Enhancing Communication Practices through Development of a Departmental Civil Engineering Writing Guide

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Abstract

This paper describes the development of a departmental civil engineering writing guide and assessment of student writing prior to implementing the guide. The pre-writing guide assessment will be compared to assessments of similar assignments after using the writing guide in instruction as part of an effort to quantify impact. The writing guide was a collaborative effort between the civil engineering and writing studies faculty. The collaboration reinforced work done in the required writing classes and allowed both parties to leverage their expertise. The writing guide currently contains sections detailing reports, figures, tables, equations, references, memos, homework, professional e-mails, and a general grading rubric. The rubric is general enough so that individual instructors can adapt it for a given assignment, while maintaining a consistent framework as students move from course to course. Civil engineering faculty used the proposed rubric to evaluate Fall 2014 assignments from a freshman-level introduction to civil engineering course, two required junior-level laboratory courses, and the department’s capstone design course; all four courses were taught prior to use of the writing guide. Results demonstrate the need for a writing guide and suggest that the writing guide will help improve student work, particularly in the areas of format, summary, and conclusion.

Introduction

This paper describes the development of a writing guide for a civil engineering department and its use to assess student writing prior to implementing the guide. The writing guide and assessment methods were the result of collaboration between faculty from the civil engineering and writing studies departments, a critical partnership to help prepare students for professional communication. The University of Minnesota Duluth (UMD) requires two three-credit writing courses, one at the freshman-level and one at the junior-level. Collaboration with writing studies faculty ensured that the material in the writing guide was consistent with content taught in those courses. The writing guide is currently being piloted by civil engineering faculty in select courses and by the UMD’s writing center, the Writers’ Workshop, which offers one-to-one sessions led by graduate student or faculty consultants. Lessons learned from this pilot will be used to improve the writing guide before implementation across the civil engineering department in the Fall 2015 semester.

The following sections first summarize the projects designed to improve writing in the engineering department and then describe the development of the writing guide and assessment rubric, including the roles of the civil engineering and writing studies faculty. The final section presents assessment data from courses before the writing guide’s implementation. Once the writing guide is implemented across the civil engineering department’s courses, this data will be compared to writing assessments from the same classes to quantify the impact of the writing guide, if any, on student performance.
Background

Strong communication skills, both written and verbal, are critical for newly graduated engineers, especially those seeking jobs in firms where interdisciplinary teamwork is the norm. The American Society of Civil Engineers (ASCE) document titled Civil Engineering Body of Knowledge for the 21st Century outlines the outcomes that “define the knowledge, skills, and attitudes necessary to enter the practice of civil engineering at the professional level in the 21st century.” One of the professional outcomes listed is Communication; the document cites the need for engineers to be able to “plan, compose, and integrate the verbal, written, virtual, and graphical communication of a project to technical and non-technical audiences.”

In addition, ABET accredited universities are well versed in the necessity of teaching communication skills within their curriculum, since one of the required student outcomes is “an ability to communicate effectively.” As mentioned above, the civil engineering curriculum at UMD requires students to take two writing courses, a standard first-year writing course, which is common in many engineering curricula, and an upper-division technical writing course geared toward engineering majors, ideally taken during the junior year. Unfortunately, scheduling this discipline-specific engineering course can sometimes be difficult for students who may have had to retake a course or for transfer students. As a result, these students typically do not take this course until their senior year. Because nearly all of the courses in the civil engineering curriculum require some sort of technical writing, such as lab reports or project papers, this situation puts a great deal of pressure on faculty trying to help these untrained students improve their writing while still covering normal course content. Needless to say, students struggle with trying to meet standards they have yet to be taught or had the opportunity to practice. The writing guide is meant to help alleviate this problem by offering consistent guidance for students beginning at the freshman year and continuing throughout the degree program.

Simply providing the students with the writing guide, however, will most likely not be enough to drastically improve their communication skills. Faculty must also demonstrate to students the importance of developing these skills as they relate to a successful career in engineering. So called “soft skills” such as communication, teamwork, information seeking and presentation skills are repeatedly identified as important to employers looking to hire new engineers. Presenting the writing guide and relevant evidence of the importance of communication skills early on in the students’ career will help them develop strong habits to be reinforced throughout their time at school. Additionally, the guide will help make it easier for instructors to provide useful feedback by aligning their comments with the elements found on the rubric, by referencing the writing guide, and by having students use the guide to peer review each other’s work, all strategies proven successful in improving writing skills.

Developing the writing guide

Motivation for creating a department writing guide came from consistent weaknesses in student writing and discussions with local practicing engineers about the skills new hires needed to improve. Following the Fall 2013 semester, civil engineering and writing studies faculty began to discuss developing a writing guide to address these concerns. Many university engineering programs and other professional organizations offer publically available writing guides, many of which are available online, or writing guide reference lists on their library’s website.
For the most part, these guides offer similar guidance for writing, which seems primarily to steer students toward technical writing and away from more casual styles. While these references served as a strong starting point for development of the guide, the authors determined that a locally developed guide would better suit expectations of common employers of UMD’s students and, more importantly, dovetail with instruction students received in required writing classes. The first step was to narrow the guide’s focus to a reasonable scope. Doing so left the current version of the writing guide with sections on reports, figures, tables, equations, references, memos, homework, and professional e-mails. The following paragraphs briefly describe each section.

The report section first describes general expectations, such as margins and fonts, emphasizing professional presentation. The guide goes on to describe a standard six-section organization: abstract or summary, introduction, background, methods, results and analysis, and conclusion. The guide provides the mission and typical elements of each report section, as well as situations when writers might omit or add to the typical advice presented in the guide. The goal is to provide students with generally acceptable practices when writing a variety of reports (i.e., testing summaries, design reports, research summaries, etc.), so the advice is necessarily broad. The authors envision instructors providing students with additional instructions for specific classes or assignments.

The figures section presents three types of visual displays common in civil engineering writing: graphs, pictures, and drawings. The section will include maps in its next edition. As with the report section, this one presents common conventions, such as following figures with a caption as well as presents a bullet list of suggestions for each type of figure. The sections on tables and equations present similar information.

The reference section refers students to UMD’s library website, which contains a guide to various citation styles. Recognizing that local employers use a variety of styles, the guide describes general requirements, such as citing all work that is not the writer’s original contribution, and then indicates departmental citation conventions, which are based on the ASCE convention. This style is similar to, but does not exactly follow, the American Psychological Association (APA) reference style, which many of the students will have used in other courses. Documentation examples are provided for commonly cited works, including journals, books, and web pages, and a link to ASCE’s website is provided.

The memorandum and homework sections show typical formats for each and describe department expectations for these genres. For memo writing, the guide provides general advice about formatting, brevity, and closing. Similar to the report section, the homework section is unavoidably broad, focusing on professional presentation of work. This section is not intended to replace each instructor’s syllabus or individual expectations for a given class or assignment.

Finally, the professional e-mail section includes recommendations from practicing engineers, who complained that too often workplace emails resemble text messages between friends. The guide includes a screen shot of a professionally composed e-mail along with the list of recommendations.
In addition to these six sections, the writing guide includes a general grading rubric, shown in Table 1, for use in evaluating writing assignments. The authors developed a rubric consisting of six grading criteria in the left most columns, followed by a brief description of each criterion in the next column and three possible levels of performance listed across the top row. An analytic rubric, where each criterion is scored individually, was selected as opposed to a holistic rubric, where the student is given one single score for the entire assignment. Using an analytic rubric offers more detailed feedback to the students, allowing them to see exactly where improvement is needed. This will hopefully result in improved writing on subsequent assignments. The authors anticipate that each instructor will modify the rubric to align with specific areas of emphasis for specific assignments and that for lower-stakes assignments, for example, the rubric may be altered to be less analytic and more holistic in nature. The intent is that the general areas in the left column will remain consistent, with only the weight and emphasis within each category changing from assignment to assignment. The reason for this is to provide students with a consistent vocabulary and a consistent set of general expectations as they experience various courses and instructors in the program. The rubric’s aim is to avoid the students’ common complaint that graded aspects vary from class to class as well as to avoid their incorrect perception that writing as an engineer is a moving target, one that changes at the whim of the person asking for the piece of writing. In addition, the rubric follows the format of rubrics used in many of UMD’s required writing classes and reflects lessons learned from the writing studies faculty.

The difficulty of creating a writing guide that is specific enough to help students and general enough to address differing audience and purpose is apparent. Accordingly, four classes are implementing the current version of the writing guide (available once the pilot is complete, anticipated for June 2015, at http://www.d.umn.edu/civileng/writing_guide) during the Spring 2015 semester: two required junior-level classes, the senior capstone design course, and one graduate elective. The authors will seek informal feedback throughout the semester and formal feedback at the end of the semester in each of the four classes from students enrolled in those courses. Additionally, the authors will seek feedback from members of the department’s Industrial Advisory Board (IAB) and from local practicing engineers who frequently volunteer as mentors in introduction to civil engineering projects, capstone design projects, and student group competitions. While student feedback will improve the guide’s usefulness for future students, practicing engineers will ensure that lessons in the guide are applicable to profession expectations. Thus, the authors will improve the writing guide before requiring its use across all department classes in Fall 2015.

Preliminary assessment results and discussion

Civil engineering faculty evaluated assignments from four courses taught in Fall 2014 using a version of the rubric shown below. The four courses included a freshmen introduction course, two junior level engineering courses and the capstone class, Senior Design. The guide did not exist when faculty made these assignments, so the students were not familiar with the expectations described in the writing guide. The evaluators separated the data collected from grading these assignments into four main categories: (1) Summary/Conclusion, (2) Technical Content, (3) Data Presentation, and (4) Format/Mechanics & Style. Figure 1 shows the average percentages earned in each category for each class.
In the Summary/Conclusion and Format/Mechanics categories, scores across the four courses were fairly consistent. Additionally, these assignments were completed prior to the creation of the writing guides so the expectations in each course were different. In both the Technical Content and Data Presentation categories, scores decreased from freshman to junior classes, and increased from junior to senior classes. Expectations are higher in junior and senior level courses. Senior writing is typically improved as students have more writing experience from junior level classes and required writing courses. Technical Content is difficult to compare because the content of this category differs significantly among classes. The expectation is that upon introducing the writing guide at the beginning of the semester to alert students as to what the expectations are on each assignment, the data will show improvement. In particular, as the students progress through the courses from the Intro Course through to Senior Design and become accustomed to using the guide, grades should also increase.

Table 1. General grading rubric to be edited by instructors for specific assignments

<table>
<thead>
<tr>
<th>Category</th>
<th>I</th>
<th>II</th>
<th>III</th>
</tr>
</thead>
<tbody>
<tr>
<td>Format (X points)</td>
<td>Your assignment is presented according to published instructions.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Summary (X points)</td>
<td>The audience for your work can understand the entire project by reading the summary. Depending on the audience, this may also be called an abstract, executive summary, or other titles.</td>
<td></td>
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</tr>
<tr>
<td>Technical Content (X points)</td>
<td>This will vary greatly by assignment. It includes correctly interpreting data, explaining results, reaching correct conclusions, presenting appropriate recommendations, effectively organizing and structuring the content according to the audience and purpose for writing.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Data Presentation (X points)</td>
<td>Data is clearly presented to your audience when you include figures, tables, equations, example calculations, etc.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Conclusion (X points)</td>
<td>The conclusion summarizes the entire document and clearly responds to the purpose, satisfying the audience that the purpose has been met.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mechanics &amp; Style (X points)</td>
<td>Mechanics refers to the conventions of edited standard written English, including spelling, punctuation, grammar, capitalization, use of numbers, etc. Style refers to the writing conventions used in the field of Civil Engineering, such as use of active voice, integration and citation of secondary sources, no use of first person, etc.</td>
<td></td>
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</tr>
</tbody>
</table>

Category I – met the criteria listed above with few/no issues (typically 100% of available points)
Category II – minor mistakes, but the criteria were still met (typically 75% of available points)
Category III – major mistakes distract from the criteria (typically 50% of available points)
Scores between each category are possible. Scores lower than those listed in Category III are possible if the content is largely missing or ignored.
One area that should greatly improve is with the writing guide is Summary/Conclusion because the writing guide will provide guidance in this area. Additionally, it is likely that grade variability across the courses will decrease as writing expectations become similar. The Technical Content portion of the grade is the exception, however, since each course will have a different expectation in this regard.

Writing done during Spring 2015 will represent the first semester when students will have and use the guide prior to being assigned work. By comparing writing done prior to the guide being introduced to students with that done after the students have the writing guide, faculty will determine the extent to which the guide affects students’ grades. Comparing work over the next several years will demonstrate whether a greater level of competency can be achieved by exposing students to the writing guide for their entire undergraduate experience as compared to exposing them to the writing guide later in their undergraduate careers.

![Grading results using the rubric for assignments in four courses.](image)

**Figure 1.** Grading results using the rubric for assignments in four courses.

**Conclusion**

In summary, civil engineering and writing studies faculty collaborated to create a department writing guide. This paper describes the guide’s contents and a method of using its sample rubric to evaluate student writing from Fall 2014, before introduction of the writing guide, in four classes at the freshman-, junior-, and senior-levels. The results demonstrate variability in students’ writing prior to implementing the writing guide. This variability should decrease as students use the writing guide and instructors continue to outline expectations based on the rubrics. The writing guide is currently being piloted in four classes, two junior-level, one senior-level, and one graduate-level, to generate student and instructor feedback. Lessons learned from the Spring 2015 semester will be applied prior to using the writing guide in all civil engineering classes beginning with the Fall 2015 semester.

At this point in the project, the authors have two major recommendations for other programs considering similar projects. First, involve writing studies faculty. Their expertise on teaching
and evaluating student writing vastly improved the content of the writing guide and the usability of the rubric. Additionally, their involvement ensured that the writing guide augmented the content of the university’s two required writing courses. Second, while still early, the authors have already collected valuable feedback on improving the writing guide’s utility for students. Therefore, the authors recommend introducing the writing guide in select classes prior to implementing it at the department level.

Acknowledgements

The authors wish to thank the staff of UMD’s writing center for their willingness to be involved from the conception of this project, for their expertise, and for their excitement throughout the writing guide’s development. This support and assistance are gratefully acknowledged.

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