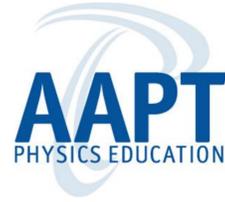


Communicating scientific ideas: Tutorials for professionally-styled laboratory reports



Kelley D. Sullivan
Department of Physics and Astronomy
Ithaca College, Ithaca, NY 14850



Introduction

Advanced Physics Laboratory is a junior-level laboratory course in which students complete five to six advanced laboratory experiments and write up their results, including error analysis, in professionally-formatted reports styled after articles in the *American Journal of Physics*. Students are encouraged to use a variety of software to prepare their reports: LaTeX for typesetting, MATLAB for data analysis and graphing, and Inkscape for drawing equipment and theory diagrams.

When I started in the course, I observed that students were motivated to learn about experimentation, error analysis, and report-writing, but were overwhelmed by what they felt was a need to learn everything all at once early in the semester. To address this concern, I developed a series of tutorials to facilitate student learning of the software and to provide students with greater detail regarding the content and style of several of the lab report sections.

The tutorials were met with rave reviews. On an anonymous end-of-course questionnaires, 5 out of 7 students in the first class in which the tutorials were used chose the tutorials as the one thing that “should not change” in the course. I present the tutorials here, along with a longitudinal analysis of student questionnaire responses to demonstrate the sustained positive student perception of the value and effectiveness of the tutorials and of the associated report-writing skills.

Changing Student Perceptions

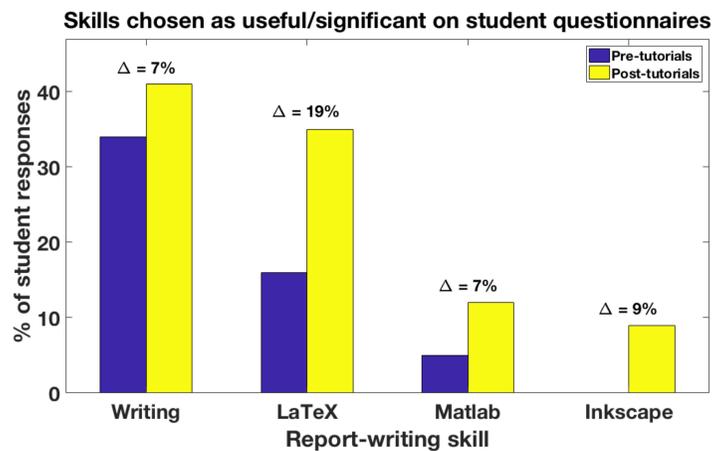


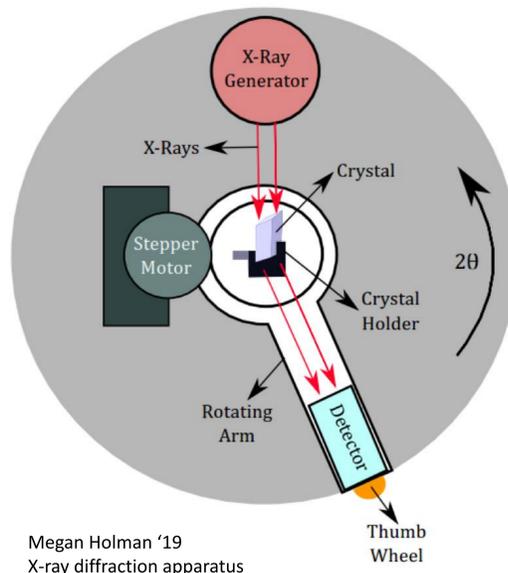
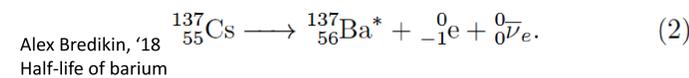
Figure 1. This graph shows the percent of student responses to the question “What was the most useful/significant thing you learned in this course” that included skills taught in the tutorials. The responses were gathered from questionnaires filled out by students in the 6 sections of the course taught before the tutorials were added (“pre-tutorial”, N=44) and the 7 sections after the tutorials were added (“post-tutorial”, N=34). The results show significant increases across all writing skills after the tutorials were introduced.

The Tutorials

L^AT_EX & B_IB_TE_X

Students edit a LaTeX report template to learn text, equation, and table formatting. The BibTeX tutorial covers manually formatting bib entries and citing references in the text.

released into the atom. In this experiment, we start with an unstable cesium atom, $^{137}_{55}\text{Cs}$. The unstable cesium undergoes ${}_{-1}^0\beta$ decay, which results in the release of an electron, antineutrino, and an excited barium atom, as shown in Eq. 2:



MATLAB

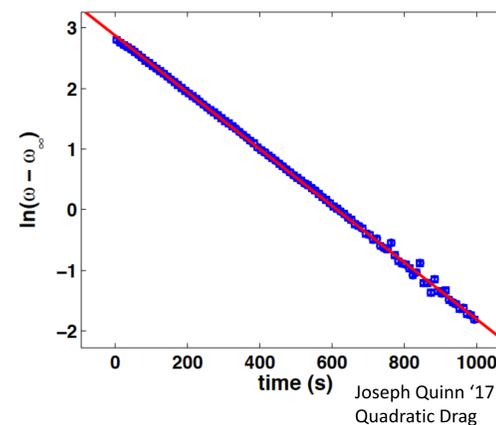
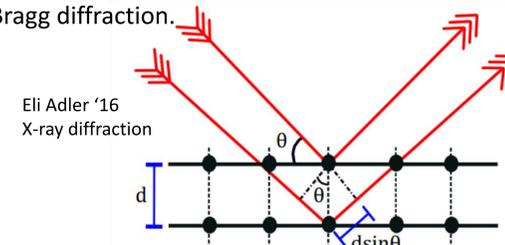
Students learn how to import data using the import wizard, plot data and fit lines using a script, and adjust figure properties (e.g., marker size, line width, font size) using the MATLAB figure GUI. Students test the appearance of their figure in the two-column lab report template and continue improving their plot until it is clear and easy-to-read. The students must also write a caption for their plot and provide a reference to the figure in the text.

Writing Conclusions, Introductions, and Abstracts

These tutorials begin with a discussion of the expected content and writing style for each section. The students then read former student work and grade it using a supplied rubric. Critiquing the work of their peers helps students recognize what common errors and omissions students make when writing their reports. The students are also empowered by examples of strong peer writing.

Inkscape

Students become familiar with Inkscape tools and menus by following instructions to create a simple landscape. The students then draw an equipment diagram for the lab they are working on and add their image, with a caption and reference, to the LaTeX tutorial document. Students will also use Inkscape to create theory diagrams, such as the one below describing Bragg diffraction.



What Students Are Saying

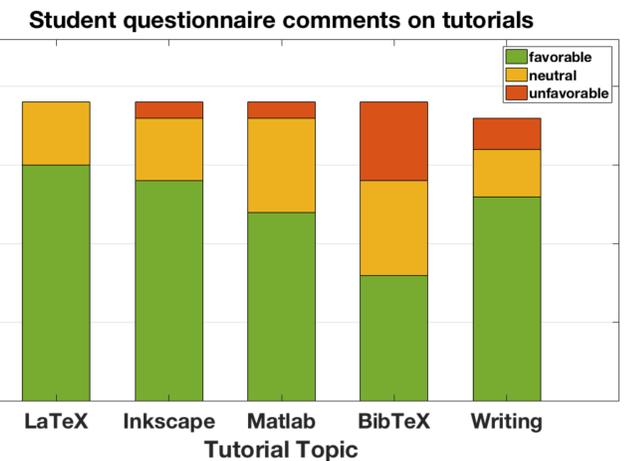


Figure 2. This graph shows the number of students responding favorably, neutrally, and unfavorably to directed questions about the tutorials on anonymous end-of-course questionnaires (N=21 total respondents). The students overwhelmingly found the tutorials to be useful in helping them learn report-writing skills.

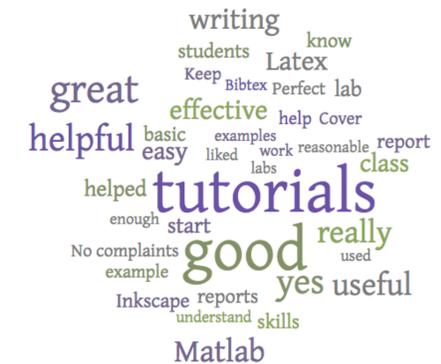


Figure 3. Word cloud created from all solicited comments regarding the tutorials. Students found the tutorials useful, helpful, good, and great!

Conclusion

The use of software and writing tutorials in our Advanced Laboratory course makes students feel supported in learning the skills necessary to produce well-written and professionally-styled laboratory reports. Students appreciate being provided with directed instruction to jump-start their learning. A recent student wrote on their end-of-course questionnaire, “Having tutorials is definitely useful as I don’t think anyone likes just being thrown in the deep end.” The tutorials are available at:

<https://faculty.ithaca.edu/kdsullivan/teaching/phys360/tutorials/>