

Electronic Notebooks to Facilitate Student Learning Within and Beyond the Classroom

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Introduction

Electronic Research Notebooks (ERN), also called Electronic Lab Notebooks, are becoming standard in many industries and academic labs where documentation, reproducibility, online access, and collaboration tools are important (1,2, 3). Jefferson launched cloud-based LabArchives in 2018 as its ERN. The product includes a Classroom Edition for use with students. It offers instructors options to embed course readings, documents, assignments, images, videos, audio files and links to other online resources. Students can type and save notes in their electronic notebook, complete and submit assignments, draw and annotate images and illustrations. Instructors can update the students' notebooks anytime, grade assignments, comment on student work, and more. At conclusion of course, students can retain an offline copy of their lab notebook in a portable format, suitable for inclusion in an electronic portfolio.

Here we present two examples—one from undergraduate biology and one from graduate occupational therapy—to illustrate how LabArchives was used this academic year for individual and group work, both synchronous and asynchronous. Faculty and student perspectives are shared, along with Quick-Start Guide and tips for implementation. Decide whether your course or your students could benefit from LabArchives.

Biology Research Course & Undergraduate Research

LabArchives fills multiple needs in undergraduate research settings, both curricular and extracurricular (figure at right).

Students used LabArchives Professional Edition to document work at the bench in the following settings:
BIOL391 (3 cr)

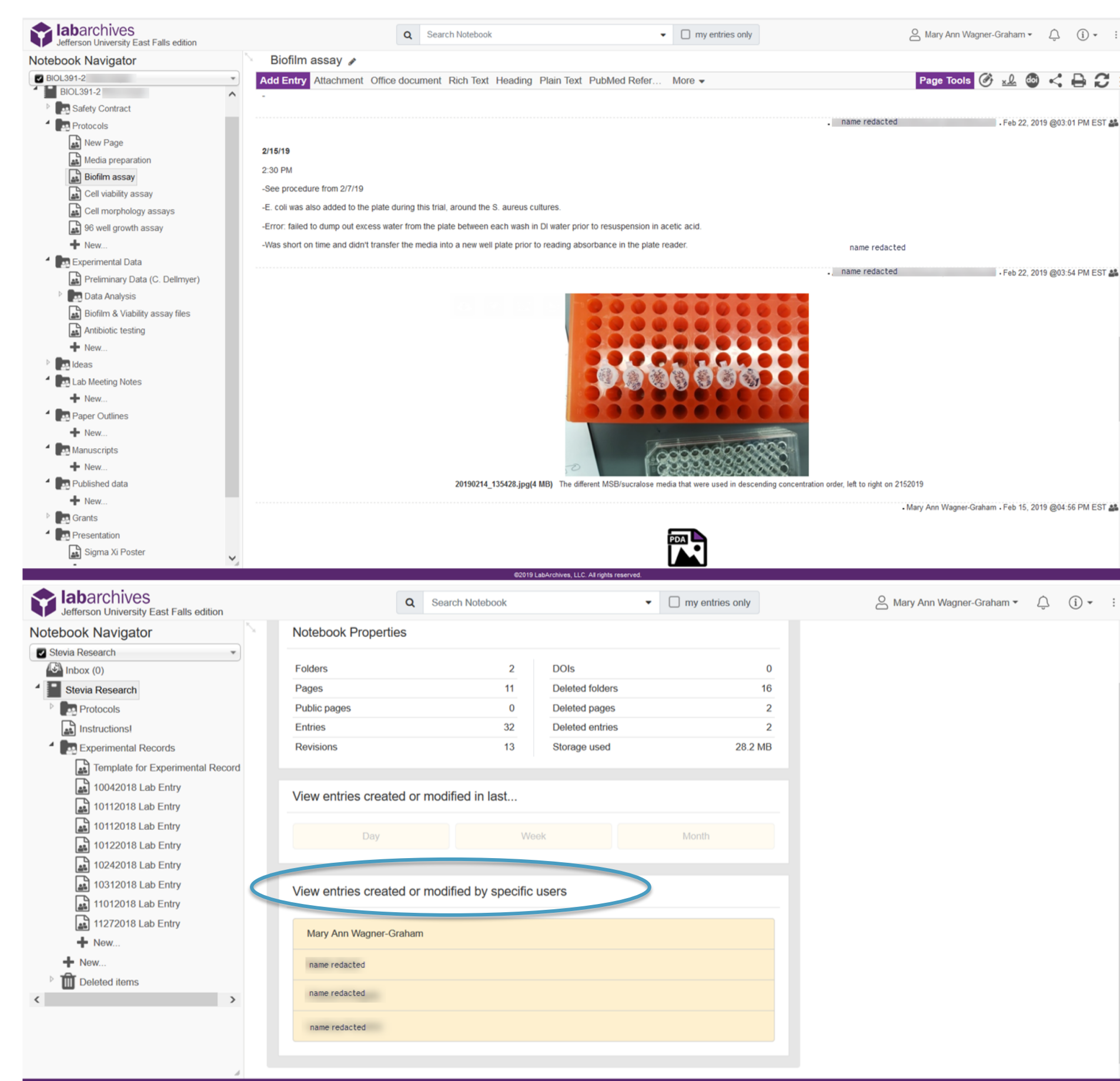
Fall 2018 – 7 students; 2 groups
Spring 2019 – 1 student

Independent Research Projects (non-credit)

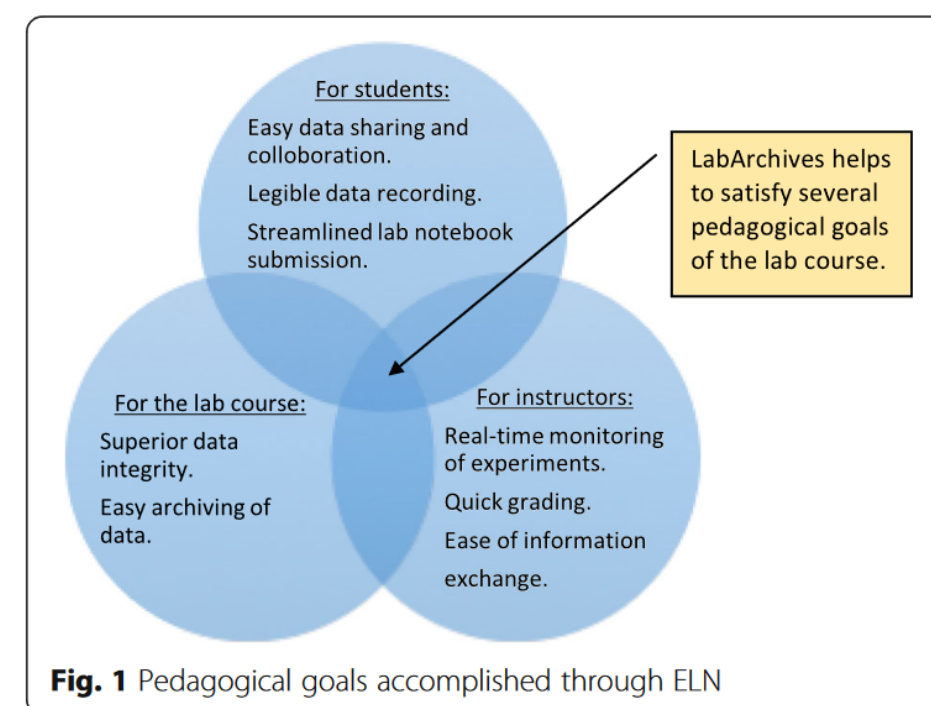
Spring 2019 – 5 students; 1 group
Spring 2019 – 1 student

In all settings, LabArchives was offered to the students for use in an open manner, with minimal constraint on format of entries. Students posted notes of their work in the lab, including protocols, observations, photographs of lab setups, hand-written instructions and notes, and posted experimental data in multiple formats (digital photographs, instrument datafiles, etc.). (Screenshots of student notebooks below.) LabArchives permitted asynchronous interaction across students within groups and also with the instructor, and gave students experience with a “real-world” tool used in research settings.

Screenshot of student work in BIOL391 notebook (1 student). Student created rich-text, photographic, and uploaded datafile entries.



Screenshot of notebook information for one student group in BIOL391. LabArchives provides an easy way to track how each student is interacting with the notebook.



From Riley *et al.* (2) licensed under [CC BY 4.0](#)

Occupational Therapy Graduate Program Lab Course

LabArchives Professional Edition was used to construct lasting resource for fieldwork use and for study, replacing previously used Google Community. Resource was created by student small groups and simultaneously shared during lab meetings across 3 separate locations. Readable electronic version or printable pdf file for future use by students.

The ERN format was an effective way to document my group's suggestions for the Children's Activity Toolkit (N = 26)

92% agreed/strongly agreed

8% disagreed/strongly disagreed

LabArchives Classroom Edition was available as an option to eliminate/reduce need for paper note keeping before and during lab activities. Students downloaded instructor's notebook template that included media files and documents posted for pre-lab review/completion, in-lab work pages with activities and space for typing/file upload. Instructor updates/additions were pushed to student notebooks in response to learning needs. All content downloadable into indexed pdf file for archiving by student.

(Of users) ERN Enhanced my learning of lab content (N = 19)

90% agreed/strongly agreed

10% disagreed/strongly disagreed

(All respondents) ERN should be used in other courses when their use can enhance student's learning experience (N= 26)

65% agreed/strongly agreed

16% disagreed/strongly disagreed

19% unsure

Qualitative Responses

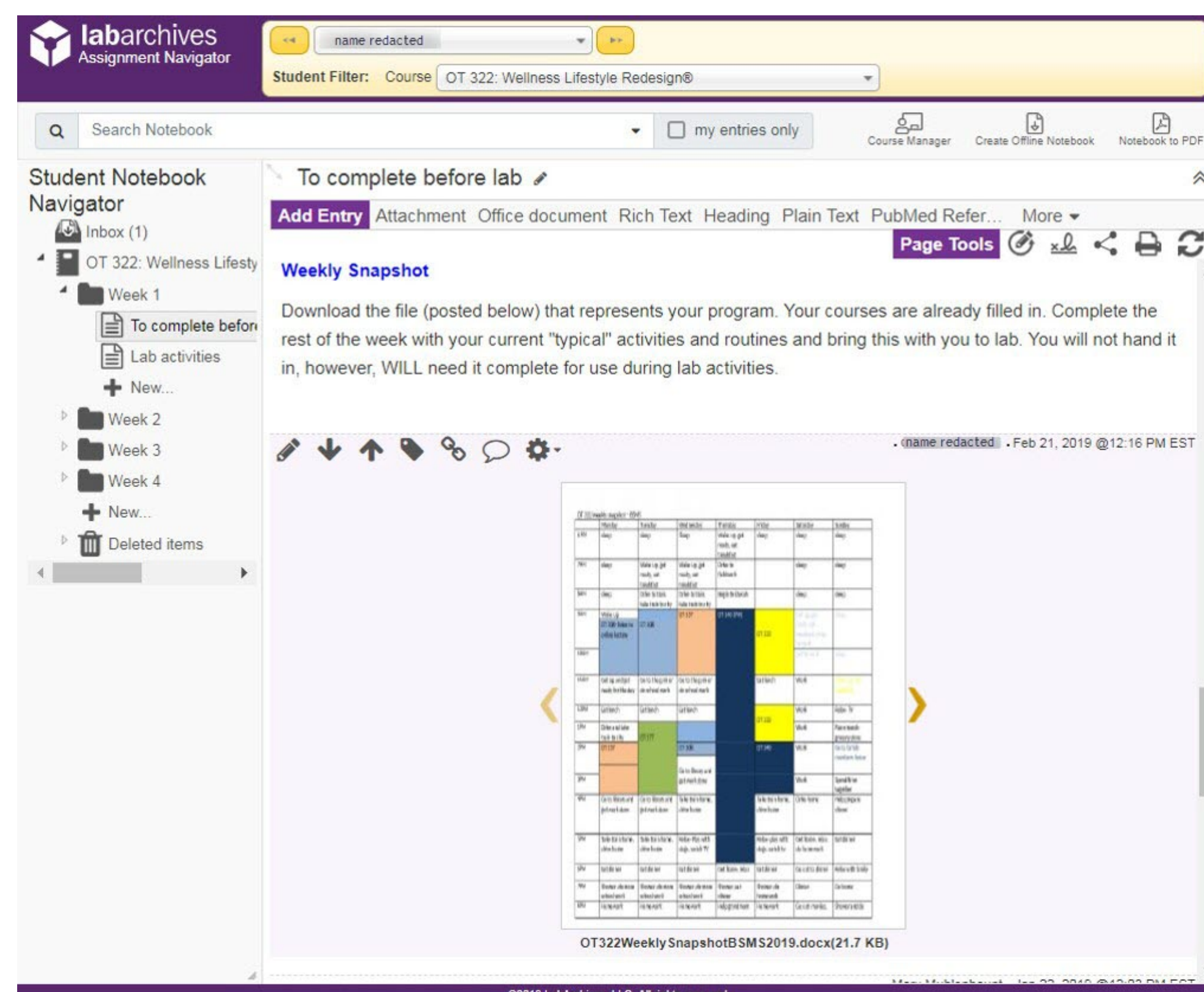
Strengths

- Organizational Convenience
- Time Saver
- Enhanced Learning

Concerns

- Instruction needed
- Blackboard/iPad compatibility
- Others: paper is refreshing in online world, technophobes, shouldn't be required, prefer handwriting

Instructor view of sample page once student completed prep activity



Implications: Use of ERN vs. Paper Notebook

Benefits

Exposure to real-world ERN tool
Synchronous/Asynchronous group work
Tracking of student effort/entries
Push updated content easily/save paper
Longitudinal continuity of project
Rapid review of results by instructor
Cannot lose anything! (restore previous versions)

Drawbacks / Pitfalls

Access/login issues
Unintended/improper use
ex. pictures of paper records
Mobile app/web-browser differences
Unavailable with web outages

Tips for Getting Started

- Plan ahead!
- Attend a LabArchives workshop for faculty; utilize LabArchives customer support
- Start with a “blank” notebook rather than LabArchives template with excess content
- Assign grade/point value to use; build into course assessment
- Provide instruction to students
- Integrate with LMS (SSO)
- Warn students to be careful not to damage computer in the lab

Summary

Although originally designed as a platform for record keeping in the research lab setting, LabArchives is a useful pedagogical tool. LabArchives offers the Professional Edition and Classroom Edition, which provides an overlay to distribute copies of a notebook to individual students. LabArchives was used in different courses and disciplines, both at the undergraduate and graduate level. We found that in all contexts in which it was deployed, LabArchives enabled simultaneous and asynchronous group work, and facilitated interactions among students, as well as between the students and instructor. Weibel (3) proposed a model for use of electronic cloud-based tools provided by Google, and showed data supporting improved student satisfaction and academic performance in a General Chemistry lab course. The use of LabArchives in OT322 was very similar to the model proposed by Weibel, and 90% of student users completing the course survey felt that LabArchives enhanced their learning. Riley *et al.* (2) provided rationale and support for use of LabArchives in a bioprocess teaching laboratory course, describing how use of LabArchives meets needs at a pedagogical “sweet spot”, where the needs of the students, instructor, and interaction with the course material intersect. This was the rationale for deployment of LabArchives in BIOL391 and in extracurricular undergraduate research projects. From an instructor standpoint, LabArchives was used successfully in these capacities in that it permitted real-time monitoring of student lab work and student-student interactions within groups. However, it was noted that students would benefit from greater emphasis on expectations of use and formatting of entries. Ideally, a plan for assessment of learning gains due to use of LabArchives should be built into the course assessment to allow for continual improvement and refinement in future courses. The assignment/grading features of the Classroom Edition were not used this year, but a Canvas integration and new Blackboard integration makes this possible for future cohorts.

This presentation was facilitated by our use of LabArchives!

References

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- Riley, E. M., Hattaway, H. Z., & Felse, P. A. (2017). Implementation and use of cloud-based electronic lab notebook in a bioprocess engineering teaching laboratory. *Journal of Biological Engineering*, 11, 40. <https://doi.org/10.1186/s13036-017-0083-2>
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