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An online educational resource to train future STEM librarians

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Work in progress: An online educational resource to train future STEM librarians

Abstract

With the recent wave of retirements in engineering and science librarianship, there is a need for tools to develop technical information librarians to support both science and engineering disciplines. At University of Illinois Urbana Champaign, an open educational resource is being developed to support both library and information science pre-professionals (graduate assistants) as well as mid-career librarians that need to up-skill in support of newly assumed STEM liaison roles. The OER is being developed in a modular format covering information important both for finding and retrieving technical information, as well as teaching STEM information literacy. Nuances of serving as an academic STEM librarian are included, such as preparing for accreditation visits and working with curriculum committees to scaffold information literacy across the undergraduate experience. This presentation will describe the development and content of the OER, as well as plans for assessment and iterative design.

Introduction

The lack of formal training opportunities for learning STEM librarianship knowledge, skills and abilities is the catalyst for the development of an open educational resource focused on upskilling to support STEM disciplines. ISchools across the country are increasingly moving away from disciplinary specific librarianship courses. [1] At the authors' institution, general liaisonship and reference classes are offered, as is a general information literacy instruction course, but no STEM specific courses are listed in the ISchool catalog. Similarly, there are no regularly offered STEM librarianship Massive Open Online Courses or tutorials, in the way that medical librarianship, data librarianship and scholarly communications librarianship have on offer.[2], [3], [4] Similarly, existing resources generally cover the concepts of liaison librarianship but do not include the STEM librarianship subject matter disciplinary content.[5]

Increasingly, the profession is seeing the loss of experienced STEM librarians as a large group of STEM librarians have reached retirement age. Financial resources of academic libraries in the United States have led to multiple liaison areas being served by single liaison librarians. Where institutions may previously have employed separate chemistry, physics, engineering and mathematics liaisons, frequently a single individual is being asked to take on multiple physical or applied sciences liaison roles. As such, there is significant need for online resources to support early career and mid-career upskilling.

To provide a systematic introduction to engineering and STEM librarianship intended for those new to the discipline of engineering and STEM librarianship, the authors are creating an open educational resource (OER). This work in progress project has the goal of creating a widely available and useful tool to support the ongoing workforce development of STEM librarianship.

This paper provides an overview of the initial steps in creating the resource and presents plans for ongoing and future updates to the work.

Review of Literature

Engineering librarianship is a distinct sub-discipline within academic libraries particularly concerned with the "design, development, or delivery of [engineering literacy and technical literacy] learning activities and programs" as well as the collection and access of scientific knowledge, particularly gray literature such as standards, technical handbooks, and technical reports. [6], [7], [8] Science librarianship is considered to be intimidating by many individuals who enter library schools due to lack of familiarity with the subject matter discipline. [6], [7] STEM librarianship is taught in relatively few ISchools, which means the pipeline to STEM librarianship is frequently on the job and through self-directed study. [9] This is so common that a book series published by American Library Association is titled "Sudden Selectors." It was created to facilitate upskilling of those unfamiliar with a given discipline to assume control of a collection in a new-to-them liaison area. [10] Other handbooks to support this upskilling are published intermittently to reflect impacts of changes in information technology on STEM librarianship, but present the problem of becoming dated quickly. [11], [12] By virtue of this commonly used, self-directed learning process, individuals receive inconsistent training in STEM librarianship as they find useful resources that meet them at their point of need for aspects of engineering librarianship, but that are generally not a comprehensive introduction to the specific disciplinary specialty that they are serving.

Additionally, there is little literature covering practices for training librarians on supporting engineering and STEM students and faculty. An exploratory study to determine important learning objectives for training engineering librarians has been published. [13] This study presses the need for a form of curriculum to train STEM librarians. Based upon the literature, no curriculum or online resource has been published to date that addresses the specific issues of upskilling for STEM librarians, presenting a gap in the disciplinary knowledge of library and information science. Other methods for training of STEM specialist librarians include participation in subject specific regional conferences for science librarians as a pathway for training and further education. [14] While conferences such as these can help support engineering librarians, they do not present a just-in-time solution for those upskilling on the job.

Professional associations have created guides and posts on pathways for those entering STEM librarianship to upskill, but do not offer ways for librarians to reflect upon the information or detailed information on specific subject areas, such as grey literature. [15], [16] Other literature on training librarians on engineering librarianship focus on educating non-engineering librarians for assisting STEM patrons on the desk through informative presentations. [17] While this form of support can be useful to aid non-engineering librarians in situations such as a reference consultation, such education may not be readily available, sustainable, or consistent in all situations where professionals assume a STEM librarian role.

International Federation of Library Associations recognizes that workplace learning is a constant demand on libraries and librarians, whether subject specialists or functional specialists, by creating guidelines for workplace learning that individual country professional bodies can adapt to guide continuing professional development programs. [18] The literature exploring the training of STEM librarians is surprisingly sparse, given the necessity of practitioners to up-skill by using existing published resources. When compared to the literature on upskilling liaisons for data librarianship (which has had an average of 2 new books published per year focused on upskilling in the area of data management[19]), the extent to which there is a gap in STEM librarianship professional development materials emerges. Carroll and Borycz published *Essentials of STEM librarianship* [12] to provide a focus on the relationship building and general concepts necessary to serve as a STEM librarian. The book is intended to support mid-career upskilling but does not have a significant focus on technical literature that is characteristic of STEM disciplines. Similarly, the books published over the past ten years relevant to engineering librarianship generally 1) focus on a single aspect of liaison work, such as instruction [20] and are presented in a format that cannot easily be updated (monographs).

While monographs continue to be written to support early career and mid-career upskilling, the fundamental problem of monographs is that they are frozen in time and are only updated after significant time has passed and with the significant expense of the publication process. While other online resources exist to support early and mid-career upskilling, many do not offer detailed information and training in a way that scales professionals into STEM information. Instead, information exists scattered across multiple sources, in a manner that complicates discovery. As such, an online, flexible, scalable resource is needed. Open educational resources provide the opportunity to create such a resource.

Open educational resources present an opportunity, that of being able to create an expansive treatment on a subject while also being able to easily update the content over time. They also present challenges including the sustainability of OER initiatives and quality assurance. OERs require management of the effort over time, peer review processes, identifying resources to support the initiative and developing community to support the initiative over time. [21]

Methodology

The Development of the Local LibGuide

Pre-professional graduate assistants (PGAs) are employed to serve as reference staff at Grainger Engineering Library Information Center at University of Illinois Urbana Champaign. The graduate students go through intensive training as part of their contract by completing an extensive Canvas module introducing the fundamentals of working in the library and STEM information sources, followed by a weekly meeting that works systematically through topics relevant and useful to reference staff in a STEM library. Sapp-Nelson has developed a series of

two, one academic year, 1-hour weekly trainings in conjunction with faculty serving liaison areas in Grainger Engineering Library Information Center, the first on the topic of evidence synthesis and expert searching with Anna Liss Jacobsen (https://guides.library.illinois.edu/Grainger_GA_ES-Training), and the second on STEM information literacy (https://guides.library.illinois.edu/Grainger_GA_STEM_infolit_Training). These series provide PGAs exposure to knowledge that enhance their reference skills and activities that build their portfolio of professional skills, which also translate to a wide variety of librarian positions.

The authors create educational interventions in the form of a library guide, structured to match a synchronous in-person instructional session for the graduate assistants. The author team includes Megan Sapp-Nelson, a 20 year veteran as a STEM librarian in Carnegie I institutions and Skylar Lucci, who is a former PGA and visiting assistant professor in the engineering library. A backwards design model is used to identify the learning objectives for each module and develop a baseline formative assessment for the content in the form of active learning activities. The content of the modules is drawn from a combination of the scholarly literature and personal experience. For the initial draft, the goal of the project is to expose PGAs to the baseline knowledge, skills and abilities that early career STEM librarians should have prior to entering the workforce.

The instruction goals for the developers include:

- Introducing participants to common information literacy pedagogy used for instructing STEM undergraduate and graduate students.
- Giving participants detailed information on disciplinary differences in the use and publication of information.
- Introducing participants to a variety of resource types and information ecosystems.
- Providing strategies for serving STEM disciplines, such as key players in academic departments to contact, understanding instructional structures for large enrollment courses, and the role of curriculum committees and accreditation in guiding value propositions around STEM information literacy.
- Making connections between the research enterprise and the information eco-system of STEM disciplines.

The learning goals for participants include:

- Participants will apply information literacy instruction pedagogies to the specific disciplines comprising STEM librarianship to effectively design and lead in-class instruction.
- Participants will synthesize knowledge of how disciplinary stakeholders in multiple STEM disciplines access and utilize information and translate that knowledge into appropriate educational interventions and services.

- Participants will be familiar with the literature used in STEM research and education.
- Participants will demonstrate proficiency at searching common STEM databases.
- Participants will apply the content introduced to gather information and conduct reference interviews with STEM patrons.
- Participants will be familiar with the research funding and regulatory environment of STEM research and the implications of that environment for scholarly sources and research practices.

The authors select the learning goals and modules based upon their professional experience as well as major publications in STEM literature and Library and Information Science Literature. The authors benchmark the contents covered in the intervention with an existing STEM literacy course and a proposed curriculum in the literature. [13], [22] The book "Integrating Information into the Engineering Design Process" [20] is the core text for the modules, in part because it is available freely through Purdue University e-Pubs. Due to the applied nature of the information in the book, participants find the text useful for providing contextual examples for the content they are learning. For each module, additional scholarly resources are identified that helped to enrich the learning experience.

The established learning goals inform the structure of the educational resource. The authors build in a scaffolded approach in which earlier information gives grounding for later, more complex topics. The modules initially introduce the participants to STEM information literacy practices and the types of literature used in STEM research as a foundation for later topics in STEM liaison librarianship, collection management, instructional interventions targeted at capstone or design classes, and the research and regulatory environment of the STEM disciplines, with heavy focus on the resources used in engineering. The authors structure the modules in such a way that the participants receive just-in-time instruction to facilitate library support for introductory courses and capstone courses that occur during a regular semester. A list of topics initially created by the authors continues to be iteratively developed as the instruction materials are created.

Included topics in the pre-professional graduate assistant training:

01 STEM Information and Usage

02 Scholarly Literature Production

03 Scholarly Literature Retrieval

04 Primary Information and Reference Interviews

05 Primary, Secondary and Tertiary Technical Information

06 Standards

07 Technical Reports

08 Patents and Prior Art

09 Repositories and Preprints

10 Materials Information

11 Capstone Design Courses

12 Regulatory Environment and Codes of Ethics

13 Liaison Librarianship – Serving Faculty

14 Liaison Librarianship – Serving Students

15 Liaison Librarianship – Scoping Services

16 Functional Specialists – Research Data Services

17 Liaison Librarianship – Working with Functional Specialists

18 Collection Management

19 Marketing and Outreach

20 Accreditation

A timeline for development of the modules was created and is maintained to support the authors in teaching each module throughout the academic year. The modules are re-ordered and added in a just-in-time fashion to meet emerging needs necessitated by events and instruction within the library.

After providing instruction for the first month of the modules, the authors received verbal formative feedback that the graduate students found the training to be strong and very valuable in applied settings such as the reference desk. At that point, the authors developed preliminary plans to transform the local training into a widely accessible resource that will enable mid-career professionals to assume roles in STEM librarianship more quickly and easily to meet needs in the broader librarianship community.

Each page is outlined according to a common structure, including learning objectives, brief formative assessments in the form of active learning, and textual and graphical content. One of two authors takes the lead in the development of each module, with the other author serving as a peer reviewer to provide feedback and to edit the initial draft. Once the peer review process is completed, it is approved and made public through the SpringShare LibGuide tool.

Each module includes a resources box that points to scholarly literature and provides additional insight on the topic. Whenever possible, open-source journal articles and OER books are cited as

resources, although in many cases, existing open-source references are augmented with journal articles and books that exist behind paywalls that can be accessed by users of the libGuide.

Each page includes textual background information on the topic that is intended to build knowledge, skills and abilities relevant to the topic. In many cases, modules include multiple sub-headings or are otherwise developed to include content reflecting a variety of STEM disciplines. Finally, links to relevant databases and web resources are included. For subscription databases, notes are included for resources that are behind paywalls with suggestions for other viable search options or materials to request. In cases where databases are available through an analogous print form, that is noted as well.

Each week the content is covered in a synchronous non-credit bearing course. While the presenter leads the instruction, the other author makes notes on any edits that are needed or ideas for future development of the modules. Active learning activities are presented to learners and feedback is solicited informally from class participants.

A Masters level course in STEM liaisonship at another institution has been benchmarked. The syllabus for the course was requested from the instructor (Rowley, 2025) and learning objectives were compared. The benchmarking confirmed that the existing list of modules in the libGuide is analogous to the contents of the credit course, and that in some areas, topics extended beyond the course offerings.

Dunn et al[13] is an additional guide for the development of the course. Topics identified as the most challenging areas of STEM librarianship by Dunn et al (p. 210) are particularly addressed in modules included in the libGuide. The description of the curriculum in Dunn et al is mirrored, although not reproduced in its entirety, in the work presented here.

The Development of the Open Educational Resource

As the libGuide was developed, the authors recognized that the content being authored could be modified to create an OER that would benefit many early and mid-career STEM librarians. The content being prepared could have broader impact on academic librarianship with a redevelopment for a broader audience of upskilling librarians and early career librarians seeking to prepare themselves for STEM roles in academic libraries.

The development of an open educational resource allows the authors to circumvent the process of getting a course listed and all steps that that entails, including multiple levels of curriculum committee approval. It also means the resource is freely available, does not require tuition or registration to be able to access the content, and is easily updated with new modules or new editions. Open educational resources allow the authors to assign a usage license to the work which will allow others to contribute new materials or rework the existing materials for their own purposes.

The process of retooling the initial modules requires redevelopment of each module for an audience outside UIUC. This means practical details of redirecting links and available resources outside of those the authors have access to at UIUC. The authors provide alternative sources to access the same types of information in different contexts. The authors are retooling the original design as an introductory or "101" level. Because the OER offers significant flexibility, the opportunity to scaffold within individual topics, as appropriate, allows greater leeway to add emerging content over time. Given that, additional topics have been added to the potential module list for addition over future iterations.

The literature recommends best practices of OER development to enhance the sustainability required to successfully maintain an OER. [21] As part of the development process, the authors propose to enlist a co-author team of experienced STEM librarians to improve upon the existing content, add additional appropriate content as technologies emerge that impact upon STEM librarianship, and to peer review existing and new content. With the addition of creative and interested partners, the author team feels that the resource can be developed over time into a truly useful resource that can improve the quality of STEM librarianship across academia.

The authors are treating the current year of development and instruction as a pilot year to better understand what has worked with the libGuide, how that can improve the OER, and where the authors can refine it to apply in a more targeted way to mid-career librarians. After this pilot year, the authors plan to collaborate with peers and seek out formal review of modules to refine the OER. This project is in initial development as a learning object, and therefore, there is no existing human subjects approval for a strategically developed assessment project to measure learning impact or gains with the educational intervention. Future phases of the project will include research to determine efficacy of the intervention through both self-identified individual efficacy indicators and through summative evaluations of the modules and the entire resource.

The OER can be accessed at https://guides.library.illinois.edu/OERforSTEMLibrarians.

Discussion

As a pilot project, the authors meet the goal of creating a useful educational resource to support midcareer upskilling. The development of the modules has occurred over the course of nine months, with an anticipated first public roll out of the OER to engineering librarians at approximately the 12 month mark. This extended development time has required that the author team evaluate multiple aspects of the long-term project.

The author team has created a development process in multiple phases. A template for modules has been developed to standardize content to a uniform look and feel. This template can be used by future module authors to maintain continuity in look, feel, and accessibility. The template serves to create a uniform educational experience for the end users of the OER. A process for peer reviewing the content of the OER is a crucial quality control mechanism, as is an initial

presentation with formative feedback provided by other members of the author team. Repeated qualitative feedback is sought on each individual module to improve the educational experience.

The primary resource necessary to create the OER is author time. The authors alternated creating sessions. Management routines for this project developed naturally across the process. Weekly meetings kept the project on track. Management documents were shared. As a small team of two, the authors were able to mutually negotiate content and edits through conversation. We anticipate that a larger, geographically dispersed group of authors will need a more formalized project management plan, including tools to manage group GANTT charts and citation libraries. By using a common library instruction application, libGuides on Springshare, the authors have both made the content accessible to the primary audience and provide a common mechanism for others to join in the development of the OER.

This has proven to be a learning experience in that it forced the authors to articulate internalized knowledge in a clear and straightforward way for multiple audiences, both novices and expert librarians who are novices to the STEM field. Researching the needs of STEM librarians has improved the authors' professional practice and provided opportunities to expose pre-professionals to a rich range of literature and experience that would not generally emerge during daily professional practice. The development of the OER encourages us to research alternative sources of technical information outside of the subscription databases that we have access to and thereby expose pre-professionals to alternative sources that they may use at a smaller institution in the absence of those subscriptions.

The authors hope to continue to grow this open educational resource as others outside of the author's local context use and provide feedback on the OER. Librarians who use and offer feedback on the resource are welcome to join in the creation of the resource through authorship, editorial work, or serving on an editorial board that oversees changes and developments to the work. There are many potential topics that experienced STEM librarians could help develop, leveraging their personal experience and research dossiers to strengthen the existing and future concepts.

The existing learning goals and modules are still primarily focused on entry level and basic concepts. The authors have developed a list of more advanced topics that would be relevant and useful for version 2, including more advanced topics on collection management, working with vendors, standards management, patent instruction, and working with specific populations such as undergraduate researchers, design focused courses, and in-depth instruction in patent searching and chemical structure searching.

An important addition in the future will be a proactive, research based formative assessment plan with multiple types of assessment, including self-efficacy and mastery. From simple communication channels such as a dedicated email to provide feedback on each module about the contents and user experience, to larger scale research-based assessments of the learner experience and the design of the resource from a usability lens, there are many avenues for

gathering input and soliciting feedback. The authors look forward to feedback from any interested users as the resource is made available and continues to evolve.

Conclusion

The authors of this paper initially set out to create an educational library guide in companion to their in-person synchronous learning experience for the pre-professional graduate assistants within their library. As development of this guide proceeded, the authors discovered that there was a gap in STEM professional development material and set out to turn their initial project into an OER to support the upskilling of engineering librarians. The authors hope to further develop the resource and hope to have peers join in the creation of the resource or serve on an editorial board to assist with the creation of the OER. The authors additionally plan to develop materials for the OER on more advanced topics that would be more relevant for the target audience, as well as formative assessment.

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