Is It Worth It? Implementation of Electronic Lab Notebook Software Among the STEM Community at an American University in the UAE

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Amani Magid has a degree in Integrative Biology and a minor in Arabic from University of California, Berkeley. In her career as a scientist, she has worked as a researcher in Pharmaceutical Chemistry and managed biology lab classes at a community college. She soon realized her passion was in finding and locating science information and earned her Masters in Library and Information Science at University of Pittsburgh while interning at Bayer Material Science Library. She worked in Qatar for over five years as a Medical Librarian before her present position as an Associate Academic Librarian for the Sciences and Engineering at New York University Abu Dhabi.

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Abstract

Scientists and engineers have been recording the results of their scientific findings and studies via lab notebooks for hundreds of years to lay out protocols and track their progress. Most of this recording of protocols and progress has been done via paper lab notebooks. With the popularity of the internet, many have been turning to electronic means to record their study data, though this does not imply that paper lab notebooks have been completely abandoned. In the beginning, many were making use of tools not necessarily created for the sole use in laboratories, such as Microsoft Word, Evernote, Google Docs, or other means of recording notes online and/or via a computer. However, there proved to be a market for products used especially by those doing research on scientific fields and thus the electronic lab notebook was born. New York University Abu Dhabi has a growing faculty specializing in STEM fields. As with any other university, the STEM faculty rely on many other staff to help conduct their research including Postdoctoral Scholars, Research Scientists, Research Assistants, etc. The Science and Engineering Librarian received one request from a scientist about the library purchasing Electronic Lab Notebooks, and she and a colleague sent out a survey to STEM faculty and staff to ascertain if others were also interested. The feeling was mutual and thus the NYUAD library set out to purchase and market the Electronic Lab Notebook software. However, the question remains as to whether the process was worth it? Have the science and engineering community embraced the electronic lab notebook software? Or has the community held strong to their methods of recording their findings before the availability of the software? This paper will review the results of surveys conducted both before and after implementation of Electronic Lab Notebook software.

Background

New York University Abu Dhabi (NYUAD) is a portal campus of New York University in New York City, USA. Located in the United Arab Emirates in the city of Abu Dhabi, NYUAD is a liberal arts university with over 20 majors that students can choose from under the disciplines Arts and Humanities, Social Science, Sciences, and Engineering[1, 2]. With slightly more than 1000 students, NYUAD boasts a 5:1 Student to Faculty ratio. Faculty conduct research in each of 4 aforementioned areas. In addition, the Research Institute consists of over 12 centers, labs, and projects, the majority of which fall under Sciences or Engineering.

Pre-Use Survey

As a STEM Librarian, Amani Magid provides outreach to her constituents via STEM Librarian Day. Every other week, she spends the day in the science building, fielding questions about library resources and services. As this service has been provided for the last 4 years, she has become acquainted with many of the faculty, staff, postdocs and graduate students, even given the growth of the university. As a result, there are some who attend the STEM Librarian Day for the social aspect, as said Librarian welcomes this as well, for it forges ties and can build friendships. On one such day, one of the scientists who came for a social visit, began talking about business and began to discuss the instrumentation he manages. This then led to a discussion about recording data from not only the instrumentation but also from the labs and how presently this data recording has been done by paper lab notebooks. This then evolved into a discussion about electronic lab notebooks. The Library at that time, had no subscriptions to electronic lab notebook software. The librarian sent out a Qualtrics survey to all science and engineering faculty, staff, postdocs, and graduate students to determine if there was any interest in using electronic lab notebook software. The survey was left open for 4 months and received 46 responses. Some of the survey results are presented in Figure 1.

Q5 - What specifications would you require from an electronic lab notebook? (please explain in detail)

What specifications would you require from an electronic lab notebook? (please explain in detail)
Need to be able to add text, graphs/charts and also rough sketches and diagrams.
import of excell tables, jpg images, word documents
Multi-disciplinary/general purpose and flexible
Or it would have to be paper like feeling to write freely. With still the ability to take a pic of something if needed to add raw data
simple writing, simple drawing capabilities (sketches) uploading of data Wifi capability
Designed for chemistry/science set up To include risk assessment for reactions, can attach PDFs or images, can edit after experiment has been closed
Ability to link related reactions Search Function (by keyword AND structure) Grouping of Experiments by Project Links to related references (Endnote, etc.)/Ablility to group experiments by source reference Easy copy paste functionality (i.e. Paste in a graph/chart from Excel or other data software) Ability to attach pictures/drawings (jpeg, gif, etc.) Ability to copy/paste whole pages/experiments (for repeating several trials)

Figure 1 Sample Survey question

The librarian asked a variety of questions on current paper lab notebook usage, such as if one was being used, and if so, how. When posed with the question of would a person

use electronic lab notebooks if they were available, 88.64% replied yes. The librarian also wanted to know the types of features her customers wanted from a lab notebook. The responses are varied and range from ability to add: images, pdf's, excel tables, and graphs/charts, ease of use, ability to share notebooks with lab members. When asked if one would use a lab notebook if it were made available at no cost, 90.91% replied yes. The librarian asked what would prevent one from using an electronic lab notebook and the responses varied widely. Some noted difficulty in using it over pen and paper, "If it is more difficult and time consuming to write up experimental details and data" and "I'd stop using an electronic lab notebook if I find out that it is not user friendly" and "If it is not practical. I really need to be carrying around and to feel comfortable writing on it, with a pen. If I end up always writing on paper and then having to copy it, it will not last. I need to be able to draw make arrows etc." and "If it wasn't easy. The software can have limited ability to collect data from the instrument, but if it becomes intrusive to the function of the instrument or data collection". One respondent noted difficulty in syncing would be a deterrent. Yet some were worried about another entity seeing their lab data, stating that "an obtrusive DRM. A lack of privacy/security...controlled access/password/encryption" and another noted, "Before publishing the paper, we hope that the electronic lab notebook is safe and confidential" and finally, "Research data/material being online before it is published or patented". "Difficulties in syncing data" was another reason given. Another noted lab notebooks created for certain types of research," some of the ones I've seen are only really useful for bench science. I realize I'm in the minority of people who use a lab notebook but don't do bench science, but anything that's too targeted to biology would be not useful to me." Finally, one person noted that they preferred "book, paper, and pen".

Based on the results of the survey, the librarian decided to investigate electronic lab notebook software that the library would purchase. She investigated to see if the New York University-New York campus had subscribed to a lab software or were interested in subscribing to a lab software. As the answers to both questions were negative, the librarian then investigated to see what major universities in the US subscribed to lab notebook software and searched the literature for lab notebook software implementation.

Literature Review

Electronic Lab Notebooks have had an impact on recording experimental results in academia. The Translational Science lab at the New York University of Medicine have determined that using Evernote as an electronic lab notebook performed as well as a paper lab notebook[3]. Nussbeck et al believe that electronic lab notebooks will become very common and eventually replace paper notebooks due to its ability to record data structures, standardize protocols, and facilitate data storage [4].
Regarding implementing an electronic lab notebook software, librarians at Yale University discuss the process of deciding on Lab Archives and information on how it is introduced to the university community[5]. Researchers at Max Planck Institute surveyed scientists to determine which features are required features when considering an Electronic Lab notebook software purchase[6] Microsoft OneNote proved to be the

favorite ELN at a Biomedical Research Institute in Spain when scientists were presented with 5 different software programs which they tested out[7].

Electronic Lab Notebook software has also been implemented in the classroom environment. In a Biomedical Engineering class where students were assessed on their degree of documentation in a notebook, students who used Electronic lab notebooks received higher rubric scores than those who used paper notebooks[8]. In a comparison of electronic Folio (eFolio) versus paper lab notebook in an engineering design course, eFolios allowed for clearer documentation than the paper notebooks[9].

ELN Software Choice

The author was looking for a software created specifically for a research environment, as opposed to software that can be used for any environment such as Evernote. She found discussions about Electronic Lab Notebook software on various email listservs for STEM Librarians. In addition, she virtually attended a webinar on Electronic Lab Notebooks that was hosted by librarians[10]. Lab Archives was chosen as the software to subscribe to.

Rollout campaign

Amani Magid commenced an aggressive rollout campaign to make all STEM community members on campus aware of the availability of Lab Archives. Each Thursday afternoon, the equivalent of Friday afternoon in the West as it is the end of the week, an email is sent out by the manager of the STEM division announcing upcoming events and announcements for the coming week. The Librarian regularly sends out information through this announcement email. When Lab Archives had been approved for purchase, she sent out a "Coming soon" announcement. When it became available, she sent out a "Now Available" announcement each week for a month. With this announcement, she sent out promotional materials provided by Lab Archives. She also announced that for labs interested in the software, she could set up training seminars with the Lab Archives representative. She also attended each of the individual department meetings, and announced this to faculty there. She also discussed this informally at STEM social events and while attending lectures of each of the departments.

Post-use survey

As the subscription is only for one year, the Librarian opted to survey the faculty, staff, post-doctoral scholars, and students that had signed up close to the end of the subscription. A total of 35 people signed up for Lab Archives since it was announced as available. The librarian asked a variety of question, including short-answer, which are included in the appendix.

Of the short replies back, one biology postdoctoral scholar noted that her lab was not interested in new technologies as well as her preference for paper, " ...What I could say is that all my lab doesn't like tech stuff and I actually like to carry my paper around and the feeling of writing on paper as I take my notes... So for it to work, best would be to

have the whole lab (or most of it) making the switch with the push from the PI. My guess is that younger generations will be better with it". Yet another biology postdoctoral scholar also noted lab adaptation as reason for not using it, "...I am afraid I will be not able to give you any feedback for lab archives. I looked on that sometimes in the past but I never really used it. Software like that will be good if the whole group will use it. For me as an individual was just easier to use the old fashion written notes in the notebook…". One physics professor noted that it wasn't geared for his discipline, "...but I have to say that after opening the account I quickly realized that it's a software mainly aimed to chemistry/biology, and not quite as useful for the use in a research group such as mine. So we switched to use Overleaf to share documents". Many respondents fell into the category of those who have registered an account but did not use it.

One psychology professor tried it out with his lab for a while and asked for their feedback. The lab voted to not use Lab Archives citing a variety of reasons, with the primary reason as not tailored to the type of research his lab conducts, "...it seems to be good for bench science….my lab does computational research". Another reason was the unappealing interface,"...the interface was not sleek and modern...it reminded me of an older version of Excel". In the end, his lab chose Slack https://slack.com/features as it not only is project-oriented which met his needs as a computational researcher and has an interface that appealed to him and his lab. In addition, he benefits from the ability to have conversations with members of his lab without many emails and uses the to-do lists frequently.

Amani Magid also found out that one lab group in the New York City campus with a corresponding lab group in the Abu Dhabi campus, had signed up for Lab Archives prior to the Library's subscription. She interviewed 2 members of the lab group, one in New York City and one in Abu Dhabi to obtain their perspectives on using this software. The scientist in New York City reported that they used it frequently, but at that time there was a Postdoctoral Scholar who encouraged lab members to add information to it. Once that Postdoc moved to a new position, it was difficult to keep track of everything and it was eventually abandoned. He found it good for experimental data, but since his lab collects computational data it wasn't as beneficial. Surprisingly, the scientist in Abu Dhabi also noted that one member of the lab should be in charge of it and encouraging other lab members to submit their information. He agreed that it is convenient to use if one knows how to use it efficiently and effectively. In addition, he relayed an event where he contributed a great deal of information on Lab Archives for a project in collaboration with some of the team located in New York City. The results of the project were published in a journal article, and despite the Abu Dhabi scientist's substantial contribution to that research, he was only listed in the acknowledgement section and not as an author. In the end, the Abu Dhabi scientist was added as an author, only after the Principal Investigator demanded so. Although this appears to be more of a question of research ethics than electronic lab notebook failure, the Abu Dhabi scientist is understandably now hesitant of adding any of his research online in order to prevent a similar or worse situation.

All of the above comments refer to the professional edition of Lab Archives. The Library subscribed to the classroom edition as well and received feedback from one physics

instructor. He was initially very excited to use the classroom edition as he was looking for a more streamlined and easier solution to the organization and submission of assignments for the Physics lab course he was teaching. He wanted students to work in different groups every 2 weeks and therefore was hoping that Lab Archives would allow for rotation of students in lab groups, resulting in different group submissions. Even after consulting with Lab Archives representatives via video conference, he realized that this option was not available and therefore abandoned use of this software for the classroom. This instructor also tried using Lab Archives for research, as he is part of a research group in Physics. He tried Lab Archives with his group for 4 days straight and realized that there was no LaTeX in Lab Archives. LaTeX is used heavily by physicists for writing and formatting journal articles and conference proceedings, so a lack of this feature was not appealing. In addition, he wasn't keen on how one edits documents in Lab Archives. He found that he would have to download to make changes and then re-upload. He was hoping for something similar to Google Drive, where one can make changes without downloading or uploading. He was also not happy about the widgets available. He noticed there were widgets for those in the medical field but, "it would be nice to have this for other fields...I can make one but the whole purpose of Lab Archives is to simplify".

Discussion

In retrospect, the librarian wonders if providing multiple instructional webinars with the trainer would have helped in the adoption of Lab Archives. It is often easier to use a software when someone teaches how to use it. However, upon talking to many people who used Lab Archives, Amani Magid discovered that Lab Archives had reached out to each person who registered for a Lab Archives account. Would a seminar helped change the minds of those who had already decided they would rather use pen and paper? Would it have changed the minds of those who had formed the opinion that Lab Archives was not suited for their field or type of research? Perhaps not, but it might have encouraged those who had signed up for an account and had never used it, to actually make use of it. A webinar/seminar might have also swayed those who were worried about privacy and intellectual property rights of their research. Although the author surveyed the STEM community with an online survey, the post-survey results were obtained from email responses to request for interviews and actual interviews with those who used the software. So, there is the possibility that the responses of the survey would be more honest had the author used an online survey or enlisted one of her colleagues to conduct the interview.

Conclusion

Although the initial survey showed initial enthusiasm and high interest is using an electronic lab notebook system, the study has shown that this campus has not yet embraced the use of an electronic lab notebook over a paper notebook, at least not using Lab Archives. This is consistent with some literature that shows slow or no adoption of the electronic lab notebook. However, the fact that 2 respondents went on to use different software products other than Lab Archives alludes to the possibility that

adoption of software to organize research is possible. As the librarian who is a liaison to all of the sciences and engineering, perhaps a single lab notebook solution will not be the answer to accommodate the different fields and different types of research conducted on campus, whether bench research or computational research or otherwise. Investing in multiple software products is an option for the Library, however it is not an economically sound tactic. The Librarian should remain alert to the different research needs and continue to be cognizant of new software and technologies that have been developed to meet researcher needs.

Appendix

Pre-Use Survey

Q1 Do you currently use a lab notebook?

○ Yes (1)

○ No (2)

- -

Q2 If so, how often do you use it?

○ Less than Once a Month (1)

○ Once a Month (2)

○ 2-3 Times a Month (3)

○ Once a Week (4)

○ 2-3 Times a Week (5)

○ Daily (6)

- -

Q3 What types of records do you record in your notebook? (please select all that apply)

☐ raw data (1)

☐ test results (2)

☐ images generated from test results (3)

☐ sketches and/or drawings (4)

☐ tables, charts, and/or graphs (5)

☐ other (please explain) (6) _____

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Q13 Electronic Lab Notebook Survey

Q4 Would you use an **electronic** lab notebook?

○ Yes (1)

○ No (2)

Q5 What specifications would you require from an electronic lab notebook? (please explain in detail)

_____

_____

_____

_____

_____

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Q14 Electronic Lab Notebook Survey

Q6 Would you use an electronic lab notebook if you could access it from anywhere in the world?

○ Yes (1)

○ No (2)

Q7 Would you use an electronic lab notebook if there were no cost to you or your program?

○ Yes (1)

○ No (2)

Q8 Would you use an electronic lab notebook if it could directly link to your instrumentation?

○ Yes (1)

○ No (2)

Q9 Would you require an intellectual property sign off for an electronic lab notebook?

○ Yes (1)

○ No (2)

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Q15 Electronic Lab Notebook Survey

Q10 What would stop you from using an electronic lab notebook?

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Q11 Comments

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End of Block: Default Question Block

Post-Use Survey

What department are you in?

Why did you choose to use Lab Archives?

How often do you use it?
   a. Once a day
   b. Multiple times a day

    c. Once a week

    d. Multiple times a week

    e. Once a month

If you are not a regular user, can you please explain why?
    a. Lack of time
    b. Don't like it
    c. Hard to move to electronic
    d. Other (please explain)

What features do you use?

Do you find it convenient? Yes/No please explain

Do you find it flexible?
    a) Link to other pages
    b) Able to drag\drop
    c) Able to create own workflow design
    d) Able to add images/video (not from survey-my own quetion)

What comments/suggestions/criticisms/ do you have about Lab Archives?

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