

Information Competencies: A Strategic Approach.

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Abstract

This paper will discuss the need to integrate information competencies into engineering programs at the curriculum level. To support this argument, the various opportunities for library instruction available in academic libraries (and the relative effectiveness of each) will be reviewed. It will be argued that the most effective of these is curriculum-integrated instruction, which is competency based and strategic in nature. However, the quantity of work and coordination required to build an instruction program that is truly curriculum-integrated oftentimes leads to a product that is course-integrated rather than curriculum-integrated. An informal survey was conducted of NC State University students in the Colleges of Textiles and Engineering and illustrates where course-integrated instruction falls short of its goal. This paper concludes with an outline of a plan for implementing a curriculum-integrated instruction program.

Introduction and Overview of Information Literacy

"The explosion of information has serious implications for information seeking by all persons, but especially for students. For example, in most cases there is not just one right source of information to answer an information need; there are likely to be a number of alternative sources and approaches that can successfully lead to resolution of the problem. The question becomes less, "Can I find information on this topic?" and more "What are my best strategies for finding information on this topic?" [7]

According to the *Final Report of the American Library Association Presidential Committee on Information Literacy* the information literate person is, "...able to recognize when information is needed and have the ability to locate, evaluate, and use it effectively." [1] The Association of College and Research Libraries in early 2000 approved and released *Information Literacy Competency Standards for Higher Education*. These standards define the topic and address issues such as the relationship between information literacy and information technology, pedagogy and higher education. In the last ten years information literacy has become a well-used phrase in the library community and is beginning to be more broadly recognized by educators as a necessary skill set for students. It can be contended that the slowness to adopt these skills into curriculum stems from confusion between information literacy and computer or IT literacy. It is stated in the ACRL standard that "Information literacy, while showing significant overlap with information technology skills, is a distinct and broader area of competence." [2] This broader range of skills, while obviously having a technical component,

deal with the students' ability to acquire, analyze and use information effectively in a decision making process. They go beyond a particular discipline or profession and have been recognized as an elemental part of the skill set of the life long learner.

The information literate person is someone who has learned how to learn. "Learning (is) a process that culminates in the ability:

- to ask the right questions and frame good problems,
- to acquire information and evaluate sources of information,
- to critically investigate and solve problems,
- to make choices among many alternatives,
- to explain concepts to others (both verbally and in writing) and
- to generalize to new situations." [9]

The need to graduate students who are life-long learners is central to the mission of a university. The critical thinking, communication, research and information skills students acquired in their education should enable them to be effective contributors in the workplace and to society. Engineering graduates should be able to teach themselves new concepts and apply information to new and unfamiliar situations. This ability is listed in ABET guidelines as an objective for a competent engineer and has encouraged curricular reform across the country.

A Look at the Student

The Higher Education Research Institute in Los Angeles, California has conducted surveys of college freshmen for the last thirty years. This survey provides educators with insight to the pressures, values and any trends present among the students we encounter. The 1999 Freshman Norms are based on the responses of over 261,000 students at 462 American two and four year colleges and universities and represent trends for this particular class. The report cites that the number of students feeling overwhelmed/stressed is at an all time high of 30.2%. One major contributing factor to this is the number of students who have to work part-time or full-time. A record high of 39.9 % is academically disengaged, i.e. report feeling bored in class, and spend less than six hours a week doing homework. Another record breaking 62.6% of students were frequently late to class and 36.2% frequently missed class. An interesting point is that, when asked to rate themselves on intellectual self-esteem and academic and leadership ability, over 54% of students rated themselves as above average or in the top 10%. Fifty percent of them expect to make at least a B average. Grade inflation at the high school level rather than actual performance has been suggested as the reason for this high level of confidence. [14]

These statistics for freshmen provide us with some insight into the pressure students at all levels face and in particular their opinions on their performance. It is clear that grades are a powerful student motivator and, as they progress through the system, they become masters at being able to do the minimum amount of work for the maximum grade available. They expect to do well and are doggedly focused on the bottom line. "Will this be on the test?" and "Does this count towards my grade?" are still the two most popular questions asked in most classrooms. Students are product focused rather than process focused and getting the assignment completed and turned in is their goal. This approach is probably fine for the first two years of their program, but by junior year, they need to begin shifting into critically thinking about the processes that they use to solve problems. The engineering curriculum is designed to do this, but the students often have a difficult time making the mental shift and are still in the "just get it done" mode.

When faced with an information problem many students are primarily interested in resources that are accessible electronically and believe that most information is available via the World Wide Web (WWW). Evaluation of a resource's relevancy, accuracy and authority is minimal. This is problematic given the ever-increasing amounts of information made available via the WWW. It is very easy either to become inundated with information or to find nothing using a simple keyword search on a web search engine. The apparent ease with which information is often found leads them to believe that the web is a more complete source of information than it actually is and gives them a false sense of their capabilities. Engineers have never, at the undergraduate level, been heavy users of the library. However, the importance of information skills has changed because of the shift from an industrial to an information economy and students need information skills to compete and succeed in the working world. [15] As educators, we should seek to give them the opportunity to develop their skills and attain a level of confidence in themselves that is justified.

Types of Instruction

Within academic libraries, various opportunities for instruction exist. Each has its benefits and drawbacks, both in effectiveness as a way of learning and as a way of promoting the work that librarians do. There are four main ways that library instruction occurs within an academic setting: at the reference desk or other point of service; at orientation sessions; within the context of a course-integrated assignment; and through curriculum-integration. It can be argued that there is a continuum of effectiveness here, with reference desk interactions being the least effective and curriculum-integration being the most effective opportunity for instruction.

Point of Service Instruction

Instruction at the point of service occurs when students approach a reference or other service desk to ask a question and, as a part of providing an answer, librarians attempt to teach a student some basic concepts about finding information. This is beneficial because it is a "just-in-time" kind of instruction -- it gives students what they need when they need it. Oftentimes though, students are caught up in the anxiety of turning in an assignment and are not interested in learning a new skill -- they just want the answer, and they get frustrated with our attempts to educate them. Additionally, the short duration of the interaction does not make it an ideal time for instruction.

Orientation Sessions

Librarians have more time to explain things thoroughly during a formal orientation session, where there is a dedicated block of time and students are not worrying about meeting a deadline. Such sessions tend to take place at the beginning of a semester, either with the librarian being invited to come to the classroom or with the class coming to the library. Either way, the content tends to be the same: an introduction to the library's information system, resources, and available services. These orientation sessions are useful to students who are interested and have an opportunity to apply what they learn right away. Graduate students are an ideal group for this sort of service. It tends to be less effective for undergraduates, because they tend to place low value on information skills and because of the timing -- the beginning of the semester -- when

they are being inundated with information and haven't had any assignments to make library instruction relevant to them. Perhaps the greatest benefit of the orientation session is that it gives students some personal contact with a librarian, which will hopefully make the library feel more accessible to them.

Course-Integrated Instruction

Course-integrated assignments address many of the weaknesses of other types of instruction. The opportunity for instruction occurs in the context of an assignment. Students need to learn how to find information in order to complete the work. Thus it addresses their focus on the end product. Because of this and the fact that their instructors support it, they tend to value such learning more. The instruction is relevant and well timed. It doesn't happen too far in advance of the assignment or at the eleventh hour when they are stressed about meeting the due date. Course-integrated assignments come in a few different forms. The best kinds are the result of collaboration between the librarian and the instructor, where the librarian helps with the design and grading of the assignment. These often involve a great deal of interaction between the librarian and students. Another form tends to be assigned mostly to freshmen and sophomores: this is a short assignment created by the instructor (and usually given at the beginning of the semester) which requires students to do some basic tasks, like look something up in the catalog. The only interaction with the librarian that occurs at this point is when the students show up at the reference desk asking for help. Still another form is just a straightforward assignment with a research component, such as a term paper or a design project. These are the kinds of projects typically assigned to the upper classes. There is little librarian interaction, because faculty assume that by the time students reach their junior or senior year, they should already have information skills. This, of course, is an entirely appropriate assumption but, as discussed earlier in this paper, it does not reflect the reality of the situation that exists in colleges and universities today. The main drawback to course-integrated instruction is that, despite its relevance to class work, students don't seem to retain what they learn. This view is based on a great deal of anecdotal evidence accumulated from personal experience working with students over the years and getting a sense of what they know. In the fall 2000 semester, we decided to investigate the matter further by conducting an informal survey among NC State University undergraduates, a discussion of which follows.

Many librarians confuse course-integration with curriculum-integration. Getting library instruction into a course is quite an achievement and involves a great deal of work on the part of the librarian, but creating and teaching an information-based assignment for a course does not constitute curriculum integration. True curriculum integration means that information skills are deeply embedded across the curricula; instruction in information skills should be so prevalent that students aren't even aware it's happening. Such a program requires taking a strategic or system-wide approach to information literacy and thus calls for the buy-in of the entire department.

An Informal Survey

The survey was developed to gather evidence on whether or not students were retaining the information skills they learned while doing course-integrated assignments. Anecdotal evidence

suggested that a low level of retention was the norm. A good example of this kind of experience is a project created for a group of seniors in the College of Textiles at NC State University. Students have an assignment in which they must prepare a traditional library pathfinder on a course-related topic (industrial management issues). NC State librarians designed the assignment and helped the instructor to grade it. They visited the classroom and guest lectured approximately five times per semester, then built and maintained a detailed web site to support the project. This course has been taught every semester since the Fall of 1998. Students spend at least six weeks working on the pathfinder, and there is significant interaction between the librarians and the students. Students who completed the pathfinder project (sometimes even in the previous semester!) routinely come to librarians seeking help because they are completely at a loss to reapply what they learned for a new or different assignment. As a result of this, and a parallel effort to move toward a competency-based model of instruction, it was decided to explore the matter further via a survey. The main goals of the survey were to get a sense of what students *think* they know and what they really know, and to find out if having a course-integrated assignment made any difference in either.

We realize that many of these concepts are intangibles, and are thus hard to measure. Additionally, there are many factors that can skew results one way or another. For these reasons, it was decided to make the survey very informal -- we do not in any way wish to present it as anything else, and therefore will not spend a lot of time discussing its structure or methodology. Some basic facts about the survey will be useful to know: the survey was entirely confined to a selection of classes taught within the College of Textiles at NC State University. Four classes were used, two within the Textile Engineering and Chemistry department, and two within the Textile and Apparel Management department. A total of ninety students were surveyed, seventy-five seniors, eight juniors and seven graduate students. Fifty were male, forty female. Each class had performed some kind of research assignment during the Fall 2000 semester, and the survey was given at the completion of the course, in December 2000. Students were asked a total of fifteen questions: two were demographic, five rated their actual skill and experience levels, and the remaining eight rated confidence level in using libraries and finding information.

Perhaps the most significant result of the survey is that there was absolutely no correlation between the amount of instruction a student had received and his or her skill level. And since most of the instruction that students reported on was in the form of a course-integrated assignment, it's evident that a majority of students may be completing their assignments, but are not learning or retaining the skills involved. Another interesting result was that more than half (52%) of the students were more confident about their abilities than their skills indicated they should be; students think they know more than they actually do. Perhaps this is because they have an inaccurate and misinformed view of the world of information. If they don't see the complexities, then they can't be expected to understand that they need skills to deal with those complexities. The advances in technology of recent years have made finding and accessing information easy and immediate; as a result students have a false sense of security about what is required of them.

Curriculum-Integrated Instruction at NC State University

We have discussed the many different types of library instruction applied today in universities, most of which have been implemented at NC State. These instructional sessions can be considered training to provide skills in a particular area, for example the catalog, or a database. These are necessary skills to possess, but when delivered discretely do not significantly increase the information literacy level of the students. At the NC State University College of Textiles, faculty members often incorporate requests for information into homework assignments. Students are expected and encouraged to make use of the library resources. However, they come into the library unable to transfer knowledge from previous instruction in information skills and require substantial individual help from library staff.

The recurring question is, why does this happen and what is the solution? In discussions with students, faculty and other librarians, we have come to believe that what becomes lost in the choppy, incidental instruction they receive in various courses is an awareness of the process. If students have no concept of how the information universe is structured, if they cannot use "traditional library tools", and if they have never had to solve an information problem using an appropriate research method, then they will not be competent acquirers, users, managers, and transformers of information. Curriculum integrated instruction refers to the integration of these competencies into the curricular content. The competencies we have used as the basis for our thinking were defined by Lin at MIT in 1999 [11] and are as follows:

The ability to:

- acquire and interpret information
- manage information
- communicate information
- apply information to specific tasks and be innovative
- apply the above competencies in international and multi-disciplinary contexts.

To begin the integration of these competencies into the curriculum, our first step was to develop a simple way for faculty to know what was an appropriate assignment for students at a particular level. For example, sophomores would probably find it difficult to collect data and do an analysis of the application of a new technology and its impact on the global economy because they don't have enough exposure to information skills and resources.

Using the competencies as a guide, a list of concepts that students should have encountered at the end of each year of study was developed. These competencies have then been translated into skill building exercises that are relatively easy for faculty to integrate into their teaching and homework assignments. At the freshman and early sophomore levels the focus is on developing basic skills, gaining knowledge of the library information system, and getting an introduction to the information universe. As course work progresses, this knowledge is applied and expanded upon within the context of the disciplinary study. The competencies for these levels along with a sample exercise are included below:

Freshmen Competencies

Information-oriented assignments given to freshmen should be highly structured, with expectations clearly stated. In general, assignments should help orient students to the NCSU Libraries' information system, and the variety of resources available. Emphasis should be placed on print resources and the library catalog as the tool to access them. By the end of their first year, students should:

- Be comfortable using the physical library and be able to identify full time staff members. They should know where to go when they want to check out a book, return a book, or get some research help.
- Have a good understanding of the library's catalog; what it contains, what one uses it for, etc.
- Be able to read and understand a catalog record so as to extract location and status information.
- Be able to renew and check their borrowing record online.
- Posses a basic library/research vocabulary, understanding words like:
 - *Call Number*
 - *Catalog*
 - *Circulating/Non Circulating*
 - *Citation*
 - *Reference Book*
- Be firmly grounded in the use of print materials, especially reference books.

Sample Assignment	Library Tour
Degree of Library Involvement	Medium
Skills/Competencies	Locating Information
Details of the Assignment	Students must take a tour of the Textiles Library and introduce themselves to a permanent staff member.
The student turns in	Signature of the staff member they introduced themselves to.
The instructor provides	Dates/times when students may ask for a tour.
The library provides	Tours.

Sophomore Competencies

Information-oriented assignments given to sophomores should be very structured, with expectations clearly stated. In general, assignments should reinforce and build on the information skills of the freshman year. Emphasis should be placed on print resources, with particular focus on finding journal articles. By the end of their second year, students should:

- Be able to search the library catalog using subject headings.
- Be able to formulate a keyword search in the library catalog or a citation database.
- Understand the difference between a scholarly journal and a trade journal.
- Be able to evaluate and select appropriate databases for a research topic.
- Posses a basic library/research vocabulary, understanding words like:
 - *Journal*

- *Article*
- *Abstract*
- *Citation*
- *Database*
- *Subject Heading*
- Know the titles of some major journals in their field of study.
- Have a broadened knowledge of library services.

Sample Assignment	Summarize an Article
Degree of Library Involvement	Medium
Skills/Competencies	Finding, locating, analyzing and synthesizing information.
Details of the Assignment	Students should find, located, read and summarize an article in half a page.
The student turns in	The citation of the article, and the written summary.
The instructor provides	The topic(s) of the article, and a resource for the appropriate citation format.
The library provides	Some instruction on how to do the assignment; resources on how to write the summary.

Junior Competencies

Information-oriented assignments for students in their junior year should be less structured, with more open-ended expectations. They should build and expand on the information skills obtained during the freshman and sophomore years. Specifically, students should: be aware of the wide variety of formats and sources that deliver information, have a more in depth knowledge of electronic information sources and be capable of more sophisticated search techniques. By the end of their junior year, students should:

- Be able to name a few of the major reference books, journals and databases in their chosen field of study.
- Be able to perform online searches using basic Boolean logic.
- Have a basic understanding of other types of information sources (standards, conference proceedings, and patents).
- Have learned multidisciplinary ways of thinking.
- Be able to present a verbal or written strategy for solving an information problem.
- Be thoroughly comfortable with all major library services (checkout, return, online renewal, check borrowing record, MyLibrary, ILL, etc.)

Sample Assignment	Research Paper
Degree of Library Involvement	Medium - High
Skills/Competencies	Finding, identifying, evaluating, and synthesizing information
Details of the Assignment	Students will write a short research paper (5-7 pages) on a topic related to the course.
The student turns in	The research paper with bibliography and footnotes cited in a standard and consistent style.
The instructor provides	The topic(s) to research and a resource with style samples.
The library provides	An instruction session on how to prepare a research paper and/or individual guidance sessions for students.

Senior Competencies

Information-oriented assignments for students in their senior year should help build advanced searching skills, and a firm understanding of the "information universe." Seniors should graduate with information competencies sufficient for functioning in the working world or for beginning a graduate degree program. Examples of such competencies include:

- Knowing what patents are and how to find them.
- Knowing what engineering technical standards are and how to find them.
- Knowing the major professional associations in one's field.
- Being able to think in a multidisciplinary way.
- Being able to formulate a complex search statement.
- Being able to synthesize information from multiple sources regardless of format.

Sample Assignment	Patent Search
Degree of Library Involvement	High
Skills/Competencies	Synthesizing and evaluating information
Details of the Assignment	For classes with design projects: students can look at how new technologies have been applied by searching for patents that use a particular technology to support their design.
The student turns in	A listing of relevant U.S. and foreign patents.
The instructor provides	Guidance on the approach to take.
The library provides	Instruction on patent searching.

Integration of these competencies into any curriculum will take considerable work and planning. The first step is to have administrators and teaching faculty accept the idea and agree that students do need to possess this level of information competence. The next step is to look at the syllabi of the courses offered and identify those that already have information-based assignments or those that could include assignments. In larger colleges it would be best to select one or two degree programs with which to begin.

In the College of Textiles, there are two departments, the Department of Textile and Apparel, Technology and Management, and the Department of Textile Engineering, Chemistry and

Science. They offer five bachelor degree programs that in the freshman and sophomore year require many of the same core courses. This will make the integration of these competencies into the early part of the curriculum relatively easy. The courses identified as having an information component will then be mapped against the required courses for the degree programs and in this way any gaps can be identified. Librarians will then work with faculty to develop assignments that capitalize on information available through the library and any other channels. After the initial work the involvement of the librarians with each course can vary from low to high depending on the particular assignment. It is important that expectations on all sides are reasonable and imperative that they be met. Evaluation of the effectiveness should be measured at the sophomore and senior level. This will be in the form of a questionnaire delivered to all students at the end of these years.

Conclusion

This paper suggests that in order to be relevant, library instruction must be planned strategically across the curriculum and implemented in a way that allows the student to grasp the complexities of the information universe. There needs to be collaboration between teaching faculty and librarians and critical evaluation of the students' information competencies. The approach is measured and focused and because it builds upon the existing course requirements requires no major shifts in the established curriculum. We should take notice of the following statement made by Lyman, et. al.:

"The world's total production of information amounts to about 250 megabytes for each man, woman, and child on earth. It is clear that we are all drowning in a sea of information. The challenge is to learn to swim in that sea, rather than drown in it." [16]

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