

Using Writing Center Peer Tutors as a Means to Improve Mechanical Engineering Technology Student Writing

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Abstract

Despite the well-established importance of written communication skills for students in STEM disciplines, the quantitative assessment of STEM writing remains an evolving field. The present work seeks to measure the effectiveness of “generic” writing center tutors on the technical writing skills of senior-level Mechanical Engineering Technology students. A set of nineteen student analysis reports selected from a capstone design course were used as the source of the data. The reports were assessed both before and after a tutoring session using a version of the AAC&U VALUE rubric and a voice-development-style-diction method developed by the authors. By both methods, the improvements in student writing from before the tutoring session to afterwards were marginal at best, with some measures even showing a decrease in performance. The sole exception was that a significant increase in hedging, boosting, and attitude words appeared in the students’ work, indicative of a change in diction. It is concluded that an intervention by a “generically” trained writing center tutor has little effect on the quality of student writing outside of that due to the inclusion of additional adjectives. An intervention by tutors specifically trained using the WATTS methodology is proposed as a means to address this. Such an intervention will be investigated as an extension to the current work.

Introduction

The quantitative study of the differences in writing styles between and even within disciplines has been the topic of multiple studies. Boettger and Wulff [1], and Wolfe [2] are two such examples investigating variations in STEM writing. A review of roughly two decades of research on technical communication by Boettger and Lam [3] analyzed 137 articles over the period of the study. More recent works by Boettger and Wulf [4] and by Lerchenmueller, Sorenson and Jena [5] analyzed the diction and voice of published academic works in STEM disciplines, finding differences in both depending upon the lead author’s gender.

In earlier works, [6-8], the authors performed a quantitative study of STEM writing, analyzing works by practitioners (e.g. professionally-prepared, such as journal articles) and compared features of their writing to each other and to these same aspects of student work. The aspects assessed were voice, development, style and diction. The authors discovered pronounced differences not only between student writing and practitioner writing, but also between practitioner writing samples from different disciplines. For example, the academic physics writing style had significant differences in voice, diction, and development from mechanical engineering writing, and mechanical engineering writing had significant differences in the same aspects when compared with academic structural (civil) engineering and electrical engineering writing. In the present work, the authors analyze the “analysis reports” written by senior-level Mechanical Engineering Technology (MET) students as part of their senior design sequence.

The Senior Design Sequence and Analysis Report

The student design projects span two-semesters. The analysis reports are written at the beginning of the second semester. All but one of the projects were for industrial sponsors, the exception was a project intended to produce a design to meet an internal institutional need. The students work on the projects in teams of three, with occasional teams of four to ensure all students have a team and none is working alone or in a team of two. All of the projects are different.

After introductory work in which the problem is defined, the project criteria are developed, and background research is conducted, the students develop preliminary designs and proceed to the analysis phase. Each team sub-divides its preliminary design into manageable pieces, which are then analyzed for sufficiency by individual team members. For example, a design for a chair might be divided into legs, seat, and back, with one student analyzing a separate component for adequacy as appropriate to the design (strength, stiffness, weight, etc.). The results of these analyses are documented in reports written by individual students, which are then submitted for grading. The reports all use an instructor-provided template to ensure uniformity of appearance.

Assessment Methodology

The intervention is part of a larger multi-year effort comparing student writing styles and variability. Future work will include the analysis of student papers that received specialized WATTS trained tutoring.

The study began with an analysis of student papers in the absence of any tutoring to provide baseline data. The data that are presented in this paper are the “control” group, student papers that received tutoring from a “generic” tutor. The student papers were collected in draft form prior to a visit with a tutor. The students were advised that seeing a writing center tutor was a mandatory component of the assignment. The students submitted their edited reports within a week following their visit with the tutor.

The untutored and tutored papers were assessed using two scales: an adapted version of the AAC&U VALUE Written Communication Rubric and the authors’ voice-development-style-diction scale as used in [6]. As this intervention is ongoing, data from a third cohort who will receive tutoring from “Writing Assignment Tutor Training in STEM (WATTS)” prepared tutors will be compared to that from the first two groups. It is anticipated that MET students who interact with the WATTS tutors will exhibit less variability in their written works and greater harmonization with the writing style of in-discipline practitioners.

The results presented in this paper compare quantitative results as obtained from the VALUE rubric to those obtained using the voice-development-style-diction scale.

Results

The summary statistics for the assessment with the VALUE rubric are contained in tables 1 and 2.

Table 1: Summary statistics for student papers, pre-tutoring

	N	Minimum	Maximum	Mean	Std. Deviation
Context of and Purpose for Writing: Includes considerations of audience, purpose, and circumstances surrounding the writing task(s).	28	0	3	1.29	0.600
Content Development	28	0	3	1.36	0.731
Genre and Disciplinary Conventions: Formal and informal rules inherent in the expectations for writing in particular forms and/or academic fields."	28	1	3	1.64	0.678
Sources and Evidence	28	0	2	0.14	0.448
Control of Syntax and Mechanics	28	1	3	2.32	0.670

Table 2: Summary statistics for student papers, post-tutoring

	N	Minimum	Maximum	Mean	Std. Deviation
Context of and Purpose for Writing Includes considerations of audience, purpose, and circumstances surrounding the writing task(s).	33	1	3	1.42	0.561
Content Development	33	0	2	1.48	0.566
Genre and Disciplinary Conventions Formal and informal rules inherent in the expectations for writing in particular forms and/or academic fields."	33	1	3	1.70	0.684
Sources and Evidence	33	0	2	0.21	0.485
Control of Syntax and Mechanics	33	1	3	2.27	0.719

Note: The number of samples in each data set ("N") do not match, as the VALUE assessments were performed by third-party assessors in a random "blind" manner as part of the WATTS initiative. As a result, some reports were assessed multiple times, with independent assessments performed by separate assessors.

Preliminary results of the assessments of the student works using the authors' voice-development-style-diction assessment are in tables 3 through 5. These results are based on a random sample of ten selected from the set of student papers, totaling nineteen.

Table 3: Comparison of voice as measured by pronoun use

Pronoun	Frequency per paper, pre-tutor	Frequency per paper, post-tutor
Our	0.7	0.7
We	0.6	0.5
I	0.8	0.1
Us	0.0	0.2
You	0.1	0.2

Table 4: Comparison of style as measured by frequency of verb form

Verb form	As proportion of verbs, pre-tutor	As proportion of verbs, post-tutor
Active	18%	21%
Active conditional	4%	3%
Gerunds and Infinitives	33%	28%
Passive verbs	23%	17%
Statement of condition	20%	22%
Participles	1%	9%

Table 5: Diction by category as expressed as instances per report

Diction category	Instances per report, pre-tutor	Instances per report, post-tutor
Hedging	0.4	1.1
Boosting	0.0	0.5
Attitude	0.0	0.2

Analysis

The impact of the tutoring as measured using the VALUE rubric can be estimated by comparing the ranges, means and standard deviations of the different assessment categories. The net effect in each category is shown in table 6. A positive change is defined as an increase in the metric as measured from pre-tutoring to post-tutoring.

Table 6: Changes in parameters as measured by VALUE rubric

	Change in Minimum	Change in Mean	Change in Maximum	Change in Std. Deviation
Context of and Purpose for Writing: Includes considerations of audience, purpose, and circumstances surrounding the writing task(s).	+1	+0.13	0	-0.039
Content Development	0	+0.12	-1	-0.165
Genre and Disciplinary Conventions: Formal and informal rules inherent in the expectations for writing in particular forms and/or academic fields.”	0	+0.06	0	+0.006
Sources and Evidence	0	+0.07	0	+0.037
Control of Syntax and Mechanics	0	-0.05	0	+0.049

Figures 1 and 2 illustrate the changes in the students’ papers as measured using authors’ voice-development-style-diction assessment.

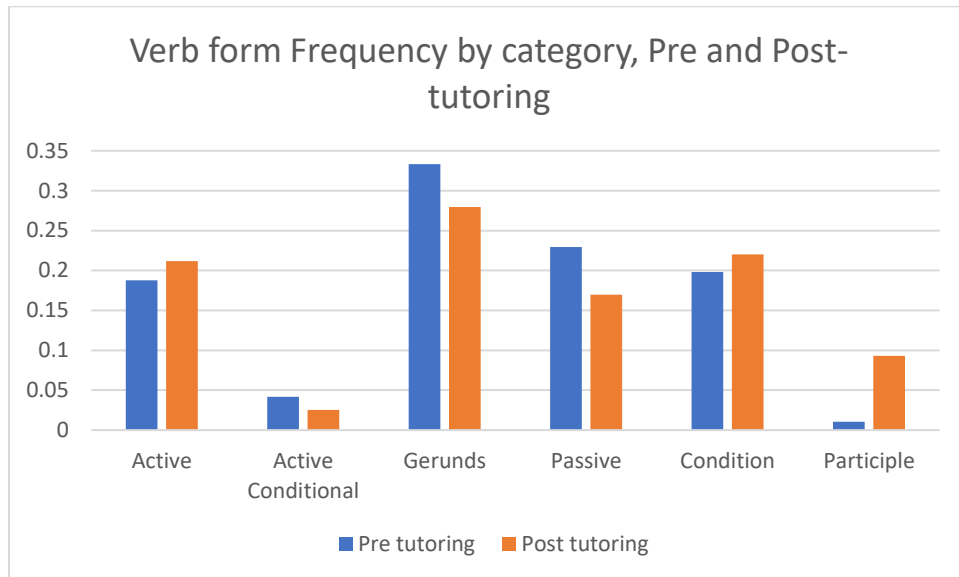


Figure 1: Verb form relative frequency, as measured pre- and post-tutoring

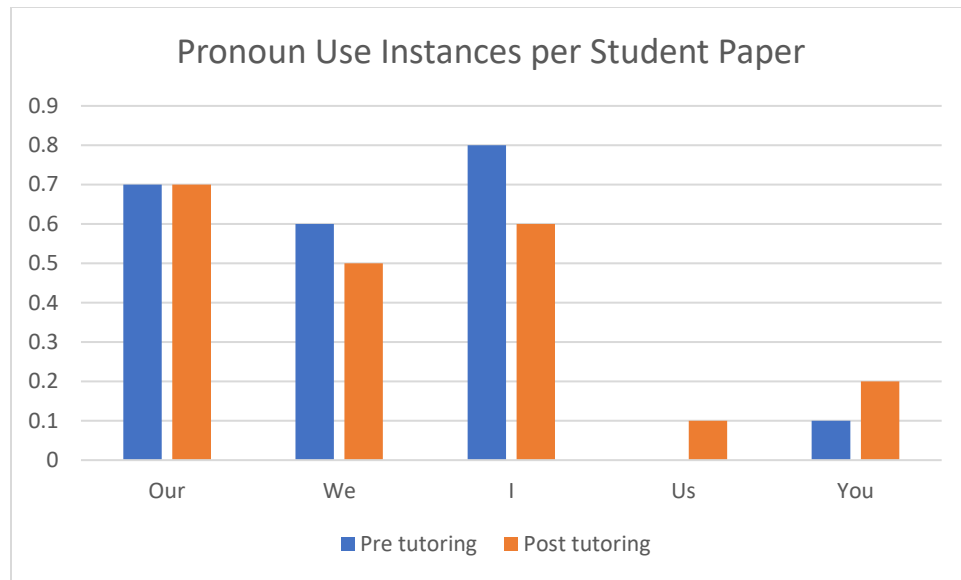


Figure 2: Pronoun use instances per student paper, measured pre and post-tutoring

Table 7 shows the change in usage of words from the diction categories listed pre- to post-tutoring, expressed as a number and a percent change.

Table 7:

Diction category	Change in instances per paper	Percent change in instances per paper
Hedging	1.1	+275%
Boosting	0.5	n/a
Attitude	0.2	n/a

Discussion

As shown in [6-8], pronoun use, voice, and style are not uniform between STEM disciplines, or even between closely-related fields, such as mechanical and structural engineering. Further, it was shown that there were significant disparities between student writing and that of practitioners. As professional writing styles are influenced at least partly by convention, the goal of developing a more mature writing style can be measured at least partly by the indicators used in the VALUE rubric, but also by comparison of the statistics as measured by the authors voice-development-style-diction metrics.

As measured by the VALUE rubric, the results were mixed. While four of the five measured categories produced marginal gains, one category (control of syntax and mechanics) showed a slight decrease. Further, the highest scoring paper in content development actually assessed lower post-tutoring. Overall, any claim as to the effectiveness of the tutoring process with generic writing tutors would be difficult to substantiate statistically.

A similar story is told as measured by the authors' metrics. With the exception of an increase in the number of participles in the student work, the relative frequency of the verb forms remained

almost unchanged when pre- and post-tutoring student works are compared. The use of first-person pronouns decreased only slightly, and the use of second-person pronouns increased.

The only truly significant changes when pre- and post-tutoring student works were compared were found in student diction. Here, there was a dramatic (+275%) increase in the use of hedging, boosting, and attitude words in the post-tutoring student works as compared to their pre-tutoring counterparts. As discussed in [6], the appearance of such words is consistent with a more mature writing style, especially in engineering disciplines.

Conclusion

From the results of this investigation, it can be concluded that “generic” writing center tutoring services at most only have a marginal effect on the quality of student writing. Reasons for this are discussed in [9]. The one significant change in student writing that was observed was in diction, and can likely be attributed to the intervention of the generic tutors and lends insight as to the influence of the generic writing center tutors on the students’ writing. As it currently stands, this influence seems restricted to the addition of the various adjectives; the overall structure, style, voice, clarity, supporting evidence, and mechanics showed little change, with some student papers even showing evidence of regression.

The next stage of this study will investigate the effect of WATTS trained tutors upon student writing, which will be the subject of future works.

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