ISSN 2161-3974

JeSLIB 2018; 7(2): e1140
doi:10.7191/jeslib.2018.1140

Journal of eScience Librarianship
putting the pieces together: theory and practice

Full-Length Paper

Support for Electronic Lab Notebooks at Top American Research Universities

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Abstract

Objective: Electronic Laboratory Notebooks (ELNs) are widely used in industry but little is known about their use in academia or the extent to which they are licensed or supported by research institutions or academic libraries.

Methods: This paper describes an environmental scan conducted to determine whether major research institutions in the United States are providing enterprise ELN licenses to their users, which products they are licensing, and what role of the institutional library is playing in licensing and supporting ELNs.

Results: Of the 35 universities included in our scan, 8 (23%) had an enterprise-wide license for an ELN and 10 (28%) provided some kind of support for ELNs. Of the 10 institutions that offered support for ELNs, 9 involved the library. A literature review revealed a number of barriers to adoption—from costs to the diversity of needs—that may be limiting the adoption of ELNs within research institutions.

Conclusions: This research provides evidence about the current landscape of ELN support within academic institutions and the role of libraries in these initiatives.

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Keywords: Electronic Lab Notebooks, ELNs, Academic Libraries

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doi:10.7191/jeslib.2018.1140

Introduction

Laboratory notebooks are the primary records that researchers from many disciplines use to document their research processes, procedures, and discoveries. As such, they are important workflow and archival information technologies, recording the methodology and provenance of research. Traditionally, lab notebooks were bound paper notebooks with sequentially numbered pages in which researchers wrote and attached materials to record the methods and results of their research. ELNs are digital replacements for traditional notebooks that also offer a number of affordances only available with digital platforms, such as collaboration, sharing, automated backup, data import, templates, and searching, among others (Dirnagl and Przesdzing 2016, 4; Du and Kofman 2007, 157-58; Machina and Wild 2013, 266).

Electronic Lab Notebooks are widely used in industry (Kloeckner et al. 2014, 95-96; Machina and Wild 2013, 266-67), but little is known about their use in academia or the extent to which they are licensed or supported by research institutions and academic libraries. This paper describes an environmental scan of major academic research institutions in the United States that was conducted to determine which institutions are licensing ELNs, which products they are licensing, and what role the library is playing in supporting ELNs. The goal of this research is to provide evidence about the current landscape of ELN licensing and support within academic institutions and the role of libraries in these initiatives.

Literature Review

A broad literature review was conducted, focusing on biomedical, general science, and library and information-science literature databases. In general, there was little literature about ELNs and their implementation or use in academia. The existing literature focused on describing individual ELN products created by academic research groups or summaries of available commercial products. Several scientific computing trade publications offered overviews of products available in the market and expected future growth. The following literature review excludes articles describing individual ELN products and focuses on overviews of use and issues with implementation, specifically in academic environments.

In industry, concerns about intellectual property, confidentiality, and quality control have been strong drivers for the uptake of ELNs, and in some sectors, such as medicinal chemistry, uptake was estimated to be as high as 60% by 2013 (M. H. Elliott 2014; Joyce 2016). Other industries that have actively transitioned from traditional lab notebooks to ELNs include the pharmaceutical, chemical, and biological research and development industries.

The growth in ELN sales in 2013 was over 5%, down from a high of 30% in previous years (M. H. Elliott 2014). Industries making use of ELNs include those focusing on biological and chemical topics, and interest in their use is coming from both quality control and research and development realms (Rubacha, Rattan, and Hosselet 2011, 91-93). In many cases, ELNs are part of larger laboratory information management systems, and recent developments include the ability to integrate with a variety of software platforms and devices (Palmer 2016).

Most literature about ELNs in academic settings notes that uptake has been slow compared to industry (C. Elliott et al. 2017; Kanza et al. 2017, 2-6; Kloeckner et al. 2014, 95-102). In an article in the trade magazine Scientific Computing, Michael Elliott reviewed the state of ELNs

and found that despite upward growth in industry the "expansion of the use of ELN in non-profits continues to be anemic at best" (M. H. Elliott 2014). Elliot identified a number of barriers, including licensing costs, the complexity of available products, minimal need for robust intellectual property protection, and no sufficiently compelling reason for researchers to adopt ELNs.

A review of the challenges to implementing ELNs in academic laboratories found that research groups at research universities are significantly different from commercial environments, with greater decentralization, less data-sharing between groups, more diverse IT environments, and a tendency for individual research groups to change institutions. The majority of ELN products did not take these differences into account. The review also points out that academic environments are particularly difficult because the diversity of work being performed makes it challenging to choose one product that will satisfy all researchers' needs (Wright 2009).

A synthesis of five surveys on researchers' attitudes towards ELNs found that, despite notable interest, there was little uptake and significant barriers to adoption. Kanza and colleagues conducted a survey to assess interest and use of ELNs in academia, finding that only 11% of respondents were using an ELN in their research group, though 76% expressed interest in implementing or learning more about ELNs. Major barriers included limited budgets, concerns about changing existing workflows, time needed for implementation, and concerns about the security of cloud storage (Kanza et al. 2017).

Both Kozlowski at Cornell and Nesdill and Schmick at the University of Utah offer insights into pilot projects that introduced ELNs into a large research institution (Kozlowski 2018; Nesdill and Schmick 2013). Both institutions used LabArchives, and they noted promotional strategies as well as features of the software. Academic libraries are becoming more involved in all aspects of data management, and the topic of ELNs surfaces in discussions about methods to efficiently gather and organize research data (Briney 2015).

Several articles have reviewed current ELN offerings. A 2011 review of the ELN marketplace found over 30 ELNs and an annual growth of over 20% "making ELNs one of the fastest growing informatics technologies" at the time (Rubacha, Rattan, and Hosselet 2011, 91). Recent research describes an even more expansive environment, with one survey finding 103 ELNs on the market, including 72 that were active and 30 that were no longer active (Kanza et al. 2017, 3).

In this rapidly shifting landscape, we sought to understand how some academic libraries were supporting their patrons in the use of these tools. The objective of this project was to identify whether enterprise-wide licensing of ELN solutions was commonplace, and where tools, whether enterprise or otherwise, were being supported through instruction and outreach efforts. As ELN needs are often specific to workflows and disciplines, and these tools may be the domain of libraries, IT professionals, or disciplinary experts, we aimed to learn who on campus was providing support and the extent to which that support was being offered.

Methods

In the spring of 2017 the authors conducted an environmental scan of ELN licensing and support at the top 35 institutions listed in the Top American Research Universities (TARU) list

(see Appendix) produced by the Center for Measuring University Performance based at Arizona State University and the University of Massachusetts Amherst (Lombardi et al. 2011). In their annual report, the Center uses nine measures to determine rankings for over 600 universities. The TARU ranking is one of three measures used to determine Tier One status for an institution, the others being membership in the Association of American Universities and categorized as having "very high research activity" by the Carnegie Foundation for the Advancement of Teaching. Well-funded research institutions were identified as they were more likely to use ELNs.

For each university, one of the authors performed a three-step searching and interviewing protocol and recorded t findings.

> ***Step 1: Search for ELN-specific information on university website***: The institutional domain for each university was searched for ("electronic lab notebooks" OR "electronic laboratory notebooks" OR "ELN"). The first three pages of search results were reviewed for information about ELN use and support.
>
> ***Step 2: Search for lab notebook information on university website***: The institutional domain for each university was searched for ("lab notebooks" OR "laboratory notebooks") to find general information such as policies and meeting notes related to traditional notebooks or ELNs. Researchers reviewed the first three pages of search results for each search.
>
> ***Step 3: Direct contact***: Using the information gleaned in steps one and two, as well as personal contacts, researchers contacted a science librarian and/or information technology specialist at each university to inquire about ELN practices and support at their institution. Each contact was asked what they knew about ELN support at their institution, what ELN products were in use, and whether the library or another department had a role in supporting them.

Results from all three steps were recorded in a spreadsheet and then analyzed for trends.

Results

Of the 35 universities included in our environmental scan, eight (23%) had an enterprise-wide license for an ELN product. The eight niversities that had licensed enterprise-wide ELNs were a mix of public and private institutions. LabArchives was the most commonly licensed ELN, with seven of the eight institutions with enterprise licenses using LabArchives. For institutions for which we could determine the source of funding, campus information technology (IT) units were a primary supporter of ELNs. Libraries contributed to funding for only two of the eight institutions with enterprise licenses.

Ten (10) of the 35 institutions queried provided some level of support for ELNs by the libraries or other units on campus. We categorized the types of support as either "active," i.e., instruction or consultation (see Table 1), or "passive," i.e., web-based guides (see Table 2). The levels of support are broken out by levels of adoption (enterprise license, some classroom or lab use, or neither). Because some institutions offer support in multiple forms or from multiple units on campus, the totals for support types are not the same as the number of

JeSLIB 2018; 7(2): e1140
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institutions offering support. Libraries were involved with the ELNs of nine of the 35 institutions, and seven of those were involved with at least one other unit on campus, typically information technology.

Table 1: ELN Active support offerings at major US research institutions by level of ELN adoption. NB: Offerings are not mutually exclusive.

	Instruction (Libraries)		Instruction (Not Libraries)		Consultations (Libraries)	
	n	%	n	%	n	%
Institutions with enterprise-wide ELNs (n=8)	3	37.5	5	62.5	4	50.0
Institutions without enterprise-wide ELNs but with classroom or lab adoption (n=14)	0	0.0	1	7.1	2	14.3
Institutions without enterprise-wide ELNs and without classroom or lab adoption (n=13)	0	0.0	0	0.0	0	0.0
Total (n=35)	3	8.6	6	17.1	6	20.0

Table 2: ELN-related web pages or library guides (passive support) at major US research institutions by level of ELN adoption.

	Libraries-Created Guides		Non-Library-Created Guides		Jointly Created Guides (Libraries + Non-library Units)	
	n	%	n	%	n	%
Institutions with enterprise-wide ELNs (n=8)	2	25.0	5	62.5	2	25.0
Institutions without enterprise-wide ELNs but with classroom or lab adoption (n=14)	2	14.3	1	7.1	0	0.0
Institutions without enterprise-wide ELNs and without classroom or lab adoption (n=13)	0	0.0	0	0.0	0	0.0
Total (n=35)	4	11.4	6	17.1	2	5.7

The eight (23%) institutions with an enterprise ELN license offered varying levels of support by the libraries and/or other campus units. One institution with an enterprise-wide license offered no support services to users. Two others offered support from non-library units. Only two did not offer both active and passive support.

There were 27 universities that did not hold enterprise licenses. A total of 14 institutions without enterprise-wide licenses had some level of ELN adoption on campus. Five (19%) reported being aware of at least one or two instructors on campus who required students to use an ELN for their classes, and 12 (44%) knew of usage in research labs on their campuses. Two universities without enterprise licenses provided some form of support for ELNs by institutional units like IT or libraries. At one institution an academic unit unrelated to the library taught workshops and maintained online guides, and another university had a web guide created by the library and offered consultations with librarians.

Discussion and Conclusion

Unlike their counterparts in industry, researchers in academia have been slower to adopt ELNs, despite showing interest in adopting them into their research practices. Our literature review and our own experience revealed several barriers to adoption, ranging from costs to the diversity of needs between academic disciplines. However, adoption of ELN solutions is not exclusive to researchers at institutions with enterprise licenses. In this research we learned that while only eight of the institutions analyzed have enterprise licenses, at least 14 have some use of ELNs which indicates that there are individuals and groups within institutions adopting new practices. Anecdotally, the authors know of several labs at their own institution using ELNs that would not have appeared during this scan. For this reason, we suspect that ELN use in academia is broader than these results show.

The reasons for the lack of library support for ELNs remain unclear. While financial support for licensing and implementation may not be feasible, libraries interested in developing services to support ELNs may find that instruction and consultation provide opportunities to do so, while also offering opportunities to get more involved in research data management at an earlier stage of the research lifecycle. Given the prevalence of ELNs in industry, providing graduate students with an understanding of these tools is an important, marketable skill for those seeking employment.

ELNs are tools through which research data is collected, documented, shared, and stored. Despite the interconnectedness of ELNs and research data management, best practices for managing data using an ELN have not been fully articulated. Given that the effective use of ELNs requires an understanding of diverse issues ranging from intellectual property implications to digital preservation to licensing, librarians providing support for research data management could consider the ways in which their current offerings could be extended or framed to apply to ELN usage.

This research has a number of limitations. The results are based on publicly available information and contacts with library staff at the institutions. This likely underestimates the number of researchers and labs who are using ELNs. Anecdotally, the researchers know of a number of labs at our institution that have adopted ELNs without coordinating or notifying anyone from the Libraries or Information Technology department, and assume there are similar

practices happening at other institutions. Future research could consider investigating the reasons for lack of institutional and academic library support; identifying the number of researchers who have implemented ELNs without institutional support, and how those individuals selected the tool - what factors were most important in that decision; exploring the potential benefits and costs of using ELNs in academia; and surveying the grey literature on this topic. Research into these questions would further clarify the role of enterprise ELN licensing in academic institutions, the role of the library, and the value of these products.

Supplemental Content

Appendix
An online supplement to this article can be found at http://dx.doi.org/10.7191/jeslib.2018.1140 under “Additional Files”.

Disclosure

The authors report no conflict of interest.

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