

A Longitudinal Study of the Integration of Writing Support in a Multi-Semester Senior Capstone Course

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Ruth Pflueger has been the director of the Learning Resource Center at Penn State Behrend for 20 years, where she is also an affiliate instructor of English. She has been involved in a number of federal grants, including two NSF STEM grants, an EU-Atlantis grant, and is currently PI for an NSF IUSE-EHR collaborative grant.

Prof. Jonathan Alan Meckley, Pennsylvania State University, Behrend College

Jonathan Meckley has been the Chair of the Plastics Engineering Technology program at The Pennsylvania State University at Erie, The Behrend College (PSB) for 10 years. He is now the Program Coordinator. He has been teaching full-time since 1999 and part-time since 1990. In 2008 he was promoted to Associate Professor. Mr. Meckley has been a firm believer in the need for better writing for engineering and won "Best Paper in the Injection Molding Division" for the Society of Plastics Engineers Annual Technical Conference in 2008.

During his time at Penn State, he has been involved with Senior Project teams and advised on their papers. One of his goals with his lab courses was to increase the quality of lab reports with a focus on explaining why the results are happening. When the program created the new Senior Project format, the guidelines for writing came from the lab course and modified to fit the content for a project.

Several years ago, he was sending his students over the writing tutors so they could improve their writing and turn in a report that was easily readable. While there was some improvement, the reports still were not easily readable. Dr. Weissbach and Ms. Pflueger were working on training a group of writing tutors to improve the writing tutor experience. He trained his first group of tutors and sent students to them for report improvement. While it was an improvement, refinement of the tutor training was needed. Over the course of several years, the method did produce good student interaction and better reports from the students.

He will be responsible for the tutor training at PSB. He will also assist with research instruments, data collection, and assessment activities.

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Abstract

ABET lists the ability to communicate in writing to both technical and non-technical audiences as a required outcome for baccalaureate engineering students [1]. From emails and memos to formal reports, the ability to communicate is vital to the engineering profession. This Work in Progress paper describes research being done as part of an NSF-funded project, Writing Assignment Tutor Training in STEM (WATTS). The method is designed to improve feedback writing tutors without technical backgrounds give to engineering students on technical reports.

Students in engineering programs have few opportunities to develop their writing skills. Usually, composition courses are part of the general education curriculum. Students often see these courses as unrelated to their majors and careers [2]. Ideally, writing support should be integrated throughout a program. Since WATTS capitalizes on existing resources and requires only a modest amount of faculty time, it could enable engineering programs to provide additional writing support to students in multiple courses and provide a bridge for them to connect writing concepts learned in composition courses and their technical reports.

WATTS was developed in a junior-level circuit analysis course, where students were completing the same lab and writing individual reports. This paper focuses on a senior capstone course that utilizes concepts taught in previous courses to prepare students to complete an independent team research or design project. Projects are unique, usually based on the needs of an industrial sponsor, and are completed over three consecutive semesters. Each semester, teams write a report based on their activities during that semester, with a comprehensive report in the final semester.

The multi-semester nature of the senior design project provides an opportunity for the researchers to chart longitudinal changes from the first to the students' third semester interactions with the writing tutors, assessing the value of an integrated approach. The program's impact on students' attitudes toward revision and the value of tutoring, as well as the impact on tutors, are part of the assessment plan. The goal is to change the students' focus from simply presenting their results to communicating them.

The goals of the project are to demonstrate to students that revision is essential to the writing process and that feedback can improve their written communication abilities. The expectation is that they will continue to seek critical feedback as part of their career growth even after graduation. Surveys given to both students and tutors revealed that the sessions were taken seriously by the students and that meaningful collaboration was achieved between them. An evaluation of the writing in pre-tutored to final submitted report shows statistically significant improvement. Preliminary and current results will be included in the paper.

Introduction

The WATTS training is an interdisciplinary collaboration between an engineering instructor and peer writing tutor supervisor. They conduct the one-hour tutor training together. The instructor presents the content, which in the case of the circuits lab consisted of describing the assignment, giving the tutors a layman's understanding of the lab, and comparing samples of well and poorly written reports. The supervisor relates the tutors' previous tutoring experience to this application of writing principles that students are taught in first-year composition courses, but rarely retain.

As noted above, WATTS was developed in a course where all students were completing the same lab and writing their reports individually. Adapting WATTS training to a senior design course where students work in teams and write a team report for unique projects posed substantial challenges. However, adaptations to the training enabled the collaborators to maintain the one-hour timeframe.

First, since it was clearly not possible for the instructor to give the tutors a layman's description of all the projects, the students did that via an elevator speech that they were required to prepare and present to the tutors at the beginning of the tutoring session. This practice not only benefits students beyond its use in the tutoring session, but also facilitates rapport between the students and tutors. Second, it was necessary for all team members to be present during the session, as they divide the report writing among themselves. Third, the content needed to be reconsidered. The description of the assignment was a much longer document, which included templates for each semester. The templates were used to "describe the assignment." Also, rather than using well and poorly written sample reports, the instructor used sample paragraphs of elements that were common among all reports, e.g., equipment choice and description, explanations for graphs and results.

The Senior Project

The senior project is a team research and design experience that spans three consecutive semesters. In the first semester, the students research the project area and learn more about the background they need to understand their project. The students are told to become "experts" in their project area. They need to show where their project fits into the body of research that has already been done. The students are asked to form a hypothesis on the outcome of their experiment. These students will then create a project plan. During the second semester, the students should complete most of the project and justify the selection of the molding and testing equipment used. They must include a discussion of a key result that proves or disproves their hypothesis. In the third semester, students finish any remaining research and write a comprehensive report presenting a key set of results that prove or disprove their hypothesis.

For this study, only teams who started their project in Fall 2020 and completed all three sequential semesters have been included. There were originally five teams. One was disbanded after the first semester because of poor performance. They began a new project the following semester. One of the included teams received a deferred grade in their third semester and are currently working to finish their project.

During the first week of the first semester, the new students are provided a list of projects and rank them from their favorite to their least favorite. A faculty member composes the teams based

on students' top three choices. The faculty evaluate the students regarding their work ethic and change pairings based on the students' ability to work together.

Each team consists of two or three students and has a project advisor who guides them throughout their project. Each team has two graders who are current in the project area. Every semester, all student teams present their progress and results to the entire senior project class and all the professors. Both students and faculty can ask questions. The faculty assess the progress and provide feedback. The teams use this feedback to strengthen their reports.

Students are evaluated on several distinct criteria. The report comprises 40% of their grade and they are informed from the onset that the report grade is based on the quality of the report, not the research they perform. It is their responsibility to present their work in a logical and readable manner. The writing tutors can provide support in that area.

Reports have a ten-page limit. The students must include necessary, relevant information while being mindful of the paper's length. Students are given a report guide that helps them determine the required information in each section of the report. Templates are used to ensure that they use the correct format for each semester's report.

Students are instructed that the entire team must attend the tutoring appointment. Occasionally, if circumstances merited, an absence was permitted. The role of the writing tutor is explained during class. Students are informed that the tutors will not revise their reports. They will point out errors and explain the reasons for the suggested revisions. It is to be a learning experience, which is why the entire team is to be present.

Results

The data presented below is part of a large, comprehensive data plan that includes WATTS implementation at two other institutions across three campuses, for a total of four campuses. Baseline (no tutoring), control (tutoring with untrained tutors) and experimental (tutoring with WATTS-trained tutors) reports have been collected. A modified version of the Association of American Colleges & Universities (AAC&U) VALUE Written Communication Rubric is being used throughout the project to assess the writing of all reports—untutored, pre-tutoring and post-tutoring. The evaluation of the quality of the writing has been completed for the baseline reports. The evaluation of the control reports is currently underway. The experimental stage reports are scheduled to be evaluated during the 2022/2023 academic year. However, in spring, 2019, prior to the NSF grant, student writing was evaluated with funding provided by an institutional seed grant. Two raters assessed writing samples taken before and after tutoring by WATTS trained tutors. Overall, statistically significant improvement was found, $p < .01$. Of all four campuses, the senior project students had the largest effect size, at a significance level of .001.

A number of surveys are completed by faculty, students and tutors. The following data have been excerpted from student and tutor surveys. Student responses are individual. Tutor responses evaluate teams rather than individuals.

The questions were chosen to illustrate the students' perception of the value of tutor feedback to the revision process (which is essential to continued improvement in writing), and the likelihood that they will continue to seek feedback and revise technical documents when they are employed.

Survey questions were rated on a scale of one to seven. The responses were converted to a numerical value and averaged. This can be seen in Table 1. For each graph, the Y-Error Bars are set to the 95% Confidence Interval.

Table 1 - Student Response Numerical Conversion

7	Strongly Agree
6	Agree
5	Somewhat Agree
4	Neither Agree nor Disagree
3	Somewhat Disagree
2	Disagree
1	Strongly Disagree

Table 2 - Writing Tutor Appointment Statistics

	Number of Appointments			Combined Length of All Appointments		
	Fall 2020	Spring 2021	Fall 2021	Fall 2020	Spring 2021	Fall 2021
Group No. 1	1	2	2	0:20	2:00	1:30
Group No. 2	1	3	2	0:25	1:05	1:15
Group No. 3	1	3	2	0:15	2:45	2:00
Group No. 5		2	2		1:15	1:30

Tutoring sessions for the four teams that finished their projects in three semesters can be seen in Table 2. Teams were required to attend only one session, which they did in their first semester, except for one team that did not meet the requirement. Session length was brief. Session length is essentially a negotiation between the students and the tutor. If students are not engaged and tutors are uncomfortable, the session ends quickly.

During the second and third semesters, all teams scheduled one or more sessions beyond the requirement. This indicates that the students saw value in the tutoring experience to improve their reports. This is reinforced by the fact that the length of the sessions increased as well.

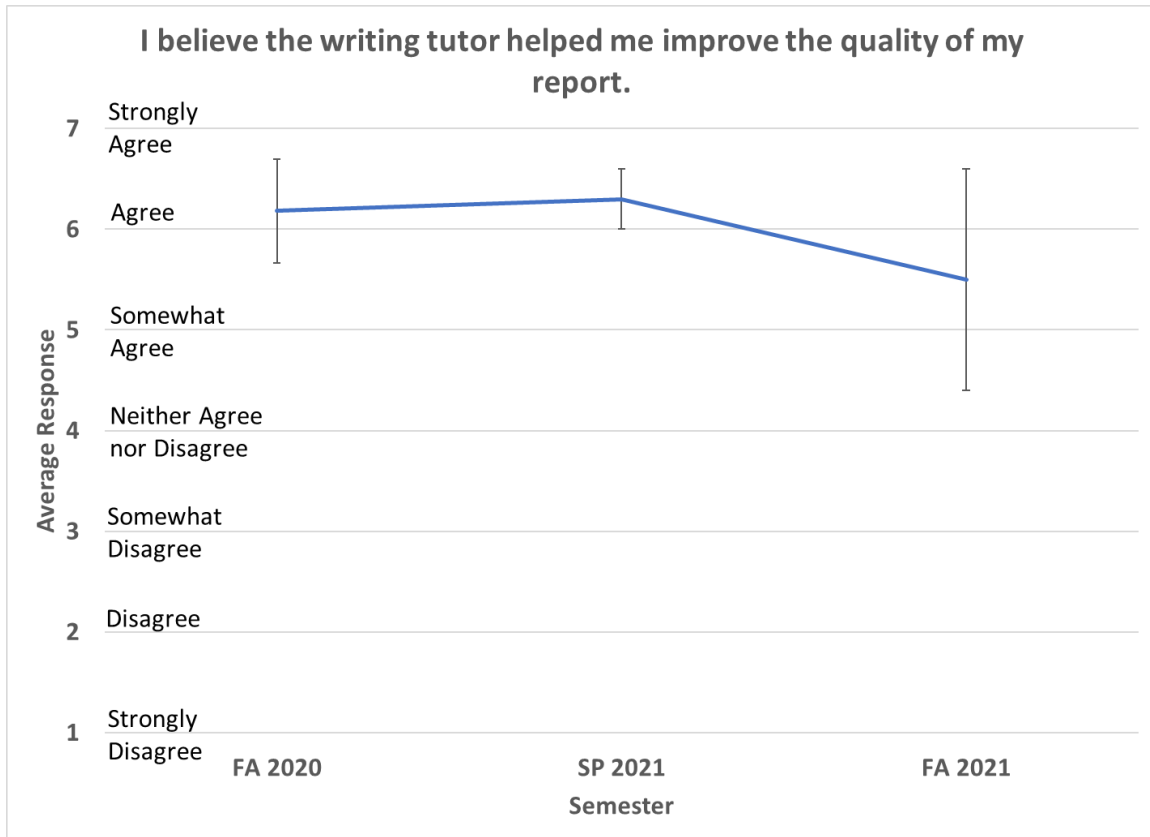


Figure 1 - Student comment on Tutor's ability to improve the quality of the report

In Figure 1, the semester is indicated on the X Axis and the Average Response is plotted on the Y Axis. Responses were mostly in the Strongly Agree and Agree categories for the first and second semesters. There was some dissatisfaction during the third semester. There were two Disagree/Strongly Disagree responses that skewed the average below six. Because of Covid, some teams were unable to perform most of their research during the second semester of their project. Completing research in their final semester would have added to their workload and delayed the writing of their reports. In addition, to give students time to meet with a tutor and revise their reports, their drafts are due approximately one week before their final report is due. This created additional stress and added to their frustration and most likely dissatisfaction with the quality of their reports.

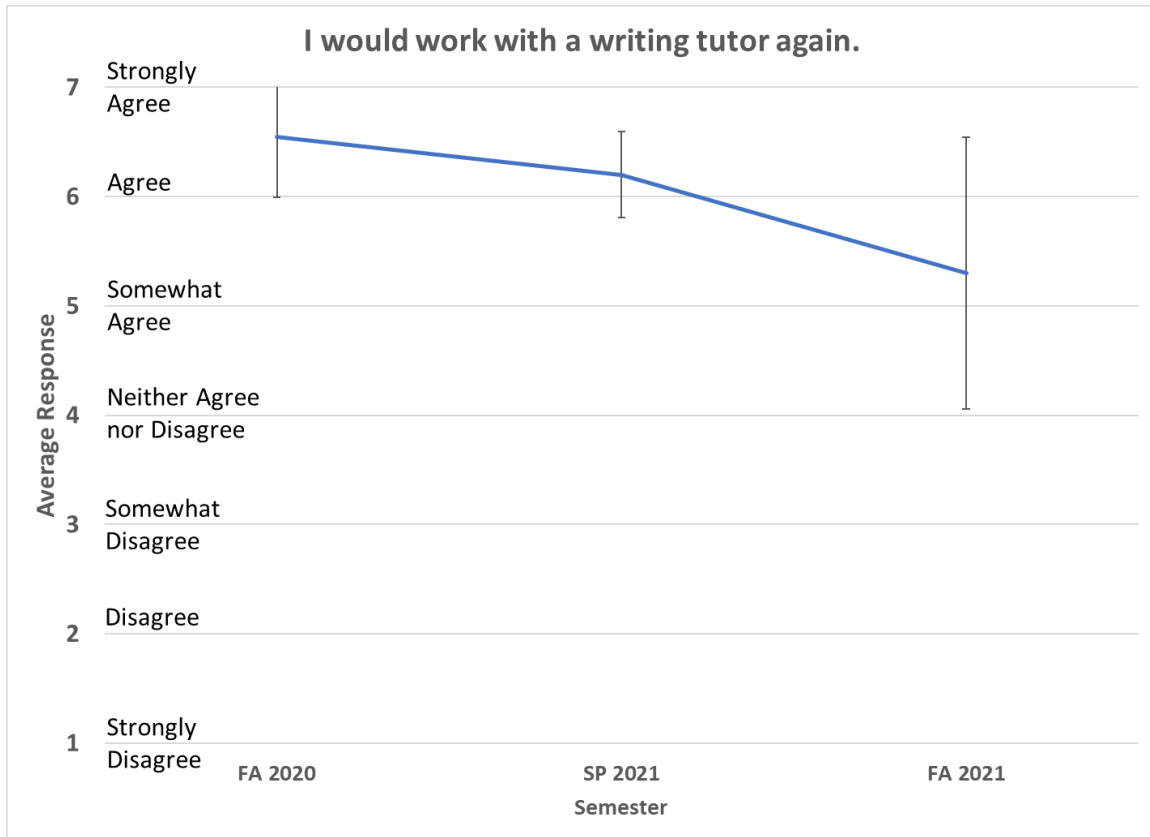


Figure 2 - Student comment on returning to Tutor

Students' willingness to get additional writing tutoring can be seen in Figure 2. Given that all teams were only required to see a tutor once but came an additional time or two during their second and third semesters leads the researchers to believe that there were teams composed of students whose perceptions of the value of tutoring differed. For the first and second semester, the students' responses were Strongly Agree or Agree. During the third semester, there were three students who responded with Neither Agree nor Disagree or lower. This is most likely due to the reasons noted above.

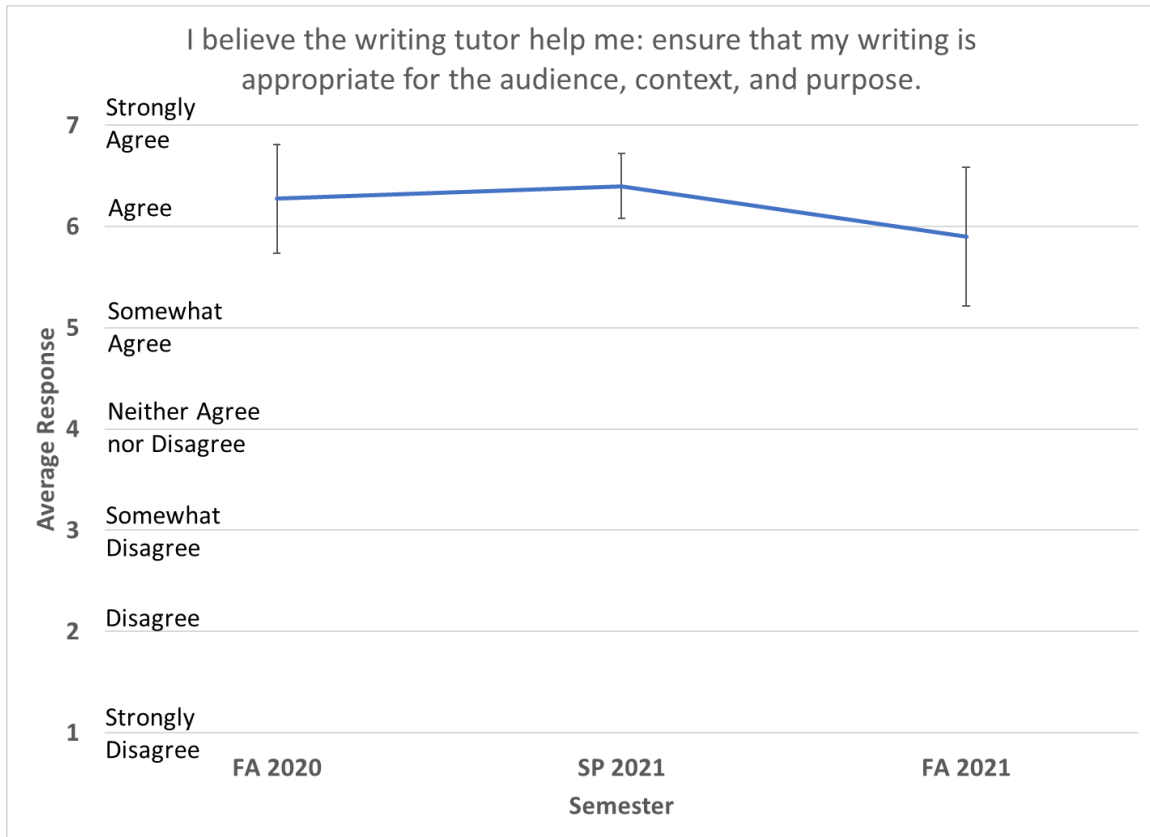


Figure 3 - Student comment on Tutor's ability to help with writing for audience

The students' belief that the writing tutor helped them write for their audience is demonstrated in Figure 3. The strengths of receiving feedback from a tutor without a technical background are that it creates greater audience awareness in the students, and it requires them to develop clarity in their writing. A non-technical audience is not unusual for working professionals. While following the same trend as the results in Figure 1 and Figure 2, the ability of the writing tutor to help students write for their audience was valued higher than improving the report or returning to the tutor. That higher rating, in part, may be because students consider their audience to be their professors.

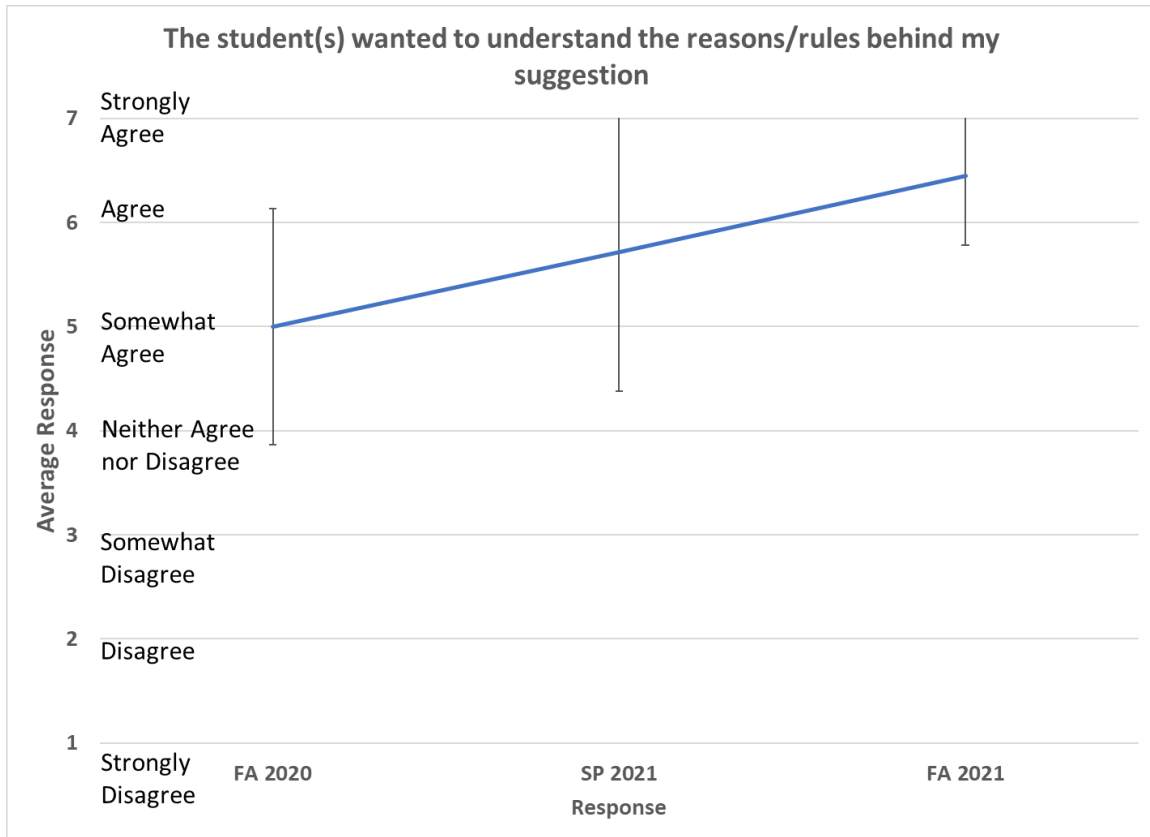


Figure 4 - Tutor comment on students wanting to learn rules behind suggestion

In Figure 4, while the Y-Error bars are quite long, the trend shows that the tutors perceived that the groups were engaged and wanted to learn about the errors they made. As noted earlier, student responses are individual. It is possible that one or two of the students on the team did not see the value of the tutoring session. However, one or more students on the team engaged with the tutor. These results are particularly encouraging, as they indicate that students are actively learning to better understand the rules of writing and improve their writing skills during the sessions.

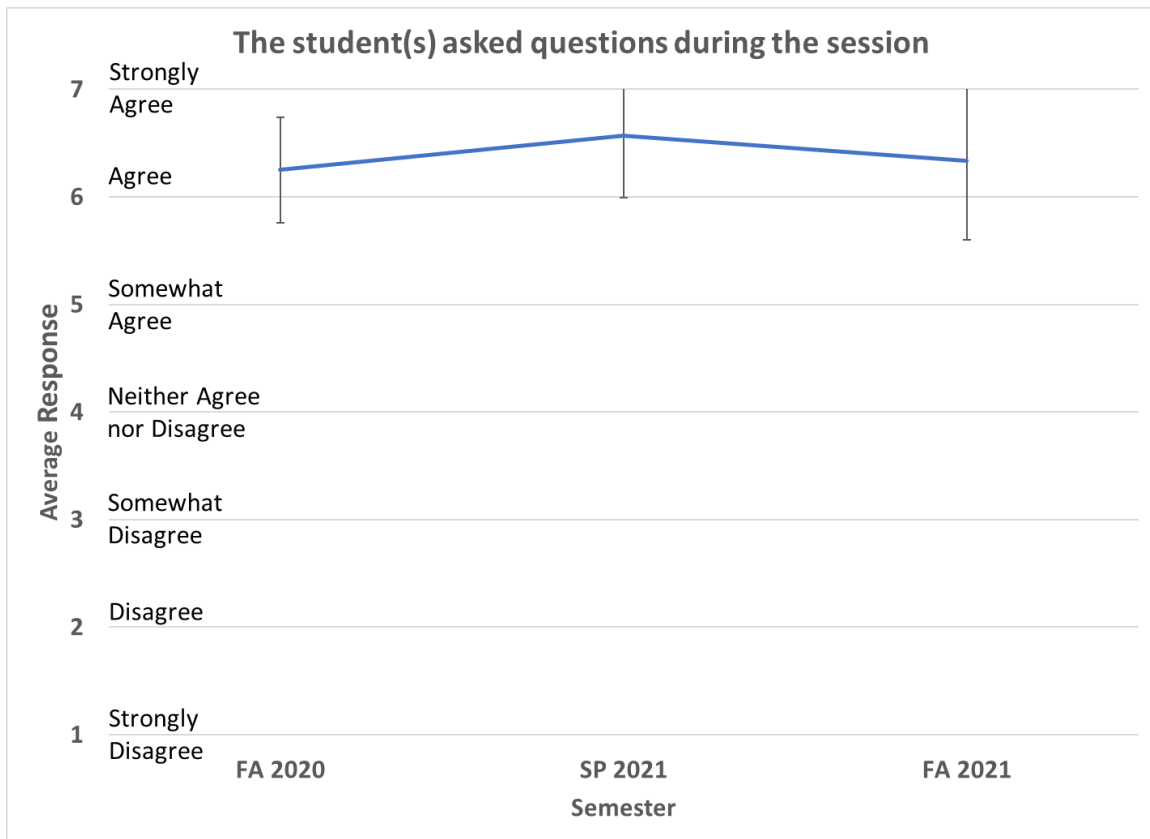


Figure 5 - Tutor comments on students asking questions during session

The data represented in Figure 5 above are also encouraging. The fact that students consistently asked questions in the sessions throughout all three semesters demonstrates engagement, whether they come to the session with questions or think of them during the session. Regarding the latter, they clearly must be listening to the tutors' comments.

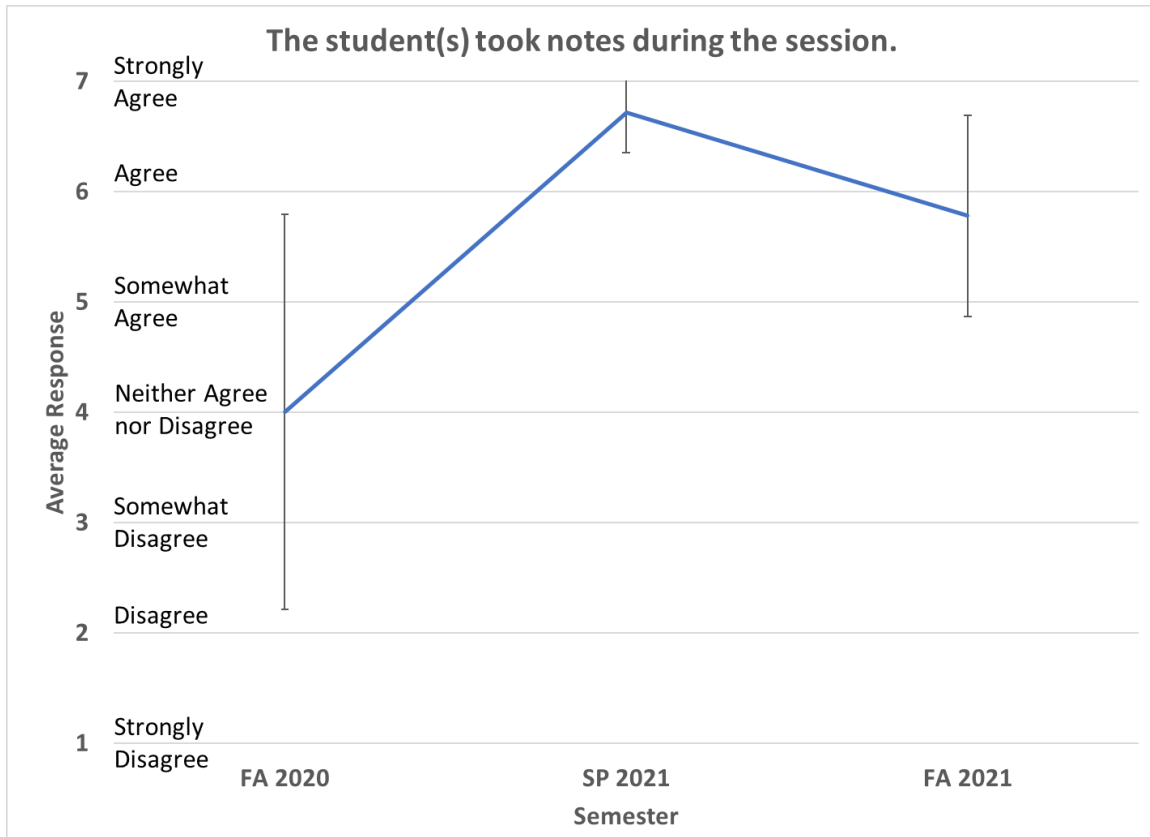


Figure 6 - Tutor comment on students taking notes during session

The tutors' observations that students were taking notes during the session are presented in Figure 6. Taking notes is an indicator that students are more likely to make the revisions that were suggested by the tutor, in part because they recognized value in the suggestion and in part because they would not forget the suggestions. Based on the students' responses from their third semester (FA 2021), this may show that some of the students in each team were not as engaged in the tutoring session. While they may have asked questions, they may not have been willing to write the answer down.

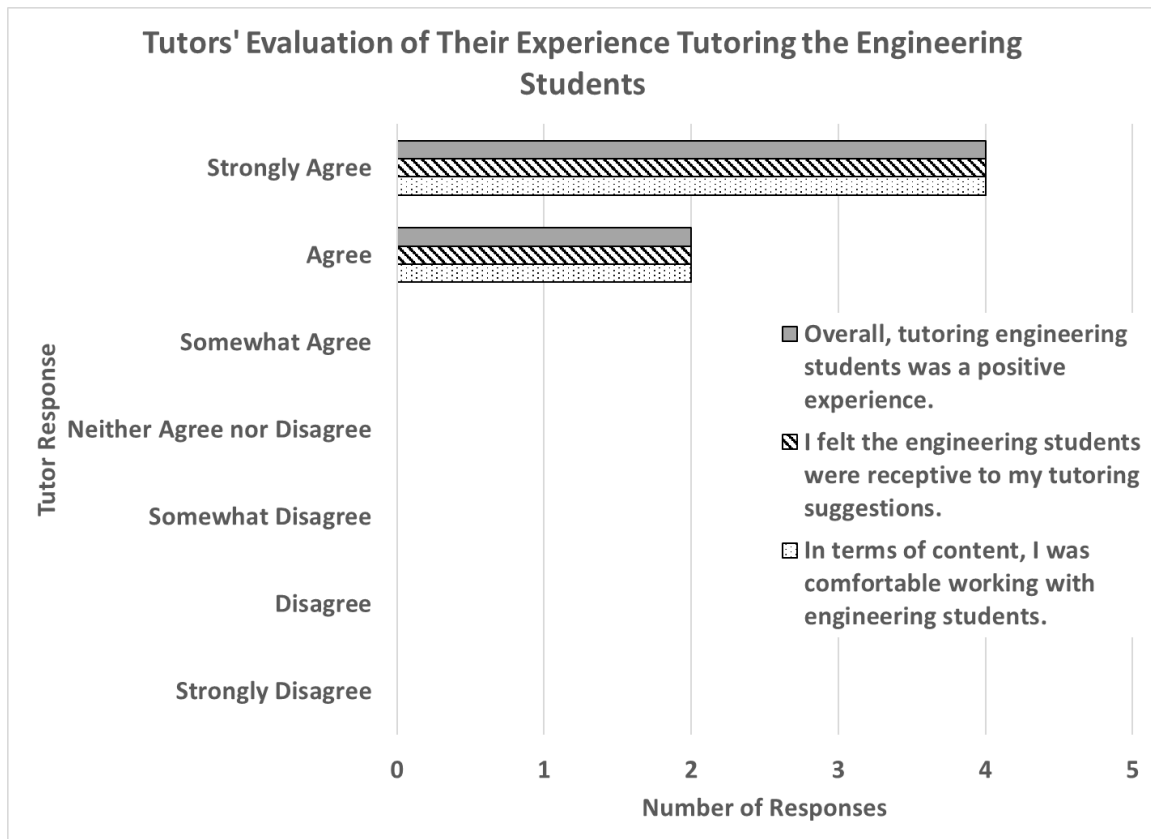


Figure 7 - Tutors' Evaluation of Their Experience Tutoring the Engineering Students

Figure 7 represents data collected from tutors for semesters one and two. Data from semester three has not yet been collected, as the survey from which it is taken is administered at the end of the academic year. The tutors' responses indicate that the one-hour training adequately prepares them to work with the students.

Conclusions

These data admittedly represent a small sample. Also, they are not yet informed by the assessment of the writing in the pre- and post-tutoring reports. As mentioned earlier, during the first year of the grant, baseline data were evaluated. Control data is currently under evaluation. Baseline and control data were not collected for the senior project reports, as WATTS training was already underway prior to the start of the grant.

The results show that most of the students feel that the writing tutors helped them improve the quality of their reports. While two students had disagreed or strongly disagreed with the three survey questions, the fact that all teams returned for one or two more tutoring sessions during their second and third semesters shows that overall, they saw value in the interactions. The writing tutors' responses about student engagement were positive. Thus, even though there were some negative responses from individual students, they did not disrupt or negatively affect the group during the tutoring session.

The data are encouraging. The quality of writing of engineering students continues to be an issue that needs to be addressed. WATTS adapts existing, ubiquitous resources (writing centers) to support the improvement of engineering student writing in an economically viable way. It requires minimal faculty time, does not add to the credit load of students, and fosters interdisciplinary collaboration between students, also benefiting the tutors.

Future Work

A significant amount of data has been and will continue to be collected and assessed over the course of the grant. WATTS training is being implemented in courses in several engineering disciplines and with students of different academic standing, as well as with individual and team reports. If the results prove the method valuable in improving engineering student writing within a broad range of classroom environments, further funding will be sought to initiate broad dissemination.

Works Cited

[1] Criteria for Accrediting Engineering Technology Programs, ABET, Baltimore, MD., 2020, p.5, ETAC Criteria (abet.org)

[2] Bergmann, L. S. and Zepernick, J., "Disciplinary and Transfer: Students' Perceptions of Learning to Write," Writing Program Administration, 31, Fall/Winter 2007.