

The Dreaded Laboratory Report

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THE NEMESIS OF MY undergraduate studies was the dreaded lab report. There were several reasons I found the lab report so daunting:

1. I had to understand several pages of technical background information and then reword it into an *introduction* section of the lab report material.
2. Calculations had to be done with the *data*, then analyzed and *discussed*.
3. There were *questions* to answer.
4. A *conclusion* had to be written.

Although I did not realize this when I was an undergraduate, as a teaching assistant (TA), I have found that the reason the lab report was so challenging has to do with academic integrity. In my capacity as a TA evaluating lab reports, I have found that integrity concerns arise related to each of the points that I outlined above. More specifically, taking the text and data sections into consideration separately allows for a discussion on how to give direction to the students to improve the quality of both their learning and their work.

The Written Material: Introduction, Questions, Discussion, and Conclusion

Similar issues arise with the different “text sections” of the lab report, which include the introduction, questions, discussion, and conclusion. In these sections, the students must write about technical information. Within the text sections of a lab report, there are two common problems: 1) direct plagiarism from the lab manual or textbook, particularly for the introduction, and 2) identical written material from multiple students.

The major reason why students copy from the lab manual, particularly for the introduction to a lab report, is feeling overwhelmed by the report. The second most common section that is plagiarized is the answers to the questions. Just as I found the lab report daunting as an undergraduate, my students have

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told me that they feel the same way. Directly using sections of the text from the manual without summarizing or rewording is a faster way to write the introduction and answer questions, because they do not need to first comprehend the information.

Of particular note in the TA's responsibilities is the task of informing students about the acceptable use of the lab manual, because one might think this

chore should be done by the professor. The professor of the course will usually have the policy outlined in his or her syllabus; however, the TA is the person who deals with the practical application of this guiding principle. Ensuring that the TA has made the policy clear means that the student cannot say, "Oh, you never told me that." It is a way of eliminating one of the many excuses that students like to use when they have been caught cheating.

A useful strategy to discourage students from copying from the textbook is to make use of the pre-lab lecture. In most labs, the TA talks at the beginning for 10 to 15 minutes to help familiarize the students with the theoretical concepts involved in the lab and any procedural details. During this time, it is essential to make the theory as simple as possible so that students really understand the essence of the lab and can describe back to you what they are doing in the procedure. I have found that giving them a handout with the pre-lab lecture notes on it helps them to listen to the lecture rather than concentrate on writing down every word I say. When asked if these handouts were helpful, one student said, "Yes, I really like that you write out all the important information for the pre-lab so that when you talk about it, I can focus on the actual idea rather than trying to write everything down. Really helpful!" After all, this is the reason that students take lab: to obtain a practical and hands-on understanding of a theoretical concept that was taught during lecture, not to take notes.

The discussion part of the lab is unique and encourages student collaboration, leading to the second kind of textual plagiarism: copying each others' work. From my experience, the discussion is the hardest part of the lab report, because you need to understand the theoretical information and procedure in order to

process your results. In this section, students are forced to make their own analytical statements about the results. They need to answer the critical question of how theoretical values relate to results and to use their own judgment about how experimental factors have influenced these results. Thus, no two students, even lab partners who have worked together, should have the same discussion. Identical discussions indicate that students have not done their work independently and are in violation of academic integrity policies.

While it might be tempting to conclude that identical lab reports are the result of laziness or not understanding the lab, hard-working students may produce identical reports for multiple reasons. During the experimental part of the lab, students are allowed to work with partners; it is likely that some students, perhaps not realizing it is not allowed, continue to work with their lab partners outside of class on the lab report, which can result in identical reports. This is often the case with the discussion, conclusion, and questions, because these cannot be copied from the manual. The case of students having the same lab report is difficult to deal with because TAs do not know if both people were equal contributors or if one person did the work and the other copied. Therefore, it is crucial to make it clear to students in the syllabus and by verbal communication that each student must turn in his or her own unique lab report. *It is your responsibility as a TA to make sure that students know what is and what is not acceptable to use from the manual and from other students.*

Most professors will have a standard policy for dealing with these infringements of academic integrity. The TA's responsibility is to recognize these violations. Before grading labs, the TA should be very familiar with the lab manual text to be able to recognize if an introduction has been copied. Additionally, the TA should try to grade the lab reports within a short time period so that he or she is familiar with the students' reports and can recognize if two are the same. When a TA is grading a lab report and finds sections directly copied from the text, he or she must first talk to the student before passing the issue along to the professor of the class.

The data section of the lab report is completely different, because this section requires students to analyze their results. The critical point in the data section is to ensure that the students are accurately reporting their results, which can be achieved by the point distribution of the lab, by signing data before students leave the lab, or even by requiring the submission of the results before they leave the room.

The Non-Textual Part: The Data

Unlike the text of the lab report, the data cannot be directly copied from the lab manual, and several students can have identical numbers, since they worked

together to generate the results. The issue at hand is accuracy in reporting those results. It is not uncommon to find that a student has changed his or her results to make it look as if almost 100% of the desired product was obtained or that the values measured perfectly match those expected theoretically. This problem is of particular importance since some of the students in lab are the researchers of tomorrow.

One strategy I use to discourage students from changing their results is to give more points for the analysis of the results than the actual numbers, which stresses to students that explaining the results is much more important than obtaining perfect results in the first place. In reality, the only way a student can lose credit on the data section of his or her lab is by not writing down a number. This way, there is no incentive to change the results. Additionally, the point of lab is to learn a technique, which means a student probably will not be very good at it the first time he or she tries.

The focus on explanation in lab reports is a way to encourage academic integrity when the students transfer their class skills to real research. In my work with undergraduate students doing original research, they often find their first several weeks to be very discouraging, because the desired results are not obtained on the first or second try as happens in the undergraduate teaching laboratory. It becomes very tempting for them to lie about their research results. Therefore, helping students to learn that experiments do not always “work” in class promotes academic integrity in both the short and the long term.

Encouraging good analysis rather than penalizing poor results is helpful to prevent students from increasing their yields or otherwise improving their results. A TA can also support honest reporting by monitoring the data during the lab. For example, I noticed that some students leave the laboratory with no

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results recorded, which allows them to improve the results without needing to change the data sheet. Once, when I asked a person in one group where his results were, he told me he was going to get together with his lab partners later. This is certainly not the point of lab, to have students teaming up with partners later to make up perfect data.

Another time, when grading a lab, I discovered that a lab group of two students doing the same experiment reported radically different yields—one 98% and the other 62%. The first lab partner had forgotten to let his partner know he had improved the results he was reporting! Thus, at minimum, a TA needs to look at students’ results before they leave class. An even better strategy is to require

students to hand in a copy of their results before leaving or to put a stamp or signature (in a uniquely colored pen) directly on students' data to ensure that they have each recorded the results and cannot change them at a later date.

It is possible that a student could purposely write down a number while in lab that is better than the one he or she actually obtained. This can be discouraged by the TA having an active presence in the lab, such as walking around the room and communicating with students about their results while they are doing the lab. This attention to the students' activity will make them less likely (and less able) to cheat. Additionally, these short conversations with students give them an opportunity to ask questions about the material, thereby helping to prevent other integrity concerns like a plagiarized introduction or a copied discussion.

As with the written sections of the lab report, the TA must make clear to the students at the beginning of the semester that accurate reporting of the data is critical. Even more so than with regard to written sections, a TA must talk with a student found to have falsified his or her results. Unchecked, falsified results in many research fields have devastating results.

The Penalties for Infringements of Academic Integrity

The strategies outlined in this chapter have the intent of reducing issues of academic integrity, but if a TA does have a problem, most professors will have a standard policy for dealing with these infringements of academic integrity. The TA's responsibility is to recognize these violations. Talking with the professor in charge of the lab will clarify his or her policy.

Getting the Right Results: The Role of the TA

In the scientific community, accurately communicating results is as important as obtaining them. Although daunting for students to write and for TAs to grade, the laboratory report is an important component of undergraduate study. Since this report serves as training for a career in the fields of science, it is critical to demand academic integrity with this report. The following is a timeline for implementing the strategies:

- On the first day of class, give clear instructions to students about what is and is not acceptable to copy from the text and from other students.
- Before they begin testing, give students a clear understanding of the theoretical background of the experiment to dissuade them from copying the text, which includes handing out pre-lab notes in hard copy to the students.

- Have an active presence in the lab.
- Keep a copy of the results or sign data sheets to encourage integrity.
- Grade lab reports within a short amount of time to recognize reports that are the same.
- Emphasize accurate reporting of results by giving more points for good analysis than for the results themselves.

Although the lab report will certainly continue to be the nemesis of students who think going out with friends is more important than writing the report, encouraging academic integrity will make the exercise good training for the real world, where there is little a scientist does that is more important than communicating through written results. As a professor recently told me, “Our job is to inform students about the issues of academic integrity and to make an environment that discourages plagiarism so they choose not to cheat. Preventing cheating is better than catching them after the fact.” Doing so will make science students into scientists.