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Abstract—Engineering students need research skills to effectively complete research and design projects; information literacy education during the first year of college positions future engineers to complete projects both during their college years and when they move into their careers. This study provides evidence that faculty-librarian collaboration is an effective method to train students in these critical skills, and proposes an efficient model that can be adapted to other courses. This work-in-progress, in the third year of a four year analysis, assesses and develops a method of sustainable faculty-librarian collaboration that improves information literacy outcomes in a first-year, project-based engineering design course at Worcester Polytechnic Institute (WPI). To assess the effectiveness of information literacy instruction methods, citation analysis of group project bibliographies, faculty feedback, and student opinion survey data will be used. Preliminary citation data and faculty feedback suggest that increased librarian contact with students, development of resource guides, and design of grading rubrics to incorporate reference list requirements improve student projects and information literacy outcomes. The end result of this four year study will be a recommendation of a sustainable and effective faculty-librarian collaboration that improves information literacy outcomes among students and can be easily adapted to other courses.

Keywords— Engineering Design, First Year Students, Citation Analysis, Information Literacy

I. INTRODUCTION

This paper presents the first three years of a four year faculty-librarian partnership aimed at improving information literacy outcomes in a first-year engineering design course. Information literacy skills are critical during the college years and set the stage for effective information seeking at the professional level. The outcomes assessed in this project are based on standards developed by the Association of College and Research Libraries and include the students' ability to effectively find and use relevant and varied information sources for the completion of a project [1]. Total citations of final group reports for each class are analyzed for diversity of sources, increased use of in-text citations, increased use of scholarship and decreased reliance upon web sources. The total number of citations reviewed over the first three years is 205 across 36 engineering design project reports. The first year of analysis reviews citations and reports from prior to the faculty-librarian collaboration; years two and three review citation data after the librarian and faculty member began to partner. The final year will include review of both citation data and student opinion survey data in order to get a fuller picture of the impact of the faculty-librarian collaboration.

II. BACKGROUND

The citations analyzed are from ES1020: *Introduction to Engineering Design*, a first-year, project-based design course at Worcester Polytechnic Institute (WPI). Students work together in groups of 4-5 with a total of 12 groups per class. This course has been the subject of innovative teaching for over a decade. For example, in 2003 it was one of the earliest reported first-year engineering design courses built around project-based learning [2]. A 2005 paper describes the use of case studies and reverse engineering activities in the course [3].

One objective of ES 1020 is for students, within seven weeks, to complete an engineering design and prototype, often in the area of rehabilitation engineering. Literature on information seeking in the engineering disciplines makes it clear that to effectively complete such a project, students need a variety of information ranging from scholarly articles and books, to trade publications and patents [4,5]. The instructor had attempted to introduce this concept into the course without much success. In 2011 the faculty instructor and librarian initiated a partnership after the instructor realized that the first-year students enrolled in the course lacked skills to conduct a proper literature search related to their design project and locate appropriate references for constructing prototype devices. Prior to 2011 group project reference lists reflected that student groups lacked the ability to judge the quality of the references cited and were relying almost solely on web based searches. The instructor and librarian had collaborated previously, in an upper level mechanical engineering design course, so adding information literacy instruction to this first-year course was a natural extension of their prior work.

III. METHODS OF INSTRUCTION

Yearly increases in faculty-librarian collaboration over the first three years of the project have included longer librarian face-to-face instruction with students, development of source analysis rubrics to provide formative assessment to students early in the term, and development and promotion of a

customized online information portal. In the final year the grading rubric will incorporate more clearly defined information literacy requirements for final project reports. Details of each year's evolving collaboration are described in the following paragraphs.

In 2010 all research instruction was facilitated by the faculty instructor. Library inclusion was informal and limited to the faculty instructor encouraging students to visit the library and consult with a librarian as needed. In 2011 instruction was collaborative, with the librarian visiting class for ten minutes of contact time with students. For final grades on project reports, references were mentioned within one portion of the grading rubric as a part of the final project report grade. This section of the rubric, worth 20 points out of a maximum of 85, incorporated other project requirements in addition to references.

In 2012 there was a major shift in instruction methods since the instructor saw beneficial results from the previous year's collaboration. First, librarian contact time with students was increased from 10 minutes early in the term to 45 minutes over two class periods. Second, the librarian created an online resource portal (http://libguides.wpi.edu/es1020) and provided a low-risk source analysis rubric to help students determine whether they were successful in finding and citing sources effectively on an early homework assignment designed by the faculty instructor. Through the rubric students were made aware of the need to 1) collect a minimum number of sources, 2) find diverse sources (scholarly research, news, trade publications, patents, and websites), and 3) cite sources both in text and in a reference list following a specified citation style. After reviewing a sample of the first sets of papers using the rubric, the librarian made specific recommendations to students for ways to improve on final project reports. The comments reinforced the importance of the information seeking concepts taught at the librarian's first visit and included reminding student to avoid heavy reliance on commercial websites, use library resources, and cite sources using a standard citation format. Students were also reminded that if they were unsure of who published or created a source of information that they should avoid citing it in their project report.

In 2013 information literacy instruction will increase in several ways. First, the librarian's in-class instruction will extend from 45 to 75 minutes over two class periods. Second, students will be introduced to a citation management tool. Third, they will be given an opportunity to provide opinions on the librarian-led instruction through a required end of term survey. Finally, the summative assessment rubric for the final project will be more descriptive, and include specific grading criteria for references. These additions are anticipated to yield further improvements in student performance and increased assessment data.

IV. METHODOLOGY

Citation analysis has been the primary method used to assess the effectiveness of the faculty-librarian collaboration over the first three years of the project. A total of 205 citations from 36 project reports (12 per year) were analyzed from the 2010-2012 student reports. Information types were simplified or updated based on the methods used in prior research [5,6,7].

The citation analysis consisted of reviewing each group report for number of in-text citations and reference list entries, and types of sources in the reference list. The types of sources fell into the following categories: books, standards, government regulations, reports, scholarly articles, patents, trade news, general news, websites (.com, .org, .edu, etc.), government websites, or indiscernible. Secondary methods of assessment are faculty feedback gathered over the first three years, and a student opinion survey to be administered in the final year.

V. PRELIMINARY RESULTS

Results from the first three years of analysis suggest that librarian-led instruction and faculty collaboration in the development of grading rubrics is effective in improving information literacy outcomes. An increase in librarian contact time with students appears to have a direct relationship with the quality and diversity of sources students use in their papers and the quantity of sources included in reference lists. In each year of the study 12 group project reports were completed and reviewed. Between the first and third years of the study, there was a significant increase in the number of sources cited by teams, both in text and in reference lists (Table 1). Class-wide reliance on web sources decreased from 34 cited in 2010 to 21 in 2012. The number of scholarly sources increased from 0 to 18 over the same period. Another significant finding is that students in year one (2010) cited only four types of sources. By 2012, the diversity of source types increased by over 100% to 9 types of sources, and included books, scholarly articles, government regulations and standards. The increase in book citations was modest over the first three years growing from 0 used in 2010 to 3 in 2012.

TABLE I.

Year	Total Citation Counts for Team Projects by Year	
	Total In-text Citations	*Total Sources in Reference Lists*
2010	43	52
2011	37	72
2012	72	81

VI. DISCUSSION AND FUTURE WORK

The faculty-librarian collaboration has improved student outcomes regarding the use of information sources throughout the design project. During the fourth year of the project, data from student surveys will be analyzed to learn about what portions of the faculty librarian collaboration were perceived as most helpful for students to successfully complete projects. There is little research that provides this type of citation analysis as a tool to assess a long-term and evolving method of information literacy instruction in a first year engineering design course. At the completion of the four year examination the authors will provide a detailed assessment of citations used, and student and faculty opinion, and will contribute an example of a sustainable, effective model of librarian-faculty collaboration in teaching information literacy outcomes that may be generalized to other engineering design courses.

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