

Comparing electronic and traditional lab notebooks in the advanced lab

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Introduction

The use of electronic lab notebooks (ELNs) is expanding in a variety of professional settings. ELNs allow for easier management and organization of data in electronic form as well as facilitating collaboration among groups of researchers; however, portability and ease of entering sketches continue to be advantages of paper lab notebooks. For the past two years, students in the advanced lab course at Carleton College have used ELNs, and in particular, LabArchives. In the wake of this change, a survey of students in the class shows that over 80% of the students would recommend other science classes use ELNs, although students acknowledge there are benefits and drawbacks to both ELNs and traditional lab notebooks.

Course overview

Advanced lab course typically taken in the junior year

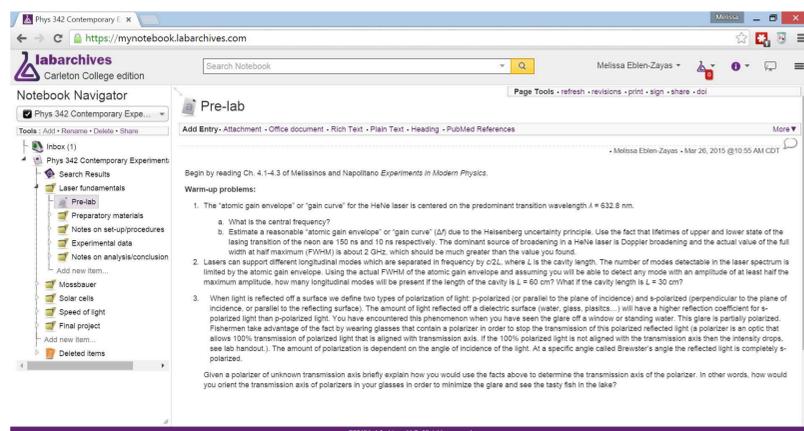
- First six weeks include three two-week, instructor-designed experiments, worked on in groups of 2-3
- Final four weeks include an open-ended, student-designed experimental project, worked on in groups of 2-3
- All students had completed two additional intermediate lab courses before this one, including one course in which keeping a traditional paper notebook was a significant portion of the lab grade.
- None of the students had used an ELN before taking this course.

Selecting an ELN

When choosing an ELN, six aspects were considered:

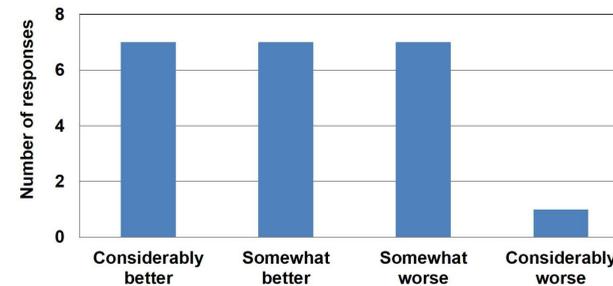
- Ability to easily, and selectively, share of portions of the notebook with others in the class. Instructors and peers could comment on notebook entries of the others.
- Robust performance across different device platforms and operating systems.
- The option for the instructor to populate the lab notebook with some materials at the beginning of the term and to push additional materials to the student lab notebooks during the course, without overwriting student entries in the lab notebooks.
- Some way to facilitate importing photos from a phone into a the notebook, preferably a phone app.
- Ability to handle equations well.
- The cost of the ELN should not be significantly more than the price to purchase a paper lab notebook.

Screenshot of LabArchives, the ELN software we chose to adopt

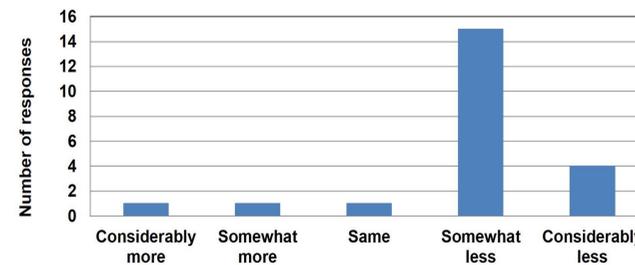


Student response

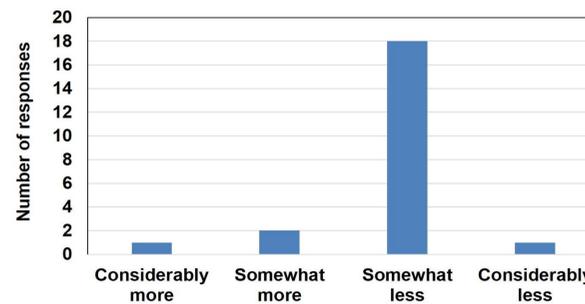
Did you keep a better or worse record of your laboratory experiment and data with LabArchives as compared to a traditional lab notebook?



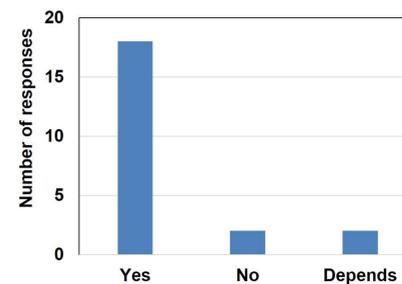
How did the effort required to organize the information in LabArchives compare to a traditional lab notebook?



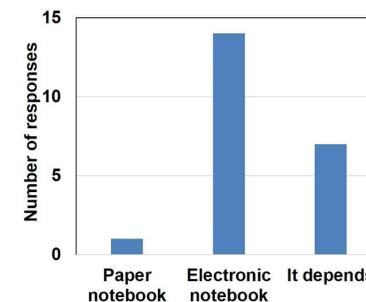
Do you feel that you spent more or less time entering information into your electronic lab notebook as compared to a traditional lab notebook?



Would you recommend that other lab classes adopt LabArchives?



If you were given an option (in a curricular lab or a research lab) of how to keep a record of your work, what would you choose?



Students were positive in their response about possible future use of ELNs, both personally and in other science classes. For those students who said that their choice of lab notebook would depend on the situation, the biggest factor impacting their decision would be the nature of the collaboration that was required; nearly every student indicated that ELNs were better for collaborative work.

Benefits and drawbacks

Benefits of ELNs identified by students

- Easier collaboration with group members (8 students)
- Easier integration of photos and graphics (11 students)
- Storing many different file formats easily
- Easier organization of files, and the ability to reorganize later
- Accessibility from any device, anywhere
- Ability to link to external on-line resources
- Easier to read notes of those with illegible handwriting

Drawbacks of ELNs identified by students

- The difficulty of including equations or sketches (5 students)
- Technical difficulties
- Taking more effort to record simple things
- Having to write notes by hand and transfer them later, if a computer is not present
- Absence of a hard copy to show someone else or to reference later

Benefits of the ELN for the instructor

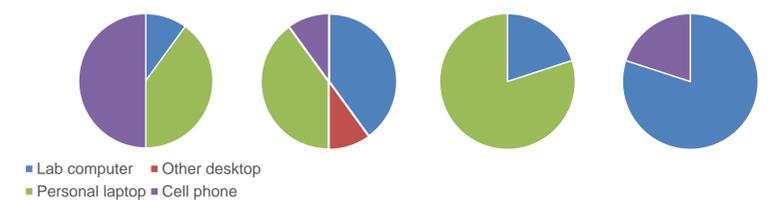
- The ability to view any student lab notebook at any time provided a better understanding of how the experimental projects were unfolding
- Easier to help troubleshoot a project by examining student notebooks from anywhere at any time

Future considerations

Student response to electronic lab notebooks generally, and to LabArchives in particular, was overwhelmingly positive. 82% of the students would recommend the use of LabArchives in another science course.

An additional factor that may impact student satisfaction with using ELNs is the type of device used to access the notebook. For this course, students could use desktop computers in the labs or personal laptops, tablets, or phones to access the software.

Samples of four different students and the % of time they accessed LabArchives from a particular type of device



Further examination of the nature of the lab notebook entries, the notebook organizational structure, the types of devices used to access the ELN, and how those factors impact student performance in the course might yield interesting clues about the pedagogical value of ELNs, as well as identifying the challenges that this instructional technology poses for students.

Acknowledgements

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