

AC 2009-2080: WRITING TO LEARN: THE EFFECT OF PEER TUTORING ON CRITICAL THINKING AND WRITING SKILLS OF FIRST-YEAR ENGINEERING STUDENTS

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Writing to Learn: The Effect of Peer Tutoring on Critical Thinking and Writing Skills of First-Year Engineering Students

Critical Thinking, First-Year Engineering Students, Writing Fellows

Abstract

In an effort to study the writing and critical thinking skills of first-year engineering students, the authors have engaged in a research study which asks whether critical thinking and writing of first-year (FY) students can be improved by linking engineering with English courses. One intervention developed for this study was the use of Writing Fellows (undergraduate peer tutors) in the engineering course. Writing Fellows (WF) have been found to be effective at enhancing the writing abilities of students in courses across the curriculum. The specific sub-questions for this segment of the larger study are the focus of this paper: Does the WF experience improve writing and critical thinking? Do the FY students perceive the WF experience as helpful? Can the Writing Fellow experience help improve scores on reports in the engineering course? How does the experience have an impact on the Writing Fellows who are also Engineering students? Four undergraduate engineering students and one undergraduate English student were chosen as WFs. There were 71 students enrolled in Engineering 1111, a one-credit introduction to engineering course. The FY students in the class wrote two reports based on design activities: one was written at the beginning of the semester and the other at the end in order to compare scores and the effectiveness of the interventions. Results of grades on assignments, student evaluation of the tutor experience and reflective experiences of the WFs themselves were positive. These initial results confirm and extend work done with Writing Fellows across the curriculum: WFs do enhance the writing skills of students in the disciplines; the students perceive them to be helpful; and they do help content-based writing scores. In addition, the WFs' writing and communication skills benefit from the experience.

Introduction

In an effort to study the writing and critical thinking skills of first-year engineering students, the authors have engaged in a research study^{1,2}, which asks whether critical thinking and writing of first-year (FY) students can be improved by linking engineering with English courses. One intervention developed for this study was the use of Writing Fellows (undergraduate peer tutors) in the engineering course.

Writing Fellows (WF) are undergraduate peer tutors who come from the disciplines of the students they are tutoring. Many universities across the United States and now abroad (O'Neill³) engage these tutors in various ways across the curriculum. The notion of peer tutoring draws on Bruffee's^{4,5} work on collaboration—that the work of the academy is a conversation and we are engaging students in that conversation, and that collaboration is a means of advancing that conversation. Writing Fellows (WF) have been found to be effective at enhancing the writing abilities of students in courses across the curriculum,

such as biology (Gladstein⁶Spigelman and Grobman⁷), and as agents of change—that is positively affecting the writing across disciplines (Mullin et. al⁸). The Writing Center director at Oklahoma State University and one of the authors had successfully piloted a writing fellow program in History and Animal Science, so for this study, the authors wanted to examine the benefits within the context of the writing and critical thinking study as a writing intervention. The specific sub-questions for this segment of the larger study are the focus of this paper: Does the WF experience improve writing and critical thinking? Do the FY students perceive the WF experience as helpful? Can the Writing Fellow experience help improve scores on reports in the engineering course? How does the experience have an impact on the Writing Fellows who are also Engineering students?

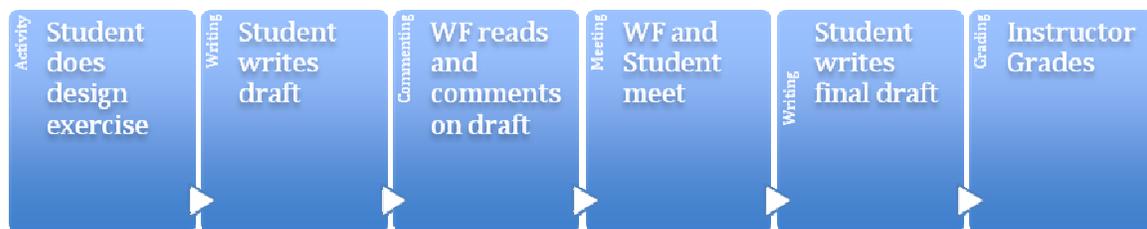
Method

The 71 students were distributed across four sections of Engineering 1111, a one-credit introduction to engineering course. The FY students in the class wrote two reports based on design activities: one was written at the beginning of the semester and the other at the end in order to compare scores and the effectiveness of the interventions. Four undergraduate engineering students and one undergraduate English student were chosen as WFs. The engineering students had taken the Engineering 1111 course the year before and had been identified by the course instructor as excellent students and writers. The English student had been trained and worked as a writing fellow for the Writing Center earlier.

The Writing Fellow Process

For each report, the students were required to turn in a draft, i.e. the Fellow Draft. The reports were distributed to the Writing Fellows who then read the reports; filled out a checklist (based on the requirements of the assignment); and wrote a cover letter, which addressed the strengths and weaknesses of the individual student’s report. The Writing Fellow and FY student then met for a 30 minutes face-to-face tutorial to discuss the Writing Fellow’s comments on the paper. The meetings took place in a lab in the engineering building, which was convenient, but also to put the students at ease in a familiar environment. The FY students then revised the reports and turned in the final draft to the Engineering 1111 instructor, who then graded the reports. See Figure 1 for the process.

Figure 1. The Writing Fellow Process



The Assignments and Writing Fellow Comments

Both assignments for the semester were reports based on design experiences. All students did the first assignment, the Aircraft Design Project. The second design experience varied by section. However, the report requirements were the same for all assignments. They were designed as Introduction, Methods, Results, Conclusions and Implications, with a section for formatting called 'Requirements'. The assignments were written around the eight Elements of Critical thinking from the Paul Model of critical thinking^{9,10}. See Figure 2 for the Aircraft Design assignment.

Figure 2: The Aircraft Design Assignment Sheet

Individual Introduction Lab Report
<p>The purpose of this report is for you to consider the differences between product and process design using information and evidence from your reading on D2L ("ProductProcessDesign.pdf") and your aircraft design experience in order to understand the relationship of the two for engineering. (Your report will consist of the following five sections)</p>
<p>Introduction Your introduction should give background to the activity (including your definitions of product and process-from your sources) and your point of view about process and product design (the importance of process and product design in Engineering). Your research question is "What is the difference between product and process design?" and your thesis should answer this question.</p>
<p>Methods This part of your report should describe your team (team name and members). Describe the team prototype and why it was selected (the materials you used, and the steps you went through to design your aircraft prototype). Then detail the manufacturing method of your final chosen prototype.</p>
<p>Results Describe the results of the product ranking and process evaluation (this should be presented in a graphic form -e.g. a table, graph, figure). (What ranking in the contest did your aircraft receive?). How does this compare to other teams and why (what can you learn from looking at the other team prototypes and manufacturing processes)?</p>
<p>Conclusions This section should discuss the strengths and weaknesses of your product and process design tying that in with your team process. (Did team issues facilitate or hinder your product/process?). (You may compare your results with other teams using the data, pictures and video on D2L).</p>
<p>Implications The purpose of the Aircraft Design Challenge experiment was to help you understand the difference between product and process design. Comment on your understanding of these two concepts. How do the results of your lab help you understand the importance of these concepts for Engineering? (How does product or process design affect the other and vice versa? Why is understanding these two concepts important for engineers?)</p>
<p>REQUIREMENTS:</p> <ul style="list-style-type: none">• Minimum of 3 pages, maximum of 5 pages double-spaced/1" margins/12 point font plus bibliography page (for a total of 4 to 6 pages)• Separate bibliography page (use APA or MLA style)• Use the headings in bold on this assignment sheet in your report and number pages

The Writing Fellows used a checklist that indicated areas of concern on the reports. The checklist was developed from the assignment. See Figure 3 for the example of the checklist for the Introduction section of the report. The checklist and a cover letter, which summarized the Writing Fellows' comments were reviewed in the face to face session. In keeping with writing tutor practice, the Writing Fellows did only minimal marking on the students' papers so as not to appropriate the students' work.

Figure 3. Writing Fellow Checklist Introduction Example

X = Area of Concern	Student Name: _____
	Class Section: _____
	Tutor Name: _____
Checklist	
Introduction	
Background to activity	_____
Clear and specific definition of product/process design	_____
Point of view of the importance of product and process design in engineering	_____
Thesis statement that answers "What is the difference between product and process design?"	_____
Correct use of sources	_____

The Writing Fellow Experience

The Writing Fellows participated in a 20-hour training period the week before the semester started. A text ¹¹ for training peer tutors, which included both the theoretical and practical aspects of the peer tutoring process, was used as part the training process. Topics included everything from the writing process, to working with grammar and mechanics, as well as how to conduct face to face tutorials. The Fellows continued to meet weekly with their supervisor throughout the semester. The Writing Fellows were asked to write two reflection papers, one during the training week about their writing background and one at the end of the semester about various aspects of the program to determine the effects of the program.

Results

Results show that WF experience has an effect on student performance. On the first report of the semester, 69 students (out of 71) turned in the design project report. The overall average grade for the project was 81.8%. For the 44 who met with writing fellows, the average was 85.8%, and for the 25 who did not the average was 74.4%. Report subsections showed differences as well as shown in Table 1.

Table 1. Report Scores for Design Projects

Report Subsection	Aircraft Design			Second Design		
	All	WF	No WF	All	WF	No WF
Introduction	69.0	74.1	60	78.2	82.2	58.2
Methods	87.8	90.5	83.2	83.0	84.2	77.3
Results	82.2	88.6	70.8	92.4	93.3	88.2
Conclusions	81.7	82.7	80	88.2	90.2	78.2
Implications	78.7	83.0	71.2	82.0	84.0	71.8
Formatting	87.2	90.0	82.4	91.8	93.3	84.5
Overall score	82.0	85.9	75.0	86.5	88.2	78.0

Clearly meeting with the Writing Fellows affected the scores on both projects. Students scored on average, one grade higher when they met with the Writing Fellows.

Table 2 shows the effect of multiple meetings with the Writing Fellows. All students who turned in their report drafts received them back with comments and checklists; however, some did not show for their meetings, especially on the first report. The table shows students who met with the Writing Fellows benefitted from the face-to-face experience. The students who had two meetings with WFs clearly scored more highly on average than those who never met, or only met once. Interestingly, for the 4 who never met with their WF, their second project score was 81.6%, but still below those who met twice!

Table 2. Scores of Reports By Meeting with Writing Fellow

<u>Number of WF Meetings</u>	Never (n=4)	Once 1 st (n=5)	Once 2 nd (n=21)	Twice (n=37)
Report Subsection				
Introduction	60.0	56.0	72.0	86.5
Methods	80.0	78.0	78.5	86.5
Results	87.5	84.0	89.5	95.7
Conclusions	85.0	72.0	79.0	95.7
Implications	82.5	62.0	84.0	83.5
Formatting	85.0	86.0	89.0	94.9
Overall score	81.5	74.8	83.3	90.3

The instructor announced to the class the overall results of the first round: that the students who had met with the writing fellows scored higher on their reports. This seemed to motivate students to visit the WFs for a second (or first) meeting. These were confirmed in the reflections of the WFs, who commented that the second that the face-to-face meetings were much more productive. round of papers were much better, the attitudes of the students much more positive and

FY Student Perceptions

The evaluations of the WF experience showed that the FY students perceived the experience positively with averages of 4.8 or higher on the overall evaluation of the WF and the WF experience on a 5-point scale. See Figure 4 for the evaluation questions and averages.

Figure 4. Writing Fellows Evaluation

	Average	Round 1	Round 2
Checklist Comments:			
Comments are clear		4.81	4.83
Comments address areas of concern other than the ones covered in the appointment		4.81	4.64
Cover Letter Comments:			
Cover letter comments were clear		4.76	4.63
Usefulness of comments for revision		4.79	4.75
Writing Fellows Consultation:			
Opportunity for my active participation		4.77	4.79
Suggestions supplement/expand cover comments		4.85	4.76
Overall value of appointment		4.76	4.76
Overall Experience:			
Overall rating of Writing Fellow		4.87	4.84
Overall rating of Writing Fellow experience (checklist + cover letter + consultation)		4.81	4.87

Comments from students on the evaluations included things such as “Good program. Very helpful”, “very clear explanations”, and “This session was very useful and I would enjoy being able to utilize this tool in the future.” In addition, on a writing perception survey conducted as part of the research, two students, unprompted, indicated that they would like more contact with the WFs.

The Writing Fellow Experience

Because four of the five WFs were engineering students, the authors were interested in the effect of the program on these students’ writing and communication skills. The results of the evaluations showed external results that they were effective in the tutoring sessions. Their final reflections show that they did, indeed, perceive the benefits, in very specific ways, to their writing and general communications skills. Figure 5 contains excerpts from the WF final reflection papers.

Figure 5. Writing Fellow Final Reflections

My experience with the WF program has strengthened my writing. I make sure to apply the writing process to my own writing now; I am more comfortable with its purpose and its benefits. I think the most valuable lesson I learned is how to effectively review writing and to know where/how to best improve upon 'mistakes,' such as poor transitions, poor audience analysis, and lack of a predominating theme throughout the writing.

Throughout the semester I have been writing papers for a management class I am enrolled in. I have received a perfect score for every assignment. I think this is a result of writing fellows which brought my attention to the content of the paper rather than the structure. So the lesson I learned most from writing fellows is there are different types of writing and using these to fit the assignment will improve your overall performance.

I think the thing that I will take away from this experience most is the feeling of what it is like to walk a couple steps in the instructors' shoes. It can be frustrating at times while very rewarding at the same time. I think I have a better grasp over the writing process and that it really does affect the final outcome of an essay. I also now realize how something on paper can seem so right in your head and make absolutely no sense to someone else. I used to have that problem in high school and just thought the teacher didn't get it. Now I see she didn't get it, but it was my fault.

This process has helped me develop my own writing. When preparing to write a paper, I put more emphasis on the writing the first draft and revising my paper. Also, I am more aware of the mistakes I make in my own writing. I am now more conscience of my audience, my tone and the overall organization of my paper. Being a writing fellow has enhanced my own writing skills, and I believe my experiences will help me throughout my career. Helping other students with their papers has improved my written and oral communication skills, and it has also made me more patient. I believe the overall process has helped all the parties involved.

Overall writing fellows took me beyond my comfort zone with the sharing of my writing and the reviews that we did the first week. I know this will benefit me in the future not only in writing but with my communication skills as well.

These students became aware of and enacted good writing practices in their own writing: attention to audience, attention to the process, focus on content for specific purposes, and specific sentence level issues.

Conclusion

These initial results confirm early work done with Writing Fellows across the curriculum: WFs do enhance the writing skills of students in the disciplines, the students perceive them to be helpful and they do help content-based writing scores. In addition, the WFs themselves engineering students benefit in their own writing and communication skills through the process.

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