

6-26-2016

Jazzing Up Next-Gen Librarians for Freshman Engineering Instruction Delivery

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Armour-Gemmen, Marian G.; Pickens, Chanelle; Hensel, Robin A.M.; Strife, Mary L.; and Jalalifard, Mariam, "Jazzing Up Next-Gen Librarians for Freshman Engineering Instruction Delivery" (2016). *Faculty Scholarship*. 1134.

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Jazzing Up Next-Gen Librarians for Freshman Engineering Instruction Delivery

Ms. Marian G. Armour-Gemmen, West Virginia University

Marian Armour-Gemmen has been the Patent & Trademark librarian at West Virginia University Libraries since 2003. In this capacity she assists inventors throughout the state of West Virginia. She is also the Engineering Librarian at WVU. Previously she worked as the head of the Physical Sciences Library and as an associate in the Government Documents department. She is a past president of the Patent & Trademark Resource Center Association. She holds a M.L.I.S. from the University of South Carolina, a M.A. from the University of Michigan, and a B.A. from Calvin College.

Ms. Chanelle Pickens MLIS, CA, West Virginia University

Chanelle Pickens earned a master's in Library & Information Science, with an Archives & Records Management focus, from San Jose State University in 2014 and a B.S. in Communications from the University of Tennessee, Knoxville in 2004. As a Resident Librarian at West Virginia University Chanelle hopes to gain a "full spectrum" view of the WVU Libraries and to understand their place within the fabric of the campus community. Chanelle is using her time at WVU to encourage a mindful investigation of how both internal and external stakeholders define and utilize information centers in this time of rapid change.

Dr. Robin A.M Hensel, West Virginia University

Robin A. M. Hensel, Ed.D., is the Assistant Dean for Freshman Experience in the Benjamin M. Statler College of Engineering and Mineral Resources at West Virginia University. While her doctorate is in Curriculum and Instruction, focusing on higher education teaching of STEM fields, she also holds B.S. and M.A. degrees in Mathematics. Dr. Hensel has over seven years of experience working in engineering teams and in project management and administration as a Mathematician and Computer Systems Analyst for the U. S. Department of Energy as well as over 25 years teaching mathematics, statistics, computer science, and freshman engineering courses in higher education institutions. Currently, she leads a team of faculty who are dedicated to providing first year engineering students with a high-quality, challenging, and engaging educational experience with the necessary advising, mentoring, and academic support to facilitate their transition to university life and to prepare them for success in their engineering discipline majors and future careers.

Ms. Mary L. Strife, West Virginia University

Mary Strife has been an engineering/sciences librarian for over 33 years, working at Cornell, Syracuse University, the University of Rochester, and SUNY Institute of Technology, Utica/Rome. She has been at West Virginia University for 20 years. She served as Director of the Evansdale Library and Senior Engineering Librarian through October 2015. As of November, she became the Lead Administrator for Library Services, WVU Tech-Beckley Campuses.

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Introduction

Because of the need for science and engineering librarians, both nationwide and at West Virginia University (WVU), a model of *Introduction to STEM Disciplines' Information Use and Mentoring* occurred at WVU. The engineering librarians introduced new resident librarians and a graduate research assistant to the Freshman Engineering program and involved them in teaching several engineering information literacy sessions. The goal of engaging the new librarians into the educational activities was to motivate their learning, gain feedback on current teaching strategies and fresh ideas for possible future implementation, and facilitate buy-in of the need for and role of STEM-specific librarians. The new team members learned the specific information literacy resources for the engineering field, provided feedback on the teaching methods, offered new ideas for implementation, and engaged with the engineering faculty and current STEM librarians about possible modifications to the types of information offered and the timing of its delivery.

Background

The literature is filled with discussions about the need for science and engineering librarians. Pellack¹ claims that although there has been a shortage of science librarians since the 1950s, the shortage remains. Level and Blair² suggest that continuing education, funding for professional development, mentoring, and library culture that supports new ideas will contribute to recruitment and retention.

Discussions vary about whether someone should have an engineering or science degree. Other articles stress that above all, the librarians contribute and expand their librarianship skills since engineering and science disciplines are constantly changing.

An introduction to and training in STEM fields must occur since these new librarians are without STEM degrees. Beck and Callison³ provide an excellent survey which discusses what a science librarian does. Above all, a science librarian should be interested in science as well as the research needs of the scientists they serve, even though they do not possess an undergraduate degree in the sciences. Kuruppu⁴ argues that individuals without preferred qualifications should be supported to gain knowledge in the field they serve. They should not only understand the subject resources but also understand “the research philosophies, processes and trends of the respective disciplines.” Hallmark and Lembo⁵ point out that librarians who succeed in working with faculty and students in STEM disciplines “have an appreciation for the literature and methodology of science and engineering... and work diligently over time to gain science knowledge and related skills and experiences.” Storm and Wei⁶ also emphasize that a science librarian must understand the “methods, culture, and language of science.” Beck and Callison³ find that science librarians must 1) know the terminology/language of relevant scientific fields, 2) comprehend the flow of scientific literature, and 3) have credibility with faculty.

Mentorship also plays an important role in training a new STEM librarian. Beck and Callison³ find that the mentor plays an important role in the development of a science librarian. Henshilwood, et al.⁷ describe their mentorship program which include subject specific databases, mastering core functions, and creating deliverable products. Davidson and Middleton⁸ demonstrate that not only mentoring, but also networking and activity in professional organizations play an important role in retention. Fritzler⁹ finds that continuing education, using study resources available (such as handbooks), staying connected with up-to-date developments, and getting involved to create a good science librarian. Smith¹⁰ demonstrates that the opportunity to work in a science library can garner science librarian recruits.

Assessment of student engagement and information literacy learning is key to continual improvement of the teaching process. While literature discussing the assessment of student information literacy exists, little is written about teaching assessments and surveys to measure the effectiveness of the curriculum and teaching from the instructor's perspective. Seldin¹¹ focuses on assessing plan, procedures, preconditions, and products as elements of teaching evaluation. Stevenson and Kokkinn¹² propose a method of evaluation of teaching using lists of evaluative statements. Ramsden and Dodds¹³ recommend the use of generalized questions in evaluation of content (what should be conveyed to the student) and structure (teaching methods). Recognizing that "[c]ommunication and collaboration with faculty are increasingly important in the development of both curriculum-integrated and stand-alone "just in time" library tutorials," Appelt and Pendell¹⁴ employ faculty feedback on tutorial structure, discipline-specific content, and content integration between tutorial and classroom activities to improve tutorials. Finally, in their book about information literacy and instruction, Thomas, Crow, and Franklin¹⁵ explore the different instructional modes, including the active learning framework, and describe the difficulty students face searching the web and the need for instructors to help them find their way effectively. Because using an active learning framework is important to teaching freshman engineering students, survey questions were developed to assess relevance, appropriateness, and effectiveness of research assignments. These evaluations are designed "to ensure the achievement of information literacy standards so that our students develop the necessary competencies to become effective and efficient users of information" (p. 161).

Context

Because the growth in first-year engineering information literacy instruction at WVU (with approximately 1,000 freshman students a year), engineering librarians have looked outside the normal scope of librarian recruitment to a noteworthy opportunity. The engineering librarians recruited "new" librarians who had initial interest in and gained enthusiasm for the engineering field. The librarians participating in this study include: (1) one of three "Diversity Resident Librarians" at this university who holds an M.L.I.S. and a B.S. in Communications and is nearing the end of her first year in this inaugural three-year residency program that was created by a partnership among several universities to give early-career librarians from traditionally underrepresented groups the opportunity to learn and apply skills necessary for leadership in academic librarians; (2) a graduate research assistant (GRA) who holds a B.A. degree in Library and Information Science (LIS) and a M.L.I.S. degree, both from international universities, with a personal interest in engineering and prior experience as a technical librarian, an "online chat with librarians" manager, and head cataloger, as well as experience as a university English instructor;

and (3) another of WVU Libraries' three "Diversity Resident Librarians" who holds an M.L.I.S. and a B.A. in Art and Visual Culture and is also nearing the end of her first year in this inaugural three-year residency program.

The students involved in this study were 727 first-year engineering students enrolled in one of 18 sections of an Engineering Problem Solving course (ENGR 101) during fall 2015. These students must research engineering literature to provide background information for their team projects and resulting technical reports. At WVU, technical reports are required for each project in both first-year engineering problem solving courses and comprise a significant portion of the final grade in each course. Students are expected to use effective research techniques, plagiarism avoidance skills, and correct source citation in their reports. Faculty have observed and noted that the level of student research, completeness of bibliographies, and correctness of citations, have improved on the technical reports over the past five years through the information literacy instruction.

The WVU engineering faculty and the librarians have partnered for several years, using several training models, to teach information literacy concepts to students in this course. The current three-stage model involves (1) an in-class direct instruction of engineering databases and proper citations, (2) a second information literacy workshop, held in the library, that reinforces information literacy concepts and provides students opportunities to practice these skills, and (3) online Plagiarism Avoidance and Intellectual Property modules. The librarians are introduced to the students as recognized subject matter experts as they teach information literacy skills in one class session. This introduction increases students' comfort level with seeking assistance from the librarians. The remaining information literacy modules are provided outside of class to engage students in a variety of media and environments.

Methodology

While the new "recruits" are familiar with library resources and teaching, they needed to be introduced to the language of engineering, the resources used by engineers, the importance of reliability of information for engineers, and the importance of lifelong learning. ABET's¹⁶ criterion 3 for student outcomes specifically addresses lifelong learning. The ALA/ACRL/STS Information Literacy Standards for Science and Engineering/Technology¹⁷ have five standards, each with performance indicators. Students should use information by recognizing the need, using it effectively, evaluating it, using it ethically and legally, and recognizing its changing nature. Since freshman engineering students need to learn the same things, engaging the new librarians in teaching basic information literacy components to freshman engineering students seemed to be a good place to train them.

The learning process included three significant steps: Observation, reflection (and input), and practice. A key component was to maintain the novice librarian's engagement at each stage of the learning process. The novice librarians first observed sections of the *in-class* component, taught by an experienced engineering librarian, with the knowledge that they would be prompted for feedback on their observations. They were then provided with the materials and instructions necessary to teach the *in-library* sections to the students in the following three weeks later. Following their first teaching experiences, they were debriefed through mentoring conversations with the experienced engineering librarian, who provided oversight to this project.

The novice librarians completed a survey to help them reflect and document their observations and experiences of both instructional modules (*in-class* and *in-library*). By providing the opportunity to offer feedback and suggestions through the survey, the novice librarians truly engaged in the observation process and were guided in their reflections.

The survey instrument, presented in Table 1 along with survey results, was created by the experienced engineering librarian and survey questions were based on research into assessing student information literacy. Questions 1 and 2 were based on Stevenson and Kokkin's¹² lists of statements; questions 3 and 4 focused subject matter mastery as enumerated by Seldin¹¹; questions 5 and 7 focused on appropriateness and relevance of content and materials based on the work of Thomas, Crow, and Franklin¹⁵, as well as the work of Ramsden and Dodds¹³; and question 6 focused on organization, based on ease of use and aesthetic concerns of Appelt and Pendell¹⁴. Since students should achieve outcomes based on the ACRL/STS standards, a separate section of the survey instrument was developed to obtain the novice librarians' perceptions of the student achievement of these outcomes. A comment section was added to provide an opportunity for the novice librarians to express their ideas for potential changes and improvements to the learning modules. The feedback gained through the survey responses provided one element of an ongoing assessment process and was considered by the larger engineering and librarian teaching team for possible future modifications to the modules.

Results

Results of the survey, presented in Table 1 below, were used, in combination with other assessment and feedback data, by the engineering librarian and engineering faculty, to identify areas of improvement. The ratings used a scale of 1 (low/poor/difficult) to 10 (high/excellent/easy). First year engineering students at this university must complete "Out of Class Experiences" (OCEs) each term; one required OCE for the Engineering Problem Solving 1 course is the in-library workshop.

Table 1. Survey Results

QUESTION	AVERAGE RATING
Did the students seem engaged in the in-class session? (<i>1=not engaged; 10=very engaged</i>)	7
Did the students seem engaged in the OCE session? (<i>1=not engaged; 10=very engaged</i>)	7.7
How well did the students learn in the in-class session? (<i>1=did not learn; 10=extremely well</i>)	7.7
How well did the students learn in the OCE session? (<i>1=did not learn; 10=extremely well</i>)	7.3
Do you think the information presented was at the appropriate level for freshman engineers? (<i>1=not appropriate; 10=extremely appropriate</i>)	9
Do you find the assignment for the OCE well organized? (<i>1=not organized; 10=very well organized</i>)	8
Did the resources and materials and worksheet reinforce instruction? (<i>1=No; 10=Very well</i>)	8
How difficult was the grading for the OCE? (<i>1=difficult; 10=very easy</i>)	5.3
How difficult was it to track the credit for the OCE? (<i>1=difficult; 10=very easy</i>)	4.5
What do you think about the length of the OCE session? (<i>1=not appropriate; 10=very appropriate</i>)	6.3
How easily could a librarian without an engineering specialty teach these sessions? (<i>1=not at all; 10=very easily</i>)	8

The novice librarians were also asked to evaluate how well each instructional module or activity met the ALA/ACRL/STS standards. These results, presented in Table 2 below, provide a subjective, but valued, assessment data point for the instructional elements.

Table 2. Evaluation of how well each module/activity met STS/ACRL standards.

STS/ACRL Standards Section (1 = "not accomplished;" 10 = "completely accomplished")		
STANDARD	EVALUATION ITEM	Average Rating
<u>Standard 1.</u> The information literate student determines the nature and extent of the information needed. <ul style="list-style-type: none"> Distinguishes different types of information 	In-class session	7.7
	OCE (in-library) session	8
<u>Standard 2.</u> The information literate student accesses needed information effectively and efficiently. <ul style="list-style-type: none"> Completes exercises in using different types of information: books, technical reports, articles and handbooks. Learns how to cite in MLA format. Familiarity with four source databases. 	In-class exercise naming parts of a citation	7.7
	OCE (in-library) worksheet	8
<u>Standard 3.</u> The information literate student critically evaluates the procured information and its sources, and as a result, decides whether or not to modify the initial query and/or seek additional sources and whether to develop a new research process. <ul style="list-style-type: none"> Evaluates information using ABCD mnemonic. Finds information in a handbook. Incorporates citations in technical reports. 	OCE (in-library) worksheet with citations and graph	7.7
<u>Standard 4.</u> The information literate student understands the economic, ethical, legal, and social issues surrounding the use of information and its technologies and either as an individual or as a member of a group, uses information effectively, ethically, and legally to accomplish a specific purpose. <ul style="list-style-type: none"> Knows four types of intellectual property. Understands the difference between common knowledge and not so common knowledge. Understands plagiarism and how to avoid it. 	Intellectual Property Module	8
	In-class plagiarism Scenarios	8
	In-class "when to cite" Scenarios	8.5
	Plagiarism Avoidance Tutorial	8
<u>Standard 5.</u> The information literate student understands that information literacy is an ongoing process and an important component of lifelong learning and recognizes the need to keep current regarding new developments in his or her field. <ul style="list-style-type: none"> Recognizes the importance of using library information because the emphasis in the ENGR 101 classroom. 	In-class session	7.3
	OCE session	8
	IP module	8

Overall, survey results indicate that the information was presented at an appropriate level for freshman engineering students and it appears that the students were engaged in the learning process. The in-library session materials were well-organized; the resources, worksheet, and

assignment reinforced instruction; however, the grading and tracking of student participation in the session were difficult and took a lot of time and effort. This feedback led the librarians and engineering faculty to discuss and implement changes in grading and tracking for spring semester.

The mentoring librarian elicited feedback from the three developing STEM librarians relating to specific parts of the in-class and in-library activities. Providing feedback and suggestions for improvements helped the novice STEM librarians become actively engaged and increased their buy-in. Their suggestions for improvement centered on two issues: (1) grading and tracking student participation and (2) increasing teamwork opportunities in teaching.

The heavy grading load was addressed during a post-fall semester freshman engineering faculty retreat. After discussions with the Engineering 101 coordinator, it was agreed to streamline the grading process. For spring 2016, the plagiarism tutorial and quiz were placed in Blackboard and thereby automatically scored. Additionally, an article was uploaded to Blackboard. Librarians had been checking the worksheets as they were turned in and, for spring 2016, the faculty agreed to accept the worksheets (with a stamp) as proof of attendance at the in-library experience. Librarians kept a record of student ID swipes only as a backup.

One point of the feedback from the mentees resulted in a teamwork exercise. Combining the desire to increase teamwork in the OCE and the faculty desire for students to practice citations even more, a new team-based exercise was introduced in the spring Library OCE activity. After forming teams, each team was given an article and indicated the important parts of the citation with different colored highlighters, and then they wrote out the citation. Next, they used highlighters while reading critical sections of the paper: abstract, conclusions and results. Finally, they wrote a citation from the bibliography of the article. This new exercise, implemented in the spring 2016 In-Library experience, was enthusiastically received by the students.

Discussion

Aside from providing a fresh perspective on course activities, the librarian mentees learned several differences between writing in their humanities backgrounds and the expectations of the engineering profession. Specific examples of these differences include voice, format of data presentation, language precision, literature currency, and type of reference materials. *Voice* is one major difference. Writing in the humanities, typically, focuses on using the active voice, while engineering technical writing uses passive voice. The *format of data* and *data analysis presentation* in engineering and technical writing, as well as the specific vocabulary and writing precision differs from those used in the humanities as well. The importance of *literature currency* is also significantly different between the humanities and scientific and engineering fields. The speed at which technology advances is ever-increasing, so the age of journal articles is critical to relevance of information. Engineers value information on the most recent advances, while humanists value the topic more than the currency of the information. The type of *reference materials* also differ between the humanities and technical fields, like engineering. While humanists value dictionaries and surveys, engineers value technical handbooks for formulas and properties.

Significant differences also exist in the scholarly articles written by engineers and scientists compared to those written by humanists; and these differences must be reflected in the content of engineering information literacy. For example, because of the trust placed on engineers by the public, engineers must “hold paramount the safety, health, and welfare of the public” [Canon 1 of the NSPE]¹⁸ and therefore, have the added responsibility to the public for the accuracy, reliability, and currency of information as well as clear descriptions of the parameters, limitations, and overall context of information. Since engineering literature, including reports, publications, and drawings, can be stored in a variety of platforms, engineers need to be taught how to find, use, and store information efficiently and effectively. Also, since databases are ever-expanding and changing, and new databases of information are created, engineers must be taught principles of database searching and information retrieval that are transferable to whatever information searching platform they may encounter in the future. Hence, the students are taught basic, transferable information retrieval principles which they will use and continue to hone for the rest of their career.

Recruiting the librarians to teach engineering classes required a buy-in by these librarians, as well as mentoring by the experienced engineering librarian. The buy-in increased as mentees became more familiar with the engineering-specific content, interacted with the engineering faculty, worked directly with students, and were given opportunities to provide feedback and to innovate. The enthusiasm of the mentors who provided the opportunities, guidance, and resources to teach the freshman engineering students, inspired the mentees and led to increased buy-in and success in the process. Through this experience, the mentees realized they needed to learn the technical language of engineering, its report-writing style, and the databases that are most important to research in that profession. As they became more comfortable in the engineer’s world, they saw the importance of convincing students to be not only consumers of information but active contributors to the scholarly conversation. The mentees believed that shifting this viewpoint early in the students’ college career is not only beneficial for them, but also for the profession as whole.

The librarian mentees observed that while librarians are showing students how to understand the research process and how to use it effectively, the students also must recognize that they are not only information consumers but contributors to the scholarly conversation. Presenting this connection when students are beginning their engineering programs is beneficial to them and the profession as well. In the long-term, students are provided the opportunity to develop the skills and tools necessary to be good researchers and enter the arena of scholarly publishing.

Conclusion

This experience confirmed the existing literature demonstrating the importance of mentorship in developing new STEM librarians and facilitated novice librarians to develop their librarianship in a new area, thereby building their resumes and providing potential future career opportunities. Additionally, the development of STEM librarians requires effective engagement with faculty and students in the STEM discipline, learning the language and necessary research databases of the discipline, and feeling like they have something to contribute to the instructional process as well. Soliciting feedback from the mentees facilitated their reflection on their experience, validated their self-efficacy as emerging STEM librarians, and provided valuable assessment to

the faculty and librarian teaching team. While many librarians have the background skill set to become STEM librarians, this team's experience validates the Beck and Callison³ study that STEM librarians need to have an interest in the STEM field for the area they serve. Specifically, engineering librarians must continually develop their interests in engineering developments and the engineering profession. Engaging in these exercises, the developing STEM librarians, along with the freshman engineering students they taught, started the process of learning to think like an engineer, appreciate the engineering culture, and develop the necessary communication skills to effectively interact with and support professional engineers.

Because of the need for science and engineering librarians, both nationwide and at this university, a model of developing new engineering librarians was introduced. The model included mentoring, engaging the novice engineering librarians in observing, reflecting upon, and teaching freshman engineering students basic and transferable information literacy skills. These mentees engaged with engineering faculty, provided feedback on teaching, provided new ideas to be implemented, and made suggestions regarding possible changes in the program. The experience was successful in contributing to the development of future STEM librarians as well as in the enhancement of the existing program in teaching information literacy skills to engineering freshmen.

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