



## Works in Progress: Integrating Information Literacy into a Multi-Disciplinary First-Year Engineering Program

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Alex serves on the editorial board of the Journal of the Medical Library Association, is a Senior member of MLA's Academy of Health Information Professionals (AHIP), and in 2016 was selected for the Award for Professional Excellence by a New Health Sciences Librarian by MLA's Mid-Atlantic Chapter. His research interests include evidence-based practice, mentoring emerging LIS professionals, and improving information literacy instruction for students in the sciences; he has published on these topics in journals such as *College and Research Libraries*, *portal: Libraries and the academy*, *The Journal of Academic Librarianship*, and *The Journal of the Medical Library Association*.

**Dr. Joshua Daniel Borycz, Vanderbilt University**

At Vanderbilt University I help graduate and undergraduate students learn how to do research and succeed academically by introducing them to a range of tools, developing new tools, creating educational programs, and advocating for the use of library services. My goal is to help connect researchers to the tools and insights that can help them to integrate good data management practices and data sharing tools to improve scientific collaboration. I became interested in Library and Information science after my PhD in chemistry and decided to pursue a Master's Degree at the University of Tennessee, Knoxville. This degree connected me with many opportunities to act as an advocate for integrating library services into modern scientific research.

I was a computational chemist at the University of Minnesota, Twin Cities whose research has focused on performing quantum mechanical calculations on the utility of metal-organic frameworks for applications involving magnetism, carbon dioxide capture, and catalysis. My interest in fundamental research stemmed from my desire to gain a deeper understanding of processes used in industrial and energy generating applications. The computational nature of my research provides me a strong understanding of the theory behind these processes and has allowed me provide insight to and learn from experimental chemists and chemical engineers.

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Dean Vernon works in the field of STEM educational research; some areas of focus include student retention and implementation of innovative pedagogy and technology. She is currently the Assistant Dean of Academic programs overseeing the First Year Courses, Study Abroad Programs, and International Initiatives at Vanderbilt University. She received her Bachelors in Chemical Engineering from the City College of New York and her Doctorate degree at University of Florida in Environmental Engineering. She has over 10 years of experience developing international and national research experiences for STEM majors, as well as project management.

# **Works in Progress: Integrating Information Literacy into a Multi-Disciplinary First-Year Engineering Program**

## **Motivation**

This Work in Progress paper describes a pilot program of integrating a librarian-led guest lecture into a first-year engineering program. While many first-year engineering programs historically have provided students with a lecture-based survey of the different potential pathways for an engineering career, students increasingly are expected to complete meaningful design projects within these programs. This change creates opportunities to introduce first-year engineering students to the complexities of the engineering information landscape via information literacy instruction.

## **Background on problem being addressed**

The engineering education and library science literature suggest several best practices for creating information literacy instructional (ILI) interventions. ILI interventions are most effective when contextualized to the specific needs of learners [1], [2] through integrating information literacy into the curriculum [3] and establishing the relevance of information literacy by aligning these skills and concepts with students' authentic interests [4]. This process is best achieved strategically, in which academic faculty and library staff collaborate to identify courses at the curricular level where information literacy skills will be directly relevant to the tasks students will be completing [5], and then work collaboratively to design rigorous inquiry-based assignments and effective instructional interventions for individual courses that will both challenge students and provide them with the skills needed to succeed [6]. In-person instructional interventions can be enhanced and supplemented by online learning objects [7]. The literature reflects the increasing popularity of using online learning objects as a supplement to in-person instruction in order to facilitate a flipped classroom, in which the traditional model of lecture followed by homework is reversed [8]. Chief among the many possible benefits of a flipped classroom is that this model may allow for more active ILI, which research suggests can lead to increased perceived relevance and increased engagement among students [9], especially for students in science, engineering, and mathematics courses [10].

While some engineering educators partner with information specialists to introduce students to information literacy topics, these partnerships often take place in upper-level, inquiry-based courses such as senior design sequences [11]. As a result, many engineering students complete the majority of their undergraduate coursework before ever working with a librarian who can connect them with the technical, engineering-specific resources needed to complete their assignments efficiently and effectively [12]. Previous efforts to design, implement, and assess ILI interventions for first-year students in engineering [13], design [14], and applied technology [15] have shown mixed success.

The large enrollment, multi-section design of first-year engineering programs creates several challenges that inhibit the application of ILI best practices. These courses are often taught by several, if not dozens of individual instructors, limiting the collaborative design opportunities between library staff and teaching faculty. At many institutions, these courses are highly

standardized to ensure equivalent content for all students and may lack a substantive research component that fits well with information literacy instruction. Finally, many engineering programs are hesitant to integrate a substantive information literacy component into an already oversaturated first-year curriculum. As a result, many of the in-person ILI programs described in the literature take the form of large, generic orientation sessions presented in a lecture hall [16]. The assessments of these training programs often rely on multiple-choice assessments, which while scaling effectively, cannot provide insights into student achievement of higher level skills [17]. In order to gain more nuanced understandings of student learning, the literature suggests designing authentic assessments that evaluate student performance using rubrics [18] [19]. Other experimental methods discussed are elective online tutorials or in-person tutoring sessions; however, librarians have reported that optional training opportunities regardless of format generate limited interest and are often poorly attended [20].

To address this gap in the curriculum at Vanderbilt University, we developed a partnership between a first-year engineering program and a university library to introduce students to specialized, technical information sources through an ILI intervention led by a team of engineering librarians. Prior to committing to a full implementation of this program into every section, we sought to test out this design's effectiveness in a sample of sections.

In the first-year program, students take a three-credit course in the fall of the first year called Introduction to Engineering in addition to the common physics, math, and chemistry courses. The Introduction to Engineering course is broken into three 14 sessions' modules. Each department offers one to three different sections of a departmental themed module. The modules are all designed differently to accommodate the expertise and interests of individual instructors, with most modules featuring significant hands-on activities for students to complete and some form of project-based learning. Students must enroll in three different department's modules in the semester. Students are advised to select modules from majors that they have not thought about, and/or areas that peak their interests. One of the main goals of the course is to showcase the major by demonstrating what students will learn and what potential jobs might await graduates. More information on the course is available on the Vanderbilt University School of Engineering's website [21].

The modules offer an opportunity for students to experience design in their first year. While the design projects vary by department, the overall approach is largely consistent across each section. Students are given topics, usually associated with the Engineering Grand Challenges [22], in which the student groups research what is currently being done to solve the problem and then design their own solution. Students are given time in the classroom to work in groups and ask their instructor for guidance on their proposed approach. Some modules also require students to build and test prototype designs; these design solutions are then pitched to their classmates via a five to eight minute in-class oral presentation. In Phase II of this project, we will require student groups to include a reference slide, which will enable us to assess the types and quality of resources they consulted when creating their pitch presentation.

## Methods/assessment

To deliver this instructional intervention, an engineering librarian visits a class as a guest lecturer. During this brief 25 minute lecture, the librarian introduces students to the idea that information has value [23], and that the kinds of technical information used by engineers to drive design decisions have value as commodities [24]. As a result, much of the information students may wish to consult during their academic careers is not freely available, but rather must be accessed from behind a paywall. This lecture then discusses why students might wish to consult specialized engineering information sources when completing an inquiry-based assignment, even if these resources must be accessed from behind a paywall. The session closes with a brief demonstration of how to access these types of materials using the Vanderbilt University Libraries' website [25], as well as using a specialized guide that highlights a curated list of resources for students to use during this module [26]. Specific resources demonstrated in class include using Web of Science [27] to find a review article, as well as using Knovel to find a handbook or manual [28]. Example learning materials used in these sections, including lecture slides and lecturer notes, are available via the Open Science Framework [29].

During the fall 2019 semester, this pilot project was implemented within seven of the 39 first-year engineering program modules, which were taught by four different instructors in three different departments: biomedical engineering (two sections), chemical engineering (three sections), as well as civil and environmental engineering (two sections). These sections were selected using a convenience sample, with module instructors having the option to allow a librarian to visit their course and deliver this intervention. We intended to enroll eight sections (two for each instructor), but because of a scheduling conflict, only seven sections were included. Based on this convenience sample, we intended to use a quasi-experimental design, in which we compared data points from these experimental groups with a sample of student projects from cohorts that did not receive any treatment during their first-year engineering program. However, the heterogenous design of these individual modules complicated our proposed assessment efforts. Due to the large degree of variation in student deliverables produced from one module to another, we did not have a consistent artifact to assess. As a result, we have designated this first cohort of students as Phase I of this project, for which no data will be collected.

In Phase II of this project, which will start in the fall of 2020, we will require student groups to include a reference slide as part of their oral presentations. We will plan to compare presentation slides and reference slides from groups that received the ILI intervention against control groups that did not receive the ILI intervention. To determine the effectiveness of this intervention in Phase II, student achievement of learning outcomes will be assessed in two ways. We will measure student achievement of two learning outcomes by customizing a rubric previously developed by a team of librarians for evaluating undergraduate research assignments [30]. This rubric, inspired by the Association of American Colleges and Universities (AAC&U) *Information Literacy VALUE Rubric* [31] and the Association of College & Research Libraries' *Information Literacy Competency Standards for Higher Education* [32], includes two criteria for which student achievement will be measured. The names of both criteria, as well as the

definition for capstone level performance, are listed below. To view the complete rubric, see Appendix I.

1. *Evaluate Information and its Sources Critically*: Chooses a variety of information sources appropriate to the scope and discipline of the research question. Selects sources using all the following criteria: relevance to the research question, currency, and authority.
2. *Access and Use Information Ethically and Legally*: Adopts multiple information use strategies (paraphrasing, summary, quoting), and distinguishes between common knowledge and ideas requiring attribution. Demonstrates a full understanding of the ethical and legal restrictions on the use of information by including both citations and references, and through consistent use of a citation style that provides sufficient information for references to be retrieved by a reader.

Additionally, students' citation patterns in their final assignments will be analyzed to measure the extent of their information use, as well as the types of sources utilized. This citation analysis will include basic descriptive statistics, such as average number of sources cited, range of sources cited, as well as standard deviation.

### **Anticipated results**

Data collection and analysis for Phase II of this project will begin following the conclusion of the fall 2020 semester. We hypothesize that students who receive this ILI intervention will achieve higher scores in the criteria of evaluating information as well as accessing and using information ethically. In future work, we will report the results of Phase II student groups, checking for statistically significant differences in student presentations from the experimental groups and the control groups. We also anticipate that students who received this intervention will show increased utilization of specialized information resources as signified by the reference slides in their presentations; these results will also be tested for statistical significance. Our results will be compared to previous studies reported in the literature, noting areas of convergence and divergence with previous findings. If our results show improved student performance, this data may be used to justify expanding this pilot program into every section of the first-year engineering program for fall 2021.

### **Limitations**

Participation in this program will remain voluntary, with course instructors needing to opt-in to receiving the guest lecture. As a result, this study design will not include randomization, allocation concealment, or blinding, which may limit the generalizability of the results. Furthermore, in order to protect student anonymity to the greatest possible extent, individual student participation in the treatment will not be tracked, so it may be possible that some students will receive this instruction in multiple sections. For these students, practice effects may impact their performance in subsequent sections, which could create bias in the results. We look forward to discussing these limitations with colleagues at the 2020 Annual Meeting and will welcome feedback from members of the community on our proposed design for Phase II.

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## Appendix I: FPD Research Assignment Rubric

	<b>Capstone 4</b>	<b>Milestones</b>		<b>Benchmark 1</b>
		<b>3</b>	<b>2</b>	
<b>Evaluate Information and its Sources Critically</b>  Points _____	Chooses a variety of information sources appropriate to the scope and discipline of the research question. Selects sources using all the following criteria: relevance to the research question, currency, and authority.	Chooses a variety of information sources appropriate to the scope and discipline of the research question. Selects sources using multiple criteria (such as relevance to the research question, currency, and authority).	Chooses a variety of information sources. Selects sources using basic criteria (such as relevance to the research question and currency).	Chooses a few information sources. Selects sources using limited criteria (such as relevance to the research question).
<b>Access and Use Information Ethically and Legally</b>  Points _____	Adopts multiple information use strategies (paraphrasing, summary, quoting), and distinguishes between common knowledge and ideas requiring attribution. Demonstrates a full understanding of the ethical and legal restrictions on the use of information by including both citations and references, and through consistent use of a citation style that provides sufficient information for references to be retrieved by a reader.	Adopts multiple information use strategies (paraphrasing, summary, quoting), or distinguishes between common knowledge and ideas requiring attribution, but not both. Demonstrates a full understanding of the ethical and legal restrictions on the use of information by including both citations and references, and through consistent use of a citation style that provides sufficient information for references to be retrieved by a reader.	Adopts multiple information use strategies (paraphrasing, summary, quoting), or distinguishes between common knowledge and ideas requiring attribution, but not both. Demonstrates an understanding of the ethical and legal restrictions on the use of information by including both citations and references that provide sufficient information for references to be retrieved by a reader, but does not demonstrate consistent use of a citation style.	Adopts multiple information use strategies (paraphrasing, summary, or quoting), or distinguishes between common knowledge and ideas requiring attribution, but not both. Demonstrates an understanding of the ethical and legal restrictions on the use of information by including both citations and references, but does not provide sufficient information for references to be retrieved by a reader.

**Total points:** \_\_\_\_\_

Adapted from: Association of American Colleges and Universities (AAC&U), "Information Literacy VALUE Rubric," *Association of American Colleges & Universities*, 2009. [Online]. Available: <https://www.aacu.org/value/rubrics/information-literacy>. [Accessed: 12-Sep-2019]; Association of College & Research Libraries, "Information Literacy Competency Standards for Higher Education," Jan. 2000. [Online]. Available: <http://www.ala.org/acrl/standards/informationliteracycompetency>; A. J. Carroll, N. Tchangalova, and E. G. Harrington, "Flipping one-shot library instruction: using Canvas and Pecha Kucha for peer teaching," *Journal of the Medical Library Association*, vol. 104, no. 2, pp. 125–130, Apr. 2016.