AC 2009-2028: EFFECT OF TYPE OF WRITING INSTRUCTION ON QUALITY OF STUDENT WRITING

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Effect of Type of Writing Instruction on Quality of Student Writing

Introduction

At the University of Wisconsin-Platteville (UWP), the Civil and Environmental Engineering (CEE) curriculum provides writing instruction to students via two freshman composition courses and by requiring multiple writing assignments in virtually every CEE course. Many CEE courses provide students with some type of writing guidelines at the start of the semester, and nearly all of the faculty provide written feedback to the students. This instructional model is very time intensive for the CEE faculty members, given the large grading load. (Teaching assistants are not employed at UWP, a primarily-undergraduate institution.) Faculty have somewhat grudgingly born the load by assuming that this method was helping students write more effectively. However, recent survey results from employers of co-op students have not been favorable with regards to student writing ability. Moreover, one of the best indicators of student writing ability at UWP is their performance on their final Senior Design reports. These are almost uniformly poorly written, despite the large amount of writing they have completed and the extensive feedback they have obtained prior to enrolling in Senior Design. Thus, the department is realizing that the current model (provide guidelines and a large amount of practice) is not working.

The study described in this paper compares an innovative writing instructional method (the "test method") to a more traditional method (the "control method"). The test method consisted of weekly lecture time devoted to discussing handouts on various writing competencies paired with targeted writing assignments. The control method is typical of the method used by the CEE faculty at University X. Both methods provided students with regular written feedback on their work.

The objective of this study is to determine whether students taught using the test method performed better on a final writing assignment than students taught using the control method. As such, this paper helps to address a gap in the engineering writing education literature, in that few studies have investigated the effect of various methods in an experimental fashion. One exception is the work of Jensen and Fisher,[1] who showed that the use of student peer review was found to be positively correlated with an improvement in student writing proficiency. The findings were based on a comparison of scores on a writing assignment at the beginning of the semester and a writing assignment at the end of the semester for a control section and a test section.

Background

The test method was guided by advice gleaned from the technical writing and engineering writing instruction literature. Two very practical papers that were of particular help were those written by Evans[2] and Berthouex.[3] These papers cite the necessity of providing students with plenty of writing practice; providing students with writing guidelines; allowing students to critique each other's work; providing thorough feedback; etc.

This advice was helpful in designing the test method, but it suffered from a lack of supporting evidence. Unfortunately, many of the claims in these and other papers on writing instructional methods are only supported with anecdotes. This is not to say that these papers are not useful. However, this lack of rigorous assessment of writing instruction in the literature was an impetus to conducting the present study.

The test method was also guided by *How People Learn*.[4] Specifically, the test method was designed to be knowledge-centered; learner-centered; community-centered; and assessment-centered. This mirrors the work of Yalvac et al.[5] , who created writing modules that also agreed with the philosophies espoused in *How People Learn*.

Procedure

The two instructional methods were implemented in two sections of a Fluid Mechanics laboratory course at University X. The course is housed in the Civil and Environmental Engineering (CEE) department. Each section was taught by a different professor. Students in each section completed the identical laboratory tasks, but the writing instructional method and the writing assignments differed. The exception to this is that the last writing assignment was identical for both sections; the student performance on this assignment was used as the measure of student writing proficiency (i.e. the dependant variable). Each instructional method required the same number of writing assignments.

The test method of instruction provided students with weekly handouts. Each handout addressed a single writing competency. The competencies covered included the following:

- sample calculations;
- graphs;
- use of equations in text;
- paragraph structure;
- use of numbers;
- grammar, spelling, and punctuation;
- conciseness;
- word choice; and
- graphics and drawings.

The handouts were organized into three sections: Overview; Guidelines; and Examples. The Examples section included anonymous snippets of actual student work from past semesters, and, depending on the handout, the snippet may have consisted of an individual sentence, a single paragraph, or a group of paragraphs.

Each week, the faculty member using the test method distributed the writing competency handout and discussed the handout with the students. As an active learning exercise, students were asked to critique the examples using the provided guidelines. The faculty member then led a discussion in which students shared the errors they found in the examples.

Each week's writing assignment was designed to focus on that week's writing competency. For example, the competency for week #1 covered the proper creation of sample calculations. The writing assignment for week #1 required students to create effective sample calculations for the

analysis of that week's data collected in lab. As the semester progressed, each week's assignment continued to provide students with an opportunity to practice that week's writing competency; additionally, students were assessed on their mastery of various competencies covered in previous weeks. Writing assignments were graded using a "score sheet;" items on the score sheet included the individual competencies targeted by that assignment.

The test method was knowledge-centered in that it allowed students to progress from being novice problem-solvers to expert problem solvers. It provided the students with a series of writing competencies and provided them with opportunities to master those competencies. The test method was learner-centered in that the various competencies were selected based on the competencies with which students had struggled with the most in previous semesters. Community-centeredness was addressed through the in-class active learning exercise and ensuing discussion. Students also performed an in-class peer-review for the conciseness competency. Finally, the weekly feedback helped make the test method assessment-centered.

The control method of writing instruction provided students with a more traditional means of writing instruction. It is representative of the way students are currently taught writing in the UWP CEE department. On the first day of class, students were provided with a 14-page handout on effective engineering writing. The faculty member delivered a lecture on the various topics included in the handout. He stressed that students would be responsible for the material in the handout and advised that they review the handout before handing in assignments. Students were also provided with a copy of the rubric with which the professor would grade all of their weekly writing assignments.

The rubric was designed by four members of the Civil and Environmental Engineering Department, with input from all department members. The rubric was not created with this current study in mind, but was intended to be a generic rubric that all department members could use for grading their writing assignments. A copy of the rubric is provided in the appendix.

The weekly writing assignments for the control method required students to complete a formal technical memo or a formal laboratory report. These were graded using the grading rubric, and additional feedback was provided to the students with detailed comments and many suggested corrections and revisions.

The final writing assignment was identical for both sections, and was used as the measure of writing effectiveness for the purposes of this experimental study. The assignment required students to write a 3- 4 page report on the open channel experiment. Students were told to write the report for a professor who would be teaching the lab the following semester. This professor had never taught the laboratory before, and students were to keep this audience in mind as they wrote. Furthermore, they were to give him advice on which open channel laboratory tasks to continue using when he taught the laboratory for the first time. This type of assignment (semi-formal report) and the choice of audience were different than students in either section had seen in previous writing assignments. Thus, students in one section did not have an advantage over students in the other section by having previous experience with this type of writing assignment.

The final writing assignment was assessed using two methods. One method was the rubric that the professor of the control section had used throughout the semester. The second method was a score sheet similar to the type that the professor in the test section had used throughout the

semester. This score sheet had seven categories: sample calculations; graphs; paragraph structure; numbers; grammar; conciseness; and word choice. One advantage of the rubric was that it provided the graders with a tried and tested method. Advantages of the score sheet were that it allowed a more objective means of assigning a numeric grade and provided a large range of scores. For example, two points were deducted for every grammar mistake (while allowing students one "freebie") and students could receive a negative score. Thus, the range on this category ranged from -10 to +10. Similarly, for the word choice topic, two points were deducted for every blatantly poor word choice. Some topics were addressed in both the rubric and the score sheet.

Students taught with the control method had the advantage of seeing the rubric before and had been provided with feedback via the rubric many times. Students taught with the test method had the advantage that the topics on the score sheet corresponded with the competencies which they had been taught. However, each of the writing competencies on the score sheet had been addressed by the instructor of the control method via the rubric, in-class discussion, and written feedback on graded reports.

The laboratory reports were assessed after the completion of the semester using the rubric and the score sheet. Both faculty members involved in the study assessed all of the reports using the rubric. A score of 4 was assigned to a response of "Distinguished," a score of 3 to a response of "Proficient," etc. The two faculty members' scores were averaged for each category of the rubric. Only one faculty member used the score sheet to grade the reports, given the score sheets inherent objectivity.

Results

A total of 46 papers were included in this study. The scores from the rubric and from the score sheet are summarized in Table 1 and Table 2, respectively. Results in these tables represent pooled data from both sections. For every rubric category, the average was between 2 (Limited) and 3 (Proficient). Relatively small standard deviations were obtained as compared to the score sheet scores.

Table 1

Rubric Category	Average Score	Standard Deviation
Purpose	2.4	0.8
Ideas	2.4	0.5
Evidence	2.4	0.6
Conclusion	2.4	0.6
Topic sentences	2.6	0.5
Paragraph order	2.9	0.3
Transitions	2.4	0.4
Word choice	2.3	0.5
GPS	2.3	0.5
Tone	2.3	0.5
Formatting	2.6	0.4

Table 2

Score Sheet Category	Maximum Possible Points	Average Score	Standard Deviation
Sample Calculations	5	4.4	1.0
Graphs	5	3.8	1.4
Paragraph Structure	10	8.2	2.1
Use of Numbers	5	4.4	1.1
Grammar	10	2.7	7.4
Conciseness	5	4.7	0.8
Word Choice	10	6.4	2.8

As compared to students in the control section, students in the test section obtained higher average scores for 7 of the 11 rubric categories and for 5 of the 7 score sheet categories. To determine whether the averages were statistically significant ($p \leq 0.05$), a two-sample t-test was conducted using Minitab. A total of 18 analyses were completed, corresponding to the 11 rubric categories and the 7 score sheet categories.

According to the t-test analysis, students instructed using the test method had statistically higher scores for three of the rubric categories and for three of the score sheet categories. The significant categories are summarized in Table 3. According to both the rubric and the score sheet, students in the test section had significantly higher scores for the word choice category.

Table 3

Source of score	Category	Test Method Average	Control Method Average	p-value
Rubric	Transitions	2.6	2.3	0.023
Rubric	Word Choice	2.5	2.2	0.016
Rubric	Tone	2.5	2.2	0.010
Score sheet	Graphs	4.7	3.3	0.000
Score sheet	Grammar	5.7	1.3	0.050
Score sheet	Word Choice	7.9	5.7	0.001

Note that of the four rubric categories and the two score sheet categories for which students in the control section had higher average scores than students in the test section, none of the averages were significantly different.

Discussion

Results in Table 3 might be explained by the fact that each of these categories (with the exception of "tone") were explicitly addressed by a writing competency handout and associated discussion in lecture. However, other competencies (sample calculations, paragraph structure, use of numbers, and conciseness) were also explicitly addressed by the test method, but did not show up as significant. More research is required to determine why the test method seemed to lead to significant improvement in some competencies but not in others. Possible reasons include the quality of the competency handout; the effectiveness of the in-class discussion on the competency; the extent and clarity of feedback provided on these competencies by professors using the test and control method; etc.

No attempt is made to generalize these results given the relatively small sample size, and no attempt is made to conduct an analysis of covariance. Certainly, confounding variables exist, including pedagogical differences between the two instructors; differences in student aptitude for writing at the start of the semester; student attitudes toward writing; etc. Moreover, the difficulty in isolating confounding variables for such a study also limits the ability to generalize the results. However, the results certainly suggest that the test method was more effective than the control method for certain categories.

Student opinions and feedback on the process were not formally collected for this paper. Informally, students in the test section commonly expressed their opinion that they were "getting off easier" than students in the control section, given the lighter workload. On the end-of-semester evaluations, students in the control section praised the style of writing instruction.

The moderate success of the test method is heartening in one sense, given that the faculty workload for implementing this method was less than the faculty workload for the control section. Specifically, the grading load for the test method was significantly less, as the test method assignments tended to be briefer than the assignments for the control section. Rather than require students to complete regular technical memos or reports, the test method had tailored weekly assignments that often focused on a single competency. Obviously, this is potentially good news for students, in that a method that requires less time investment on the part of the student may lead to more effective writing as compared to more time intensive assignments.

The rigor of the control method and the fact that it heeded much of the advice in the engineering education literature on how to teach writing makes the success of the test method even more notable. The results would have been much less interesting and useful if the control section had required minimal writing, had not provided students with any writing instruction, or had not provided students with thorough written feedback. To the contrary, the control section adhered to advice provided in the literature.

- In accordance with the advice of Evans,[(2)] students were provided with many opportunities to practice writing. Although student word count was not assessed for this study, students in the control section wrote approximately twice as much (in terms of word count) as students being taught with the test method.

- Moreover, the control section's use of a single lecture on writing guidelines agrees with the published method of Berthouex.[3] As Berthouex states, distributing writing rules in an engineering class is "emphatic" and shows the students that the professor is "serious" about writing.
- The control method obeyed other advice by Berthouex by using a large amount of written feedback, which convinces students how much the faculty member values effective writing. [3]
- Assignments created in the control section adhered to the many of the steps outlined by Carvill et. al.[6] Specifically, assignment features (purpose, length, guidelines) were specified clearly; the type of document was specified; the audience was identified; assignments were graded with a rubric that was available to the students before they submitted their work.

In summary, the test method shows promise as a means of improving student writing effectiveness. Compared to more traditional methods of teaching writing, the test method requires less time commitment for grading and can be tailored to the weaknesses of individual classes. Moreover, it highlights the fact that requiring students to practice writing multiple times might not be the most effective means of improving their writing.

References

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Appendix: Grading Rubric

Name: _____ Score: _____

Engineering Writing Rubric

	Distinguished (4)	Proficient (3)	Limited (2)	Unsatisfactory (1)
CONTENT				
Purpose **Points:**	Objective clearly stated; reader understands why paper was written	Objectives stated; provides direction for paper	Objectives unclear and/or mechanical	Incomplete, ineffective, or not stated
Quality of ideas/arguments **Points:**	Writer expresses original, interesting, relevant, and complete ideas	Ideas are relevant and thorough	Ideas may be lacking in relevance; mechanical; lacking in originality; or incomplete	Absent or ineffective
Support or Evidence (sample calculations, graphics, numerical results, etc.) **Points:**	Evidence is relevant, complete, presented in a professional manner, and is appropriately creative	Relevant and complete evidence is presented in a professional manner.	Evidence is either not pertinent, incomplete, or presented unprofessionally	Arguments are supported with inaccurate. unfocused, or otherwise ineffective evidence.
Conclusion **Points:**	Extends and connects in addition to summarizing	Completely summarizes previously stated information	Incompletely and/or inaccurately summarizes previously stated information	Absent, incomplete, or unfocused
ORGANIZATION				
Topic Sentences **Points:**	Every paragraph has a topic sentence utilizing effective transitions; all supporting sentences relate to topic sentence.	Every paragraph has a topic sentence; all supporting sentences relate to topic sentence.	One or more paragraph is missing a topic sentence or contains supporting sentences that do not relate to topic sentence.	Most paragraphs are missing a topic sentence or contain supporting sentences that do not relate to topic sentence.
Paragraph Order **Points:**	Contributes to an effective argument; reinforces the content	Demonstrates a clear plan	Ineffective or inconsistent	Random
Transitions (between sentences) **Points:**	Effective and varied transitions greatly assist audience in reading the paper.	Transitions are used consistently	Mechanical and/or repetitive transitions throughout	Transitions are absent for the most part.
MECHANICS & LINGUISTICS				
Word Choice **Points:**	Engaging, powerful, and appropriate	Appropriate to task	Inconsistent quality	Limited, monotonous, inappropriate
Grammar/Punctuation/Spelling **Points:**	Error-free	Some errors, yet professional	Careless or distracting	Errors block meaning
Tone **Points:**	Distinctive; appropriate to task and audience; consistent	Clear, authentic, and consistent	Mechanical or inconsistent	Unclear and inconsistent
Formatting **Points:**	"Looks" like a textbook or other professional document	Formatting helps make document easy for audience to read	Student attempts to follow norms of engineering communication, but inconsistent or otherwise ineffective	Formatting (or lack thereof) does not assist reader.