheless, the conclusion and the recommendation sections of the report rightly contained the most number of recommendations (84 from engineering students and 69 from arts students).

Table 3. Positioning of recommendations in reports by Engineering and Arts students

Sections where recommendations appear	Engineering students		Arts students	
	No. of reports	No. of recommendations	No. of reports	No. of recommendations
Introduction	0	1	2	8
Results	2	12	2	5
Conclusion and Recommendations	11	84	11	69
Total		97		82

Further analysis of the language of recommendation was carried out to find out the directness in which the recommended strategies, techniques or procedures were expressed. Ten types of language for recommendation were identified, labeled as 1 to 10 in Table 4. Some types are pairs of sentences in active and passive voice, e.g. 6A (… must/should/can do …) and 6B (… should/can be done). An attempt is made to rank the types in descending order of directness for both the active and passive sentences, subject to variations in interpretations depending on distancing and hedging.

Table 4. Directness of language of recommendation

Directness	Examples	Engineering students	Arts students	Total
Active voice				
1	We can/ need to …	3	3	6
2A	We recommend/suggest that (faculty) should/ can …	5	5	10
3A	We have the following recommendations …	0	1	1
4A	There/It is a need to …/ It is necessary to …	3	3	6
5A	Study/findings suggest that …	3	1	4
6A	(Faculty) must/ should/ can/ could/ need to …	17	35	52
7	There should be …	1	0	1
8	Imperative	0	9	9
	Sub-total	**32**	**57**	**89**
Passive voice				
2P1	It is suggested/recommended that (faculty) …	1	5	6
2P2	… is suggested/recommended to be (done) …	3	1	4
3P	These/ The following/ Some suggestions are made …	7	1	8
4P	… are necessary/needed	4	0	4
5P	… recommended by study/students.	2	0	2
6P	… should/ can/ need to be (done) …	40	8	48
9	It is hoped that …	0	1	1
	Sub-total	**57**	**16**	**73**
Others				
10	General statements. E.g. … can help to …, The better way is …, There is room to improve …	8	9	17
	Total	**97**	**82**	**179**

Figure 1 shows that the arts students tended to use more active voice and the engineering students tended towards passive voice in wording their recommendations in their reports. Table 4 shows that out of 89 instances of active sentences, 57 (or 64.04%) are from the reports written by arts students. The number of passive sentences in reports produced by the engineering students accounted for 78.08% of the 73 instances (or 57). The most distinctive difference in the frequent use of the "… must/should/can/could/need to (do) …" by arts students (35 instances of use compared to 17 by engineering students) and the reliance on the passive version ("… should/can be done …) by engineering students (40 instances compared to eight by arts students). Excerpt 5

shows the use of active and passive voice in the recommendation section of the report written Group E2:

Excerpt 5

In most of the students' opinion, the Faculty of Engineering <u>should organize</u> more outdoor activity to tighten the relationship between students and their staff. This ensures everyone know and can be friendly to each other. Other than that, **<u>more site visit should be added</u>** and at different place. The reason was most students are interested in studying directly from their observation at the sites and theory at the same time. Besides, the <u>SAFE association should be more active</u> and adding more roles. The **<u>SAFE association should be given more information</u>** about the relative jobs to Civil Engineering field in the future. In addition, the **<u>lectures should be done</u>** in fully English. To build a fully English implementation condition in lecture time, <u>lecturers should avoid</u> using other languages in the class. Even for giving explanations, <u>lecturers should use</u> English to explain and make sure the students understand. <u>The better way</u> is using simple words to encourage students to take notes during lecture. (Group E2)
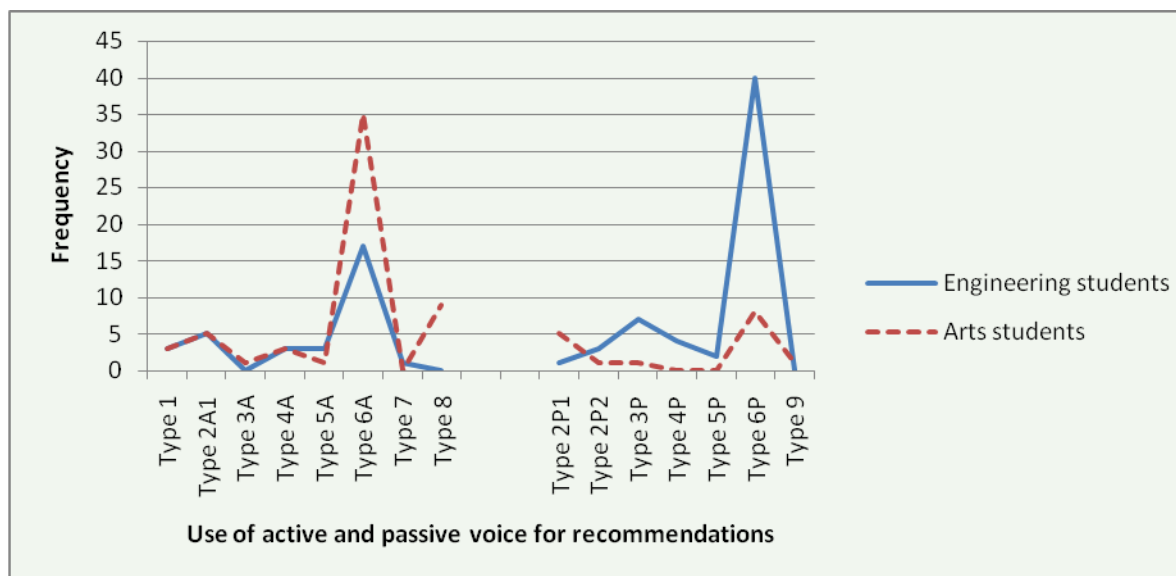

Figure 1. Use of active and passive voice for recommendations in reports written by engineering and arts students

Another difference is the tendency of arts students to word their recommendations using imperatives (nine instances of Type 8 in Table 4). A number of these were in the form of paragraphs, for example:

Excerpt 6

<u>Provide</u> handout for colour blind student can make them easy to learn what the lecturer tries to present in the slide show. This is because sometimes the lecture slides [have] colours [that] are not suitable. (Group A3)

None of the engineering students used imperatives to make recommendations. Imperatives can be seen as a strategy to distance the writer from the proposed action, as opposed to the writer's explicit presence in the use of "we". Imperative is acceptable language of recommendation as Winckel and Hart (2002) states that "a series of recommendations may be worded in instructional language; for example, each beginning with a verb". However, wording recommendations as imperatives may be more appropriate if there is a preceding persuasive statement and the imperatives are either in numbered or bullet points (see Winckel & Hart, 2002). To introduce a list of recommendations, which may be followed by a paragraph of description, the engineering students are inclined towards using the passive form "These/The following/Some suggestions are made …" (Type 3P) as there are seven instances in their reports and only one in the arts students' reports. The active version, that is, Type 3A (e.g. We have the following recommendations …) is equally popular among the engineering and arts students. The frequencies for the other types of language used for making recommendations are too small for conclusions to be drawn on the plane of directness.

The results show that the engineering and arts students generally placed recommendations in the conclusion and recommendation sections of the recommendation report although there is some leakage into the introduction and results sections. In the course, the students were taught to write a separate recommendation section after they have presented their conclusions. However, as many students included recommendations in their conclusion sections, these two concluding sections were treated as one in the analysis. The most substantive finding from the analysis of the language of recommendations is that the engineering students were inclined towards using the passive voice and the arts students the active voice. The inclination of the engineering students to focus on the proposed actions rather than the subject can be a reflection of the objective nature of the science discipline. Based on an analysis of engineering reports using a modified version of Gosden's (1993) analysis of the science research article using Hallidayan sociolinguistic concepts, McKenna (1997) shows how engineering writers linguistically convert real-world entities and processes into scientific concepts. McKenna found a small proportion of unmarked subject-themes in the participant domain of engineering reports and suggests that "the interactive metafunction is less important than in research articles because engineers do not need to position themselves within a discourse community" (p. 189).

Conclusion

The study on report writing skills shows that engineering students fulfil the basic requirements of recommendation reports, similar to the arts students. The study revealed that both groups of students are able to describe outcomes from their survey but a majority do not provide interpretations of the results or make references to supporting illustrations. There is some deviation from the conventional structure of a report in the placement of recommendations in sections other than the conclusion and recommendation. The findings suggest that the factual and precise nature of the engineering discipline has rubbed off on their students in that theirs tend to be a focused factual report with better coherence between the purpose statement and the results, and a removal of self through the use of passives in making recommendations. This study indicates that the engineering students may be a distinctive group who needs instruction in specific aspects of report writing, such as the selective use of agency to increase the assertion of their recommendations. This is an aspect of technical writing instruction that writing instructors

can contribute as subject specialists in the engineering discipline may not be sensitised or trained to teach the particularities of the language and nuances of meanings made through a deliberate selection of grammatical and organisational structures. The findings suggest that writing instructors have an important role to play in the enhancement of the communication skills of students in the engineering profession. However, as we did not examine the reports written by students in the other science disciplines and dwell on characteristics such as gender and language proficiency that might influence their report writing skills, the findings need to be interpreted within the limits of this study. These are variables which can be investigated in future studies in order to obtain better insights into the students' strengths and weaknesses in report writing skills so that teaching materials and classroom instruction can be more focused on their writing needs.

References

Artemeva, N., Logie, S., & St-Martin, J. (1999). From page to stage: How theories of genre and situated learning help introduce engineering students to discipline-specific communication. *Technical Communication Quarterly, 8*(3), 301-316.

Blair, G. M. (n.d.). *How to write right*. Retrieved September 13, 2010, from http://www.ee.ed.ac.uk/~gerard/Management/art4.html

Connors, R. J. (1982). The rise of technical writing instruction in America. *Journal of Technical Writing and Communication, 12*(4), 329-352.

Furman, B., & Robinson, W. (2003). *Improving engineering report writing with calibrated peer review*. Proceedings of 33rd Annual Frontiers in Education (FIE'03), vol. 2, pp.F3E14-16. Retrieved September 14, 2010, from http://doi.ieeecomputersociety.org/10.1109/FIE.2003.1264742

Henson, C., & Means, T. L. (1997). *English and communication for colleges* (2nd ed.). Ohio: South-western Educational Publishing.

Kerridge, D. (1990). *Presenting facts and figures*. Essex: Longman.

McKenna, E. (1997). How engineers write: An empirical study of engineering report writing. *Applied Linguistics, 18*(2), 189-211.

Monash University (2010). *Writing technical reports*. Retrieved September 15, 2010, from http://www.monash.edu.au/lls/llonline/writing/engineering/technical-report/index.xml

Penn State University, Engineering Department (n.d.). *Sample proposals for undergraduate engineering review*. Retrieved September 13, 2010, from http://www.writing.engr.psu.edu/workbooks/proposal.samples.html#samples

Rhoulac, T. D., & Crenshaw, P. (2006, October). *Preparing Civil Engineering students to meet workplace writing expectations*. Paper presented at 36th ASEE/IEEE Frontiers in Education Conference. Retrieved September 14, 2010, from http://fie-conference.org/fie2006/papers/1684.pdf

Ryder, G. (2002). The art of report writing. Retrieved September 14, 2010, from Institute of Technology Tallaght, Department of Mechanical Engineering. Web site: http://members.multimania.co.uk/gerardryder/pe/TheArtofReportWritingI.doc

Selzer, J. (1983). The composing processes of an engineer. *College Composition and Communication, 34*(2), 178-187.

University of Connecticut, Electrical and Computer Engineering Department. (2003). *Engineering report writing*. Retrieved September 14, 2010, from http://www.ocf.berkeley.edu/~anandk/math191/Technical%20Writing.pdf

Winckel, A., & Hart, B. (2002). Report writing style guide for engineering students (4th ed.). Retrieved September 14, 2010, from University of South Australia, School of Natural and Built Environments. Web site: http://www.unisa.edu.au/ltu/students/study/specific/report-engineering.pdf

Zhu, W. (2004). Faculty views on the importance of writing, the nature of academic writing, and teaching and responding to writing in the disciplines. *Journal of Second Language Writing, 13*(1), 29-48.