

Formal Laboratory Reports Pros and Cons: An Interim Report

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I. Introduction

Engineering programs have historically faced the major challenge of providing engineering students with a solid foundation in written communication skills. In response, most engineering curricula include fundamental writing courses focused on developing and improving written performance. With this emphasis in mind, the use of writing exercises in the classroom provides an opportunity for engineering students to improve other skills as well, such as becoming a vehicle to improve learning style and retention skills.

However, it is a challenge to develop written exercises that provide an effective learning experience without burdening the engineering faculty with overwhelming grading demands, especially at those undergraduate institutions where teaching assistants (graders) are unavailable and all grading is done by the faculty. The question, then, is what writing assignments would best meet the needs of improving the learning environment while still providing the engineering faculty with a manageable workload. Formal group writing laboratory reports were considered as a resolution to that major issue.

The purpose of this paper is to demonstrate both positive and negative aspects of using formal group writing exercises in conjunction with laboratory reports to improve learning.

II. The Formal Group Report: Building Laboratory Teaching Effectiveness

The traditional engineering laboratory course approach to writing consists of each student preparing his or her own individual report which is graded primarily on science content with little emphasis on form, structure and quality of writing. The use of these reports in the engineering laboratory is essential in the development of engineering skills. However, the shortcomings of this approach include the inability of the instructor to devote a significant amount of time to evaluation of each report.

The concept of introducing the formal group report in a laboratory course included the following:

- The instructor identifies groups comprised of 3 or 4 students and provides students with a description of the laboratory project. Students generally perform 8 projects per course.

- The groups are provided with instructions on generating a group report. The formal laboratory report must contain the following sections: Abstract, Introduction, Procedure, Results and Discussion, and Conclusion. The function and form of each section is discussed.
- Focus is placed on both the substance of the report and the quality of writing. The group members are expected to work together on generating the report and are encouraged to schedule several meetings to work on the report. (Groups are required to maintain a record of group dynamics and individual participation.)
- The group performs the laboratory assignment. One student from each group (author) is responsible for preparation of the laboratory report. The remaining group members are to provide assistance in both preparation and review of the document. (Authorship is a rotating position.)
- Once the reports are graded, the groups meet with the faculty to discuss the work and are provided with the opportunity to review and rewrite the reports and to resubmit them with corrections. If resubmitted, the report grade can be improved by up to 50% of the initial points lost.
- The report has two grades – one for the scientific content and one for the writing quality. The entire group receives the same grade for the scientific content. The author receives the writing grade.

To summarize, the formal group report was intended to provide the students with a written exercise to enhance their writing skills and learning styles while allowing the instructor to review fewer reports, thereby focusing more on the substance and writing quality of each. Additionally, the students were to benefit by experiencing a teamwork approach by working together in small groups and learning to critique each other as they edit and evaluate the group reports.

III. Initial Assessment of the Group Writing Strategy

A. Writing Quality

In the initial decision to introduce group writing, the assumption was made that the students would perform at least in a manner equivalent to that of their individual reports. That is, the distribution of quality of the writing would be the same as or similar to that of the individual reports. Irrespective of the focus on writing quality in the course introduction, the “mean” of writing quality appeared to decrease in the group reports.

The decrease in the mean of writing quality was notably exhibited through a comparison of the group reports with the individual reports. That is, throughout the course, students also submitted individual formal writing assignments. These assignments consisted of 2 to 3 page research papers on a specific topic. These papers, assigned in lieu of classroom lecture on elementary topics such as thermocouple theory and practice, were graded on both scientific content and writing quality. Comparing the quality (both scientific and stylistic) of the individual assignments to the formal group reports, the major observations can be summarized as follows:

- The students in the top 10 –15% of the class prepared reports that were similar in quality to their respective individual class reports.
- The remainder of the students prepared group reports that reflected less effort than individual assignments.
- No group reports appeared to optimize the group scenario with the quality exceeding the individual reports.

It is unclear whether these problems resulted from the length of the reports (which were at least three times as long as the class assignments) or the structure of the report (multi-sectioned, requiring analysis and discussion of the data) or the structure of the group scenario.

There are numerous possibilities explaining the difficulty of incorporating group writing into laboratory engineering courses. A major problem appeared to be the typical student's decision not to accept responsibility for the group assignment. That is, as only one group grade was given, students assumed others would compensate for their lack of initiative. In some circumstances, it was apparent that after the first group assignment received an excellent grade, the second writer (satisfied that he or she would receive an adequate grade) exhibited little motivation in his or her report.

B. Learning Style: One Author – One Learner

The ability to work as and function as a team was emphasized prior to submission of each group report. The team environment requires that all students, not only those writing the particular report, participate in the document preparation. Member roles and responsibility sharing concepts were emphasized.

The group laboratory reports were structured with the intent to motivate students to observe the effective skills of others and to assimilate them into their particular learning styles. Results indicated that students, in general, did not take advantage of the group learning dynamics. That is, the degree of each individual's learning was measured by the student's ability to use concepts from previous laboratories in future laboratories, quizzes and exams. In general, unless the individual was the author of the particular laboratory report at issue, all students exhibited a disappointing ability to recall information from previous reports to utilize in the current laboratory. For example, an early laboratory in the course addressed the concept of instrumentation/sensor calibration. Several weeks later, when this material was needed as a precursor to perform a laboratory operation, a large number of students focused on "learning" calibration.

However, in the case of the thermocouple research where all students submitted individual work, in a subsequent laboratory assignment where a thermocouple was an integral part, but not the focus, few students had difficulty recalling the basics.

Results similar to student performance in the laboratories where the author appeared to be the primary learner were exhibited in quizzes and tests. Students' response to specific questions were matched to authorship and compared for variation in learning.

The formal group writing exercises led to the following observations relating to the learning environment:

- Although learning styles of students differ, most students tended not to participate fully in the group writing assignments unless it was their turn to write the assignments.
- Students did not review the assignments once they were graded either for test preparation or to improve their writing skills. (Many grade points were lost through obvious and easily correctable errors such as results not being described verbally but presented solely in a tabular manner.)
- Students will repeat the above problems even though they are aware of the consequences with the bottom line being a resulting lower grade. (This is in spite of discussions during the course on grading particulars and responsibility to review prior reports and work of others.)

IV. Establish an Element of Peer Pressure Through Group Discussion of Graded Work

Among others, the goals of the group writing project consisted of:

- Improving writing skills through reviewing written material prepared by other students as they selected the positive and negative aspects of each other's writing style.
- Improving report quality through "peer pressure" of realizing that another student is reviewing your work.
- Provide an opportunity for other students to review material for errors in technical content.

As a method for achieving these goals, the initial reports were returned to each group. The instructor met with each group to discuss both the work itself and how the group functioned during its production. A rewrite of the group report (with a focus on improving both the substance and the quality of the writing) was allowed if resubmitted in 2 days. The group was required to have copies of the graded report to discuss the rewrite.

The outcome of the group discussion strategy can be described as follows:

- The students in the top 10 – 15% of the class improved the quality of their writing.
- Students authoring their own work improved the quality of their work and the comprehension of the material (as demonstrated by their performance on the quizzes).
- Non-author students (not in the top 10 –15 % of the class) did not improve on comprehension.
- Despite gains in writing and comprehension through this exercise, the method serves to create an undue burden on the instructor to grade each report twice and meet with all the groups.

V. Emphasis on Writing Quality and Commitment to the Group Through Inclusion of an Editor

In addition to the author, each group had an editor for each group laboratory assignment. This implementation was an attempt to alleviate the editing burden on the instructor without sacrificing the improvements made through the group discussions and regrading.

During the group discussions the students have at least two group members who have read (if not written) the paper – the author and the editor. Given that two people are specifically responsible for a given report, I expected that learning would increase, i.e., two “writers,” two learners. However, the initial results showed that overall student learning surpassed this expectation. In group discussions students stated that under this scenario of a writer and an editor the two responsible for the work could demand more from the others in the group, whereas an individual (under the single writer model) was on his or her own.

VI. Conclusion

One of the most significant challenges instructors face is to create a system that encourages students to assist with and integrate into the group writing process while controlling the additional work writing assignments create. The instructors must be motivated to change the way they have been conducting their courses and recognize the importance of developing the writing skills of students early in their education. However, without presenting the specific data here, it is the contention of this study that the students who write formal reports have a better learning experience than those writing informal reports. Further, students who wrote the group laboratory reports had a much better understanding of the subject matter. While this may be an obvious observation, there is a significant distinction between a simple traditional report and a formal report. The formal group report can be used as a positive and effective tool to develop writing and learning skills of the engineering student.

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