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Embedding Information Literacy Within Sustainability Research: First Year Students' Perspectives

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Introduction

Engineering curricula have witnessed an expansion of its subject areas to include an appreciation of "realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability" (Accreditation Board for Engineering and Technology (ABET), 2011-2012) [1]. More than half of eleven ABET student outcomes focus on students' abilities to view engineering within a broader framework of a socio-economic-political matrix with an emphasis on insightful understanding of the social and ethical consequences of engineering and technology that they will, one day, design and create.

In this paper, we present the argument that integrating information literacy content into an undergraduate research project provides a successful model for first-year students to develop and acquire transferable skills for lifelong learning . This integrated approach, we argue, not only enables the students to engage with concepts of sustainability as an ethical prerogative, but facilitates a better understanding of information literacy principles within a research context.

We draw our inferences from our qualitative and preliminary quantitative assessments of students' performance through their written work and team research memos in the Learning, Engagement, Achievement and Progress program (LEAP). The LEAP 1501 course ("Social and Ethical Implications of Engineering") is a part of the freshman learning cohort program at the University of Utah. Engineering LEAP (E-LEAP) is one of twelve disciplines offered in this program in which pre-engineering students form a cohort, or a learning community, and stay with their colleagues and instructor for two consecutive semesters. Courses with general education credits are offered in small classes (capped at 35 seats). This paper draws inferences and findings from Fall Semester 2011 and Fall Semester 2012 courses, LEAP 1501, "Social and Ethical Implications of Engineering."

Literature review

A 2002 report by the Pew Internet & American Life project states that "an overwhelming number of college students reported that the Internet, rather than the library, is the primary site of their information searches. Nearly three-quarters (73%) of college students said they use the Internet more than the library . . ." [2]. And students' access to and use of the Internet has only increased in the past ten years. In 2011, 95% of undergraduates reported that they have Internet access via desktop, laptop, and tablet computers, cell phones, and game consoles, among other devices [3]. While it is important to recognize the abundance of information on the Internet as well as undergraduates' ability to access it through multiple forms of media, it is even more important to distinguish that access to information is not equivalent to the skillful location of relevant, reliable information and the ability to evaluate it for scholarly purposes or, in other words, information literacy. In higher education, faculty and librarians often confuse computer literacy with information literacy and incorrectly assume that undergraduates come to their classrooms and libraries prepared to conduct academic research [4].

Weiler discovered that, regardless of the type of information need, students "will usually go to the Internet first, whether it be for personal, academic, or professional information"[5] And while they may be technologically-savvy, research also shows that undergraduates "tend to overrate their abilities a great deal when it comes to finding information on the Internet"[5]. According to Buschman and Warner, undergraduates generally consider themselves to be competent and effective researchers, though assessments of their information literacy skills show that they are not nearly as capable as they believe themselves to be [6]. More often than not, "[s]tudents do not understand the research process as well as they know electronic tools"[7].

Furthermore, undergraduates overestimate the effectiveness of their information searches. A search is generally deemed successful if it yields numerous results. Unfortunately, when it comes to research, the quantity of results often outweighs their quality as scholarly sources of information and even their relevance [5]. The real appeal of online search engines as resources for research is convenience; in addition to ease of use, they are perceived as time-savers [8].

In order to respond to the growing number of undergraduates seeking information on the Internet, the Association of College and Research Libraries (ACRL) developed "Information Literacy Competency Standards for Higher Education" in 2000. In it, the ARCL defines information literacy as "a set of abilities requiring individuals to 'recognize when information is needed and have the ability to locate, evaluate, and use effectively the needed information.'" The ARCL went onto say that, "The sheer abundance of information will not in itself create a more informed citizenry without a complementary cluster of abilities necessary to use information effectively"[9]. The document includes standards, performance indicators, and outcomes that can be used as a "framework for assessing the information literate individual"[9]. Since 2000, academic librarians have applied these standards when developing information literacy instruction in higher education.

Across science and engineering disciplines, faculty members have acknowledged a real need for information literacy instruction. In a study conducted in 1999 with two large Canadian universities, 69% of the faculty members surveyed felt that library instruction is necessary for first- and second-year undergraduates, while 78% found it necessary for third- and fourth-year undergraduates [10].

Information literacy instruction takes many forms in academia, such as course-integrated instruction, web-based instruction, general education credit courses, and first-year experience courses, with the most common model being course-integrated information literacy instruction [11]. In this model, "a librarian spends one class session, often in an English composition or a study skills class, teaching students how to use the online catalog and electronic periodical databases necessary to complete a class assignment" [11]. While this model is popular, Anderson & May point out that, "one class period is inadequate to provide the necessary information to gain the IL [information literacy] skills set forth by the ACRL"[12]. As laid out below, a more effective model involves long-term librarian-faculty collaboration over multiple information literacy instruction sessions that take place in the classroom [8].

Engineering-LEAP and its history

In 1994, University of Utah initiated a year-long program for first-year students, an integrated learning community called LEAP, to address the University's concern about transitioning students from high school to college and retaining freshmen. The program provides small classes (no more than 35 students per section) in which students can interact with professors, other LEAP students, and the campus community while completing certain general education requirements and moving into their majors. The initial student population in this cohort program did not generally include science and engineering students.

In 1999 the College of Engineering and the LEAP program initiated a specific course dedicated to engineering students, Engineering-LEAP (E-LEAP), to associate the students to other students in engineering or science classes and to activities and departments in the college itself. Thus, E-LEAP began with one section with an enrollment of 30 and taught by one instructor. In the fall of 2001, one additional section was added along with the recruitment of an instructor. During the last eleven years, E-LEAP has grown to nine sections, 273 students, and three E-LEAP instructors--almost a fourth of LEAP enrollment and 44% of LEAP first-year enrollments. Four out of eight majors (Civil

and Environmental Engineering, Computer Engineering, Electrical Engineering, Materials Sciences and Engineering) in the College of Engineering and the College of Mining require Fall and/or Spring Semesters of E-LEAP.

Description of course

Not unlike other LEAP courses, E-LEAP courses fulfill general education credits. Fall Semester course, LEAP 1501, "Social and Ethical Implications of Engineering," satisfies social and behavioral science credit (BF), while also satisfying engineering ethics requirement for some engineering majors. The Spring Semester course LEAP 1500, "Community as Idea and Experience: American Perspectives" satisfies diversity (DV) and humanities (HF) credits. This paper draws only on our experiences with the Fall Semester course.

Fall Semester: LEAP 1501

The first semester of E-LEAP is divided into two segments. The first eight weeks focus on the social and ethical implications of engineering and technology. Students explore the engineer's ethical role in the community on a national and international level by identifying the codes of ethics of professional societies and applying these codes to case studies (the meltdown at Three Mile Island and the explosion at Union Carbide Factory, Bhopal, India). This course is taught under a broader rubric of social science, thus incorporating the social and ethical responsibilities of practicing engineers within a social matrix. The students are made aware of the intersections between different social institutions and the implications of how technologies affect and effect social change. The curriculum evaluates the impact of technology on society, human institutions, such as professions, particularly engineering, and traces the trajectories of technological changes with respect to the sustainable use of natural and human resources. The course aims to encourage students to understand the ethical implications of intersections of science, engineering, and technology and society. During these eight weeks, students take a midterm exam and write a formal memo that evaluates the social and ethical implications of technology.

The second segment of the semester introduces students to the concept and theories of sustainability within engineering, where students learn the relevance and significance of sustainable practices within their role as professional engineers. What is significant about this segment is that students engage with the concept and theories of sustainability within a research project that is conducted in a team setting. The second half of the semester entails a significant pedagogical shift, wherein students are given an opportunity to learn kinesthetically. By that, we mean that students are placed in teams, introduced to their final research project, which is based on their selection of a technology that they then assess in terms of its sustainability. The criteria of sustainability are based on a myriad of perspectives presented to the students through lectures, discussions, readings, and presentations, including the United Nations' definition of sustainability and Mohan Munasinghe's Sustainable Development Triangle and Material Life Cycle Analysis [13, 14, 15].

To enhance students' education about information literacy, research, and writing, the LEAP program, specifically E-LEAP, partners with the Education Services Division at the J. Willard Marriott Library.

The Marriott Library Partnership

The basis of this paper is borne out of this partnership with a librarian from the Education Services Division of the Marriott Library, University of Utah. The ten instructional units (five in the Fall Semester and five in the Spring Semester) are designed collaboratively with librarians in order to support research based on appropriate research tools and strategies, along with instruction on citation styles. These units educate students about research by embedding an information literacy curriculum

into progressively constructed team assignments. The library instruction classes introduce students to social science and engineering resources in the Fall Semester and humanities resources in the Spring Semester. Students are taught how to navigate these resources in addition to teaching them how to evaluate and synthesize sources of information. Their research is integrated into team presentations and writing assignments for LEAP 1501 and LEAP 1500 courses.

Collaborative model

The majority of first-year students come into the E-LEAP program with rudimentary information literacy skills. Through student feedback, we know that the majority has experience using commercial search engines to search the Open Web. The majority has experience in a library setting, though usually not an academic library. The majority has produced research papers, pre-university admission.

With that in mind, the librarian makes five visits to the E-LEAP classroom over an eight-week period during the semester. In the first librarian visit, we--the faculty member and librarian--provide students with information about how each visit corresponds to an assigned research task (or set of tasks) and a resulting team memo. In other words, we create an immediate information need. We also identify the information literacy objectives for each visit and give students guidelines for their research project, which culminates in a final team presentation, so that they have expectations about what they will learn from the librarian. There is also a quiz associated with each librarian visit; the first quiz assesses existing information literacy skills, and the four following quizzes evaluate the students' understanding of the information literacy concepts that the librarian has taught them each visit. The quizzes serve to instill accountability in the students for the content that the librarian brings to the classroom.

But the critical event that occurs during the first visit, which sets the stage for the remainder of the librarian visits is this: She acknowledges the students' expertise. She does not approach the students from the perspective that they do not have any research skills. Instead, she articulates that her purpose for being in their classroom is to help them to polish and develop their existing research skills and to help them to become more efficient researchers. From the first visit, she identifies for them her specific objectives for the day and how those objectives relate to their research tasks.

Here is an overview of the information literacy objectives, organized by visit:

Visit 1

- Understanding the research cycle
- Identifying the characteristics of scholarly information
- Identifying resources for finding scholarly information
- Evaluating information sources

Visit 2

- Creating strategies for choosing and refining your topic
- Determining the extent of information required
- Developing a team research strategy
- Expanding and refining your search results
- Evaluating information sources

Visit 3

- Identifying the experts for your topic
- Using engineering-specific databases to locate scholarly publications
- Evaluating information sources
- Citing information sources

Visit 4

- Exploring library, government, and general resources (e.g. newspapers) for information about public opinion and policy implications
- Evaluating information sources

Visit 5

- Reviewing team research material and articulating your team presentation
- Identifying information gaps
- Revisiting team research strategy

The objectives draw heavily from the Association of College and Research Libraries' Information Literacy Competency Standards for Higher Education [9]. They are embedded into the practical course content that is presented to students, rather than parallel to the course content. E-LEAP students are problem-solvers and generally economical with their use of time. Previously, when presented as parallel content, E-LEAP students have shown a tendency to have difficulty making the connection between information literacy skills development, library resources, and their application to team memo assignments. The students' objective is simply to complete the team memo assignment, and so we draw the connection for them from the research need to the research skills and onto the act of conducting research, which leads, eventually, to a completed assignment. Please note that the term "library resources" refers to any resource, print or electronic, that the library subscribes to or collects (e.g. library databases, monographs, e-books) versus the term "Open Web" (or "Internet"), which requires no authentication.

We have found that point-of-need instruction also leads to a better retention of the information literacy content. As a result, librarian visits are scheduled to coincide with an immediate need so that the librarian is not presenting abstract information literacy principles out of context. In other words, there are no library assignments where students are asked to use library jargon, memorize database specifications, or do information searches about irrelevant topics. There are, however, research assignments (team memos), where students must have mastered certain information literacies and must have used scholarly resources in order to answer the research questions that we have posed to them. We put the students in this scenario multiple times throughout the course so that they can learn to apply this skill set to a variety of conditions and research needs.

For each of her visits, the librarian introduces the students to new search strategies and resources. She selects the resources according to the research tasks in the team memo assignment. She also presents search strategies from the basic (identifying keywords, composing an effective search statement) to the complex (using Boolean operators to expand or refine results, nesting, truncation, etc.) over the course of her visits. She engages students in discussion and hands-on activities that provide them with opportunities to practice and refine their information literacy skills. Student engagement is critical to information retention. So, rather than adhering to a strict lecture and demonstration model, the librarian maintains a conversational tone that encourages discussion. She presents common research problems and scenarios and asks the students to brainstorm solutions aloud. She also

requires in-class participation in discussions and demonstrations.

In her first visit, the librarian asks students to describe their own approaches to research. Simple questions, like "What is the first thing you do when you are assigned a research paper?" or "Where do you begin to search for information?" generally yields answers like, "I go to The Internet" or simply, "Google." From there, she leads the students through a thoughtful discussion about the research tasks for Team Memo #1:

1. Identify and articulate a research topic.
2. Write a research proposal, which includes
    a. An introduction to the technology and its use in society today.
    b. A discussion of how the technology is relevant to engineering and sustainability.

She encourages students to go about research for this team memo the way they normally would because, as mentioned, she acknowledges that they come to the classroom with expertise. However, she also helps them to identify potential information resources, gives them criteria for evaluating the sources they find, and teaches them how to identify a scholarly source of information.

It is important to note here that there is a relationship between reading, writing, and research. Though it may be more than apparent to faculty, it is helpful to communicate to students that these are distinctly different abilities, though they are related. In the information literacy objectives listed below, you will find evidence of the connections (for example, collecting sources, reading sources, and synthesizing the content of the sources in writing).

In Team Memo #2, students are asked to provide the history of a particular technology, an explanation of its manufacturing process and how the technology functions, along with an analysis of possible social, environmental, and economic implications. Note the complexity of these research tasks versus those in Team Memo #1. Students are also required to use different information literacy skills in order to respond to the research tasks in this memo. Students must be able to:

1. Identify research topic.
2. Understand the extent of information need.
3. Identify which information resources are best suited for their information need (ie., popular versus scholarly sources; primary versus secondary sources).
4. Select evaluate sources.
5. Synthesize sources to reply to the research tasks.

These are sophisticated information literacy skills, and most students have not already acquired them when they enter the LEAP program (or, to consider it more broadly, even the university); students develop these skills over the course of the semester with each librarian visit and demonstrate substantial growth from one team memo to the next.

The rationale for the librarian providing more scaffolding and less instruction prior to Team Memo #1 versus Team Memo #2 is that it gives students an opportunity to recognize their strengths and weaknesses regarding information literacy. Through informal feedback, we have learned that many E-LEAP students consider themselves competent researchers, but, as one student commented in Fall Semester 2012, *"I just don't know where to look for the information I need."* This is where the librarian comes in. She identifies information resources and guides students through preliminary searches. She also helps them to adapt their search statements and use filters in order to yield better

search results. (And "better" can mean any number of things—more results, fewer results, more relevant results, more current results, etc.—depending on the scenario.)

Also, beginning with Team Memo #2, we ask students to evaluate their sources, using the CRAAP Test [16]. "CRAAP" is a well-known acronym in most American academic libraries; it is a set of criteria for evaluating information, which was created by librarians in the Meriam Library at California State University, Chico. (C = Currency; R = Relevance; A = Authority; A = Accuracy; P = Purpose.) Each student is required to supply two unique sources to the team memo assignment, apply the five-point criteria to each source individually, and provide a conclusive justification for choosing those sources. In our experience, E-LEAP students are quite literal. So, if you ask a student to find five sources, he/she will. However, those sources may or may not be relevant to his/her topic, scholarly, or current, though that is what the research task requires. In fact, the student may provide citations for material that he/she has not referred to in the team memo or has not read, which explains the necessity for the CRAAP Test.

During the third librarian visit, students are asked to stipulate how the technology they have selected to research can be evaluated on the basis of its sustainability for Team Memo #3. We also ask them to describe what professional engineers (i.e. "the experts") have articulated about the technology. For many of the students, this is their first experience with discipline-specific resources, such as engineering article databases, and they experience discomfort with the writing style, the controlled vocabulary, and the depth of coverage. They often find that their search techniques are too broad, and they encounter a tremendous amount of information, which is often irrelevant. At this point, students revisit the research cycle, and the librarian helps them to update their research strategies. While the librarian identifies specific resources for the students to use, she also instructs them how to choose resources (not just those that the library subscribes to). The objective is not for students to master the use of one particular database, or even a set of databases, but to learn how to identify experts in their fields, locate information, and evaluate its quality. The container for that information is not critical.

For the fourth librarian visit, students are directed to research government policies and subsidies, both inside and outside of the United States, that affect the development and/or implementation of the technology they have chosen to research. The librarian introduces students to a set of databases that focus on social policy-related research, government documents from USA.gov, congressional hearings via the Federal Digital System website, and technical reports via Science.gov. The librarian clarifies that these resources are just a sampling of many different suitable resources for Team Memo #4.

At this point in the semester, students have a substantial amount of practice composing search statements, so they need little guidance from the librarian. However, they often find it difficult to search this set of resources using the keywords and strategies that have reliably produced results for them previously because they need to search more broadly than they would in an engineering database, for example. The librarian redirects them to consider the way that legislation is framed: generally, it is not written to address individual technologies, but under the umbrella of an industry or through a particular government agency. She recommends that they search each of the resources, but to select only those sources that they deem most relevant to their research needs—regardless of where the sources are housed, so long as they are legitimate. Again, it is important to reiterate to students the value of quality information, which they have the tools to locate and evaluate, rather than to give artificial importance to certain types of information (monographs versus websites, for example) or types or resources (academic versus government-created).

By the fifth and final librarian visit, students have completed four team memo assignments and are

preparing to create a PowerPoint presentation and final written report. The fifth visit is handled as a workshop. Student teams are given class time to work, while the librarian circulates the classroom to offer point-of-need research assistance and guidance. As mentioned, student teams also meet with the librarian outside of the classroom once they have created a draft presentation. The librarian helps the teams identify information gaps, as well as potential resources for addressing these gaps. She confirms that students have synthesized the material from all four team memos.

The current approach to the information literacy component of E-LEAP, while still fairly traditional, does not rely on a strict lecture/demonstration model. The librarian and faculty member engage the students--and each other--in discussion, hands-on activities, and demonstration in the classroom. In Fall Semester 2010, we experimented with a flipped classroom model of instruction in which students were instructed to watch two to three brief video tutorials on their own time before each librarian visit, and then come to the classroom prepared to participate in a hands-on workshop session with the librarian. (The tutorials were created by the librarian and are currently hosted on YouTube.) However, after one semester, we found it necessary to change our approach, when we discovered that the students seldom watched the tutorials and were, consequently, unprepared for the librarian visits. By Fall Semester 2011, we decided to attempt a hybrid approach to the traditional instructional and flipped classroom models, which we continue to employ as described above. In addition, we give students access to the online tutorials through a LibGuide that is linked on the course's Canvas site, as well as through the library's website.

Impressions and Observations

This model of information literacy instruction is driven heavily by our institution's support for interdisciplinary collaboration. Both the LEAP Program and the J. Willard Marriott Library foster this partnership and provide the resources that are necessary for an effective collaboration--namely, time commitment, personnel, and autonomy. We speculate that without this climate of collaboration, the model would be short-lived and, consequently, less successful. Institutional buy-in is imperative. Faculty must genuinely find value in information literacy instruction, as well as the expertise of the embedded librarian. In addition, interdisciplinary support and collaboration are core values of the LEAP Program. LEAP faculty do not consider themselves universalists, but specialists. As specialists, they regularly consult with other specialists to address and manage content that is outside the scope of their expertise, such as information literacy instruction.

This collaborative model of information literacy instruction is also more long-term and more deeply embedded into the curriculum than the standard "one-shot" (or one class period) model that is most common in academia. We have determined that the success of our model is, in part, due to the multiple-visit approach, but also due to the depth of the integration. Integrating information literacy content into the course assignments, as well as through in-person lecture and discussion, enables students to see the relationship between information literacy skills, the actual research process, and their output. It also ensures that students provide appropriate sources in their research products because we require them to engage with the sources in terms of evaluating their use and efficiency. We assign students to perform these information literacy skills in multiple assignments. We also provide them with scaffolding to learn and practice the skills so that they can develop greater proficiency over the course of the semester than they would in a one-shot visit.

We have found that one reliable measure of this collaborative model's effectiveness is that the number of citations in team memos have grown in terms of their quantitative value, as well as in qualitative terms. Another measure of effectiveness is students' use of scholarly journal articles and technical reports, alongside sources from the Open Web, which indicates that students have learned to locate, use, and synthesize appropriate information sources and have developed an understanding

of how to find scholarly information, whether it is through library databases or the Open Web. As mentioned, we can also confirm that students thoroughly evaluate the quality and efficacy of each of their sources because we have assigned them to do so and supply the criteria for their evaluation.

Conclusions

We draw our conclusions based on our experience incorporating this collaborative model during Fall Semester 2011 and Fall Semester 2012. We begin by providing our broad findings as follows:

1. Effectiveness of library quizzes: Students' library quiz scores were inconclusive in terms of assessing their information literacy skills. We found no correlation between high quiz scores and the quality of the students' research (i.e. the number of citations, the diversity of sources, and the evaluation of sources).
2. Low-impact: Students who fared well consistently on library quizzes also fared well on their team assignments, and, ultimately, the course itself. We identify this group as low-impact in terms of their grade performance.
3. High-impact: Students who exhibited the most learning are those who fared poorly on the first team assignment (i.e. showed no citations or low quality citations, low diversity of sources, and a lack of evaluation of their sources). We identify this group as high-impact in terms of their grade performance.
4. Relevance of information literacy to course assignments: Students found relevance in information literacy instruction as it related directly to their course assignments.

1. Effectiveness of Library Quizzes

There were a total of five quizzes in Fall Semester 2011 and in Fall Semester 2012. The average quiz grade for both 2011 and 2012 was 76% (or C). The lowest grade for 2011 was 35%; in 2012, it was 27% (or E). The highest grade in both semesters was 100%. While this brief description of grades is extremely cursory, we make a point here that the better or more effective indicators of learning and performance of information literacy skills are found in the content analysis of team memos (the number and quality of citations, diversity of sources, and evaluation of sources). Library quizzes were not indicators of assessing learning in this context.

2. Low-impact

As mentioned earlier, each librarian visit included a quiz that students had to complete. We found that students who fared well in the first library quiz also consistently did well in all subsequent quizzes. This is not surprising, as high-performing students perform consistently well. This same group of students also included citations, albeit from the Open Web, in their first team assignment, in comparison with the low-performing students, who did not include any citations in their first team assignment.

3. High-impact

The high-impact students were those who showed the greatest improvement in their information literacy skills and the quality of their research. Over the course of the semester, high-impact students moved from a place of no citations, either in-text or otherwise, to a place of quality citations. By requiring each student to perform and submit a CRAAP Test evaluation for each citation they collected, students learned to filter out irrelevant, out-of-date, unauthoritative, inaccurate, and biased information. What is significant for us as instructors of this course is that the quality of citations from the Open Web moved away from generic, encyclopedia-style sources (e.g. Wikipedia) to sources originating from professional entities (e.g. EPA) and scholarly publishers (PLOS.org.) This move on the students' part is attributable to the students' awareness and appreciation of the evaluation criteria.

The improvement in locating and using appropriate information sources also reflected on their improvement in terms of their overall team memos and course grades.

4. Relevance of information literacy to course assignments

By integrating information literacy content directly into the course assignments, students were able to identify the utility and applicability of information literacy skills. Each assignment, we created a research need, introduced a skill (or skill set), and provided information resources which responded to the need. students began to recognize, over the course of the semester, the relevance and value of developing these skills because they could locate information resources that were appropriate to their research needs without having to rely on the recommendations of the librarian. As researchers, they became more autonomous and skillful. The demands of the team memo (research project) led students to apply information literacy skills (see information literacy objectives organized by visit above) to real-life research needs. Rather than evaluating students on their ability to retain certain facts about a specific database, we, through this integrative model, provided students with the agency to seek out new information resources and the ability to evaluate the efficacy of such resources as well. This ability translates to, not only the LEAP 1500 course, but provides students an opportunity to apply these skills and knowledge sets to other settings and courses as well, much like "teaching fishing" in lieu of "giving fish." The applicability goes beyond this assignment, this course, and this semester, providing lifelong learning.

Future research

While our conclusions are drawn from our own pedagogical experiences**,** we recognize the need for a more formal and rigorous assessment. The findings and reflections we have presented here represent an exploratory study of our teaching experience over two Fall Semesters. The follow-up research will entail an investigation of whether students' success can be predicted by their ability to navigate the research process through the semester. In other words, as students become more capable researchers, do they generally become better students? Furthermore, the results of this exploratory analysis direct the research towards a more thorough content analysis of students' citations in their memos and their final research project. This paper establishes the necessity for embedding the information literacy content within the course content and more explicitly, into the research assignments. Embedding information literacy within the curriculum itself predicts students' success with the research process. In addition, such embeddedness enables a recognition on the part of students that these skills are transferable to contexts beyond the classrooms.

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