Evidence Based Library and Information Practice

Using Evidence in Practice

Understanding the Information Needs of Students Conducting Multidisciplinary Capstone Projects in Engineering Education

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Setting

This article describes my implementation of a study designed to analyze the learning goals and perspectives of engineering students conducting capstone projects. In principle, a capstone project serves as a culminating experience in the final year of engineering programs, where students apply knowledge and skills across disciplines, conducting projects sponsored by industry, government agencies or nongovernmental organizations (NGOs). The results in the study guided the selection of library resources to enhance access to multidisciplinary information and to provide opportunities for collaborations with faculty and students. I initiated this study because I transitioned from being a faculty member at a private technical university for 20 years, supervising engineering capstone projects sponsored by private industry, to the role of engineering librarian at Ohio State University Libraries.

With campuses, research facilities, organizations, and partners throughout the state, Ohio State University (OSU) is a public research institution, including its main campus in Columbus and several regional campuses. The academic offerings at OSU include 200+ majors with more than 12,000 courses from 18 colleges/schools, and 200 research centers/institutes. The total student enrollment at OSU increased to 66,901, up 2.3% from 2023. The Ohio State University Libraries *(University Libraries)* support faculty, students, and researchers, advancing teaching, learning, research, and innovation (Ohio State University, 2025).

In 2024, the College of Engineering reported a total of 9,212 undergraduate and 1,981 graduate students at Columbus Campus (College of Engineering, 2025). My role as engineering librarian promotes access to information resources, data sets, standards, and research tools available at University Libraries for faculty, students and researchers across some of the departments of the College of Engineering at Columbus Campus; as the college includes a large student body, the team of subject librarians also includes an architecture librarian and a food, agricultural & biological engineering librarian, serving those schools within the College of Engineering.

Problem

Traditional senior design capstone projects in engineering education suggest specific phases for a robust design process, such as problem definition, concept generation, preliminary design, detailed design, proof of concept and documentation (Hoffman, 2014; Ma & Rong, 2022; Mettler, 2023; Nassersharif, 2022). However, engineering education researchers suggest that STEM majors in higher education must also prepare students to access, explore and incorporate information across disciplines for multidisciplinary capstone projects (Carvalho Alvesa et al., 2019; Murray et al., 2020).

Since day one at my new job as engineering librarian in January 2024, I realized that I needed to find a way to learn about the information needs of faculty and students to support them with relevant library services. I started browsing online course catalogs, academic department websites, newsletters, and calendars of events related to the College of Engineering. It served as a strategy to become familiar with their courses, systems, organizational units, and research areas; at the same time, it helped me to develop a general awareness of library services that could be of interest to them. I also had a particular interest in understanding the type of capstone projects being conducted by engineering faculty and students on campus—not only because that is the type of courses I have been supervising for many years, but also because capstone courses are a core component of the engineering curriculum, providing students with opportunities to solve real-world problems in the context of a particular industry, together with the development of professional skills which are highly relevant at the workplace and described as student learning goals in engineering courses.

Evidence

I designed a study to analyze the capstone course learning goals to explore student perspectives across sections, to understand their information needs, and to better support them with relevant library services. I gathered comprehensive information about the type of capstone courses, the scope of capstone projects, and the main course assessment criteria by analyzing several course syllabi across engineering disciplines; then, I applied a pre-course survey across sections to explore the students' own preferences and perceptions about capstone projects. For the study, I obtained ethics approval from the Institutional Review Board on campus. The following research questions guided the study:

- What are the perceptions and preferences of engineering students enrolled in capstone courses about the type of projects, the benefits of capstone projects, and the course assessment criteria?

- What experiences using information resources do engineering students bring to capstone projects?

I created a list with contact information for ten faculty members assigned to teach an engineering capstone course at Columbus Campus during Fall 2024-Spring 2025. The list was created using information available on each department's website. I sent all faculty in the list an email with an invitation to participate in the study; six faculty members agreed to participate, granting access to their syllabi and the digital space for their courses.

I analyzed the course syllabi and the digital space from several engineering disciplines to understand the extent to which those courses shared similar learning goals, project sponsors, project scopes, and project management models. Several types of capstone courses were identified. The project timeline involves a sequence of two or four semesters; while one section promotes individual work, other sections emphasize and value teamwork. All sections formulate and develop multidisciplinary capstone projects, enrolling students across majors, sponsored by industry, government agencies, or NGOs. As part of the course, students must analyze the sponsor's current practices to identify opportunities for process optimization. The phases to assess the level of progress depend on the project management model selected for each section. Leadership, project management, effective communication, lifelong learning, advanced problem-solving, critical thinking, and the application of knowledge and creativity are described as student learning outcomes across sections. The importance for students to access, explore, and use information relevant to their capstone projects, including constant curiosity, connections across disciplines and opportunities to create value, is also described by all sections (KEEN, 2024).

Based on the analysis across course sections, I prepared a set of questions as a pre-course student survey, including their academic background, their perceptions about the benefits of conducting capstone projects, their experiences using information resources, and the overall assessment criteria for multidisciplinary capstone projects. Some of those questions were open-ended while others invited students to rank items within a list of criteria. Then, the survey was posted by faculty during the first weeks of classes, using Microsoft Forms. A total of 104 students across six sections agreed to answer the survey. Preliminary results were analyzed using Microsoft Forms.

Student Familiarity With Information Resources

Data from the pre-course survey results (Table 1) showed that most students are able to access ebooks and journal articles while using research databases and the library website. However, the results also showed that most students are not very familiar with accessing conference proceedings, patents, and standards.

Table 1
Information Resources Familiar to Students Enrolled in Capstone Projects (n = 104)

	Unfamiliar	Somewhat unfamiliar	Neutral	Somewhat familiar	Very familiar
Library main website	20.2%	21.2%	24%	30.8%	3.8%
Research databases	11.5%	14.4%	16.3%	42.3%	15.5%
Journal articles	6.7%	12.5%	10.6%	50%	20.2%
Conference proceedings	33.7%	36.5%	15.4%	9.6%	4.8%
Patents	35.6%	32.7%	12.5%	14.4%	4.8%
Standards	19.2%	25%	31.7%	20.2%	3.9%
Ebooks	4.8%	10.6%	21.2%	42.3%	21.1%

These results informed my selection of resources for several in-class information literacy sessions across engineering disciplines and a library guide for each section.

Student Perceptions about Relevant Professional Skills

The pre-course survey results (Table 2) showed that students prefer teamwork (65%) more than individual work (18%) when formulating and developing their projects. These are relevant results since one section promotes individual work, while other sections emphasize and value teamwork; therefore, several library resources should be available to support those types of projects.

Table 2
Student Preferences Regarding Type of Capstone Project (n = 104)

	Number of participants	Percent of participants
Individual projects	19	18%
Team projects	68	65%
Any type of projects	17	16%

The results also showed that students ranked effective communication skills with team members and sponsors, individual participation, together with research and innovation skills as the most important assessment criteria that should be considered in multidisciplinary capstone projects, which are also relevant skills at the workplace (Table 3).

All these results informed my selection of resources to enhance the development of professional skills across engineering disciplines and across the library guide designed for each section.

Table 3
Assessment Criteria Ranked by Students Enrolled in Capstone Courses (*n* = 104)

Ranking	Assessment Criteria	Number of participants	Percent of participants
1	Effective communication with team members	25	24%
2	Effective communication with project sponsor/client	27	26%
3	Individual participation	18	17%
4	Final project – research and innovation skills	21	21%
5	Final project – documentation and project report	19	18%
6	Preliminary prototype – proof of concept	16	15%
7	Final project – oral communication skills	28	27%
8	Final project – showcase poster in print format	47	45%

Implementation

The results from the analysis of course syllabi informed my selection of resources for a library guide for each section, depending on the engineering discipline, the scope and the approach of the projects, the project management model and the number of students per project. For example, one course describes a "proof of concept approach" as the project scope, five to six students collaborate with an industry sponsor to formulate a problem, identify potential solutions, and then test the feasibility for each solution, documenting what went well and what could not be done. Several resources and tools related to agile project management models were suggested to support such an iterative innovation process. In contrast, another section values and promotes individual work. The project's goal includes a "process optimization approach" during a sequence of two semesters, where a student collaborates with an industry sponsor to define areas of improvement *(D)*, measure the current process performance *(M)*, analyze root causes *(A)*, implement improvements *(I)*, and then control the process after improvements *(C)* (DMAIC*)*. Several resources, tools, and tutorials related to the DMAIC model were suggested to support those individual process improvement initiatives.

The results from the student pre-course survey informed my selection of resources for a library guide for each section, considering resources students are familiar with (ebooks, research databases, academic journals), together with basic definitions, guidelines and tutorials to introduce unfamiliar resources (conference proceedings, patents and standards).

I also identified several library resources to support the development of professional skills described as student learning outcomes across sections, including basic definitions and best practices for entrepreneurship, company research, market research, industry research, and technical writing.

By no means are these results meant to draw general conclusions since this study is part of an ongoing research plan. For future research, the frequency of use and relevant updates of library guide resources will be considered.

Outcome

To introduce myself to students and share the resources selected for their section, I scheduled several in-class information literacy sessions after receiving very constructive feedback from each faculty member regarding each library guide. The sessions were as diverse as the setting for each section: some sessions were held in a lab with 30 students; other sessions were delivered in an auditorium with 120 students, and one more session was delivered in a classroom with only eight students and a faculty member. All sessions were delivered in-person to foster collaborations with faculty and students. A few weeks after visiting all sections, I started receiving questions related to the library guides, advanced search strategies, and additional resources for their specific project goals.

I clearly identified opportunities to collaborate with engineering faculty members across departments. Some collaborations started early during summer 2024, while others started early fall 2024. One of the faculty members was so pleased with the library resources selected for her multidisciplinary course, including resources from engineering, business, social entrepreneurship and education, that she invited me to meet all faculty at her departmental meeting. After that visit, I started receiving requests for collaborations and consultations from other faculty members teaching first-year engineering courses, developing further opportunities to serve and become familiar with my audience as engineering librarian.

I also had the opportunity to collaborate with subject librarians across disciplines, sharing their expertise, tutorials, guidelines, and best practices, since all the course projects in the study required a multidisciplinary approach to find the best solutions. Such collaborations add value to existing library services by extending the expertise of individual subject librarians.

By the end of April 2025, I was able to attend the Capstone Project Showcase at the College of Engineering, and during the event, I finally met "in person" a couple of faculty members I have been working with only by e-mail since summer 2024. To my surprise, some of the students remembered my name and mentioned the library resources they used for their projects. That was a nice way to foster further collaborations and wrap up the spring semester.

Reflection

In my new role as subject librarian, understanding the nature of capstone projects was an initial step in identifying and selecting library resources that enhance student learning experiences and the development of professional skills across disciplines at the College of Engineering.

The results and insights emerging from this study suggest an interdisciplinary tendency when formulating and developing engineering capstone projects, where faculty and students strive to improve existing products, materials or processes; design and test innovative solutions to specific problems; or design, develop, and manufacture innovative devices targeting specific markets and industries.

I also realized that the scope and timeline for a capstone project could be as diverse as the setting in which each course section is offered: individual or team work, a sequence of two semesters or four semesters; therefore, my selection of information resources included those relevant across disciplines and course sections – for example, ebooks, tutorials and best practices for leadership, entrepreneurship, company research, market research, industry research and technical writing – together with those resources, tools and data sets which are specific to each course section.

Matthews (2025) described being *interdisciplinary by design* as "intentionally building services, spaces and networks to foster creativity, collaborations and integration at every level" (p. 211). Subject librarians must facilitate access to resources across academic departments and disciplines to help individuals or teams move seamlessly from brainstorming to prototyping, promoting access to information resources as interdisciplinary as the challenges and perspectives they strive to support. Therefore, I plan to keep exploring diverse resources and tools that promote the development of leadership, project management, effective communication, lifelong learning, advanced problem-solving, critical thinking, and the application of knowledge and creativity as student learning outcomes across sections.

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