A Laboratory Format for Improved Student Participation

Robert I. Egbert
Cooperative Engineering Program
Missouri State University

Abstract

This paper describes a format for engineering laboratory courses that improves student participation in the laboratory experiments. Often in laboratory courses only one or two members of a student lab group actively participate in the laboratory exercise while others in the group stand around and observe. This is especially true in large laboratory sections with many student lab groups. This format helps ensure that all students in a lab group participate by giving each member of the lab group a title and a specific role in each laboratory exercise. This format has been used successfully by the author in a variety of different laboratory courses in three different institutions.

Introduction

One of the challenges of student laboratory groups is to ensure that every student in the group participates in the laboratory exercise. Quite often only one or two students in a group take an active role in the experiment and the other students in the group tend to stand around and observe. This is especially true in large laboratory sections with a number of student groups. In such situations it is difficult for the instructor to make sure that all students in the laboratory are actively participating in the lab exercises.

In an effort to combat this problem the author began to develop a laboratory format in which each student in a lab group is assigned a specific role in each laboratory experiment. These roles then rotate among the students in the lab group throughout the term of the lab course.

Assigning of Laboratory Groups

In his experience the author has found it best to assign students to lab groups rather than have students pick their own lab partners. If left to pick their own lab partners, the author has discovered that students typically pick their friends or other good students for their group. This can result in other groups that are made up primarily of less capable students who will typically have more difficulty with the laboratory exercises. This can be avoided, at least to some degree, if the instructor assigns students to the lab groups. An added benefit is that students gain the experience of working together with different individuals as part of a team.

Roles for each member of the lab group

Once all the students have been assigned to particular laboratory groups, each student in the group is assigned a job and title in the experiment. The assigned jobs rotate through each member of the lab group throughout the course of the laboratory class.

In this format, one student in the group is designated as the, "Lead Engineer." The Lead Engineer is essentially in charge of the student lab group for the experiment in which he or she is designated the Lead Engineer. This includes understanding the purpose and objective of the laboratory exercise, organizing and wiring the experimental set up, understanding what measurements are required for the lab, and making a preliminary confirmation that the experimental data taken, correctly agrees with the expected values.

One week after the completion of the experiment, the Lead Engineer turns in a formal lab report for the laboratory exercise he or she supervises. If, over the course the laboratory term, the leadership rotates back to the original Lead Engineer, a second formal laboratory report is not required.

A second student in the group is designated as the "Assistant Lead Engineer." This individual serves as a back-up in the event the Lead Engineer fails to attend the laboratory. The Assistant Lead Engineer must be prepared to serve as the Lead Engineer if the Lead Engineer is not available. They must be as prepared to lead the lab group as the Lead Engineer. This position was created because the author had several experiences in which the "Lead Engineer" for a particular experiment was not able to attend the laboratory session for which they were to be in charge, due illness, interview trips, or other circumstances.

A third group member is designated as the "Scribe." The Scribe is responsible for accurately recording the experimental data and distributing it to the rest of the laboratory group members.

A final group member is designated as the "Safety Engineer." The Safety Engineer is responsible for insuring that all wiring for the experiment is done in a safe and efficient manner. There should be no loose connections or excessively long leads which can lead to noise pickup. The Scribe also makes sure that all power supplies, signal generators, and other devices are correctly connected in the laboratory circuit.

If a lab group has less than four members, then two of the designated titles and responsibilities can be assigned to one or more members of the lab group. For example, if there are only two members in the lab group, the Lead Engineer may also designed as the "Scribe," and the "Assistant Lead Engineer" can also be designed as the "Safety Engineer."

Grading

All students in the course keep a laboratory notebook. This is a slightly more informal type of laboratory report. These are collected periodically and graded.

In addition to the lab notebook, written and "hands on" laboratory exams covering the lab experiments and use of the lab equipment are also given. The written questions are typically related to the concepts covered in the lab experiments. In the "hands on" portion of the lab exam, students are typically asked to identify one or more pieces of lab equipment that have been used in the lab and are also asked to correctly read the value of a lab parameter displayed on a meter or oscilloscope.

Finally, the formal report submitted by the Lead Engineer in each group is turned in, graded, and given a preliminary grade before being returned to the student. The instructor makes comments and suggestions about the formal report. The Lead Engineer then meets with the instructor individually and the instructor and student go over the formal report with the instructor indicating suggestions for improving the report. The student is then given the option of accepting the existing grade on the final report or making corrections and resubmitting the report to be regraded. If the student accepts the present grade on the formal report then no further action by the student is required. However, if the student wishes to improve his or her grade on the formal report, then they are given two weeks to submit a revised version of the formal report to the instructor to be graded again. This second formal report is then graded and this becomes the final formal report grade for that student.

Student Perceptions

The overall attitude of students in laboratory courses that use this format have generally been favorable. Some students do not like having assigned lab partners but is generally a relatively mild criticism.
The most difficult part of the process for most students is the time spent meeting individually with the instructor to go over the first submission of their formal laboratory report. This is sometimes awkward for the student and some students become defensive about their work and find it difficult to accept critical comments and suggestions about how to improve their report.

Faculty Perceptions

The author has used this laboratory format in several different laboratory courses at several different institutions with good success. The two most time consuming parts of this format are 1) meeting with each student once to go over their formal lab report and 2) the time needed to set up and administer the "hands on" portions of the lab exam. Both of these activities take a considerable amount of time. However, it has been the author's experience that students who listen to the comments about the first draft of their formal lab report and then rework their report and resubmit it end up with a much better formal report and a better report grade. In addition, the author has used the "hands on" lab exam ever since he had a student mistakenly identify a decade resistance box as a DC voltmeter.

Conclusion

This laboratory format has been successfully used by the author for several years and in three different institutions. The author feels that it is a format certainly worth trying.

Biographical Information

ROBERT I. EGBERT
Dr. Egbert is a Professor of Electrical Engineering in the Cooperative Engineering Program at Missouri State University. He was formerly a member of the faculty in the Department of Electrical and Computer Engineering at Wichita State University and has also worked as a consulting engineer. His research interests are in electric power and energy.