Letters Home as an Alternative to Lab Reports

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Citation: The Physics Teacher 52, 397 (2014); doi: 10.1119/1.4895351
View online: http://dx.doi.org/10.1119/1.4895351
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Published by the American Association of Physics Teachers

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The traditional lab report is known to create several pedagogical shortcomings in the introductory physics course, particularly with regard to promoting student engagement and encouraging quality writing. This paper discusses the use of a “letter home” written to a non-physicist as an alternative to lab reports that creates a more authentic writing experience.

All physics instructors are likely familiar with the problems that lab reports often pose. Lab reports represent an artificial information flow, in which the student communicates information (e.g., the experiment’s methods and results) that the instructor reading the report already knows. Alaimo et al. refer to lab reports as a “pseudo-genre” that “bear little…resemblance to the written genres used by real [scientists]” and state that they “encourage students to think and behave like students rather than like professionals.”¹ As a result of these shortcomings, students “put the emphasis on ‘task completion’ or ‘manipulating equipment’”² and not on what they learn during the lab activity. In addition, many physics instructors find grading lab reports to be laborious and unfruitful.

Many alternatives to lab reports have been suggested. Some instructors use worksheets that combine lab instructions with questions. Others employ checkout Q&A sessions³ or require students to write only part of a lab report. One article advocates that students write a letter to a fictitious uncle who is an expert in the field.⁴

More complex alternatives to lab reports are implemented in the context of broader curricular reform. For example, Alaimo et al. advocate that students write a journal-quality paper, introduced via a series of formative assignments in a course-wide scaffolded structure of inquiry and experimental design.¹ Haagen-Schuetzenhoefer discusses using lab reports from previous years as instructions for future lab activities.²

The letter home

Having identified with many of the lab report's shortcomings (artificiality, omitted information, lack of explanation and reflection, focus on tasks), I developed as an alternative the letter home assignment. In this assignment, the student communicates the activities and findings of each week's lab project in an email message to someone back home (usually a family member or close friend unfamiliar with physics concepts). My students include me in the CC field of the message, and I grade the letter home based on how well the message summarizes the lab project and how understandable it is to the audience.

I have used the letter home in a three-semester introductory calculus-based physics sequence of 20 to 30 students, most of whom are traditional engineering freshmen. The primary goal of this sequence is to prepare physics and engineering students for their program of study by introducing key concepts of mechanics, electromagnetism, optics, and modern physics, and by training them in basic physics processes such as conducting experiments, analyzing data, and reporting results. Each course in this sequence meets six hours a week (three in class and three in an integrated lab) for 15 weeks. In both class and lab, students work in groups of two or three.

The letter home is designed to reinforce the goals of this course sequence by requiring students to explain the implementation of these concepts and practices to a third party. Each student is required to complete one letter home at the end of each week’s lab activity. Overall, my students have found the letter home assignment enjoyable and challenging, and their letter home recipients have been glad to participate by responding with feedback and questions.

During lab projects, I frequently remind students to think about their letter home as the final deliverable of the project, making sure they feel prepared to tell someone else about the experiment. I also repeatedly explain to my students why this format is valuable to them: that it helps them internalize the concepts they have learned, that it helps them learn to communicate important information through writing, and that it maintains their connections back home.

The letter home assignment must satisfy a number of criteria:

1. Each student must select a recipient from “back home”; they are free to choose a different recipient each week, to repeat the same recipient each week, or to address a single letter home to multiple recipients. Most students select a relative, significant other, or friend. A few have even selected a favorite high school science teacher.

2. The students must write the letter home in the tone of an email. If it sounds too much like a lab report, I deduct points and encourage the student to write as he or she naturally would when emailing the recipient.

3. The students must describe the setup of the experiment in sufficient detail.

4. The recipient must be able to learn some physics from the letter home. This criterion considers both the correctness of the information and the clarity of expression, placing a renewed emphasis on grammar and spelling.

5. Finally, the letter home should summarize the results and conclusions of the experiment. This context of the student teaching the recipient helps highlight the difference between numerical results and the physical interpretation of those results.
I have also awarded extra credit if the recipient responds with a question and the student provides a satisfactory answer. One can also incorporate feedback from the audience (say, an end-of-semester questionnaire about the letters) into the lab grade.

**Advantages of the letter home**

The letter home offers many advantages over the traditional lab report. In order to explain the lab in the letter home, students must engage cognitively during the activity and “internalize the concept so that it becomes their own,” emphasizing the “writing as knowing” paradigm. In my courses, this need has led some students to remain after lab to ask questions and discuss what they will include in the letter home. When writing, many of my students successfully emphasize the most important learning outcomes of the lab project, even if they are mistaken about some of the details (e.g., using the term “pressure” instead of “force”).

The students are less likely to omit important aspects of the project. In many of the letters home, students have successfully:

- Described the experimental setup, taking pictures and creating diagrams to help the reader visualize.
- Described and demonstrated calculations, instead of simply quoting numerical results.
- Identified independent and dependent variables of interest.
- Described methods of checking their work. For example, when writing about a vector lab, one student wrote, “We had to make sure that the vectors were facing the right direction.”
- Described the information depicted on graphs.
- Interpreted physical significance from results and evaluated quantitative and qualitative agreement between measurements and modeling. For example, when graphing the measurements from a lens lab, one student wrote that he “learned that there is a vertical asymptote at the focal length of the lens and that if the light is at the focal length of the lens, an image will not appear.” Students also successfully described when results were surprising, such as in the photoelectric effect experiment.

When my students have omitted important information (e.g., not defining terms or simply referring to a symbol in an equation as “a constant”) in a letter home, I have asked them about their audience’s familiarity with physics in the grading rubric; many subsequently provided more detailed background in the following letter home.

The email format introduces a writing style that is more authentic for the students than the traditional lab report. My students have:

- Included references to what they are learning in the course outside of lab.
- Described their previous misunderstandings of the topic.
- Bridged from previous knowledge to new concepts. For example, during a rocket-based lab, one student reminded his audience of their familiarity with center of gravity as a bridge to discussing center of pressure.
- Discussed what new concepts have been introduced since the last lab project. For example, one student emphasized transitioning from a one-dimensional lab activity to a two-dimensional lab activity.
- Contrasted what they learned in high school physics with what they have learned in college physics.

My students frequently receive responses from their recipients with questions and encouragement, which I have used to generate further class discussion.

I have found letters home to be much easier and more enjoyable to grade than lab reports, without having to sacrifice the rigor of the student’s learning experience. I have also found fewer instances of plagiarism with letters home, as the assignment must be personalized to the recipient.

The letter home could dovetail well with freshman English composition courses or writing across the curriculum initiatives.

**Addressing concerns**

As with any pedagogical innovation, implementing the letter home can raise some concerns. For example, we have already seen that lab reports do not accurately represent scientific journal writing, and the letter home is, in many ways, a further step away from that genre. However, many of the essential objectives of technical writing are still present in the letter home, such as:

- Understanding the audience’s background and expectations, and incorporating those factors into decisions about the writing style and content.
- Providing adequate information.
- Employing graphics effectively.
- Defining technical terms appropriately.
- Writing with clarity, conciseness, and correctness.

Because of the letter home’s authentic information flow, these objectives naturally become important to the student, as opposed to being imposed by the instructor. Additionally, I have combined the weekly letter home with a few formal lab reports (addressed to another science or math instructor) spaced throughout the course in a scaffolding structure.

**Conclusion and acknowledgments**

We have examined how a letter home can be an authentic post-lab writing exercise, offering several advantages over traditional lab reports, including a greater motivation for
quality writing and better engagement with the lab activity. I am grateful to my colleague Ed McCourt for the many collaborative discussions that led to this idea.

References

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