2006-409: THE LITERATE ENGINEER: INFUSING INFORMATION LITERACY SKILLS THROUGHOUT AN ENGINEERING CURRICULUM

Honora Nerz, North Carolina State University

Honora F. Nerz has a Bachelor's degree in Mechanical Engineering from Manhattan College and a Master's degree in Library and Information Science from The Catholic University of America. Ms. Nerz is currently the Head of the Textiles Library and Engineering Services at NC State University where she oversees library services to the colleges of Textiles and Engineering.

Lisa Bullard, North Carolina State University

Lisa G. Bullard received her BS in Chemical Engineering from NC State and her Ph.D. in Chemical Engineering from Carnegie Mellon. She served in engineering and management positions within Eastman Chemical Company from 1991-2000. At N.C. State, she is currently the Director of Undergraduate Studies in Chemical Engineering. Her research interests include the integration of teaming, writing, and speaking into the undergraduate curriculum.

The Literate Engineer: Infusing Information Literacy Skills Throughout an Engineering Curriculum

Abstract

Research and information skills have become increasingly important for the current and future success of engineering students. Engineering faculty and administrators have recognized this and as a result, have placed greater emphasis on information literacy in their programs. At North Carolina State University (NCSU), engineering librarians have been building a curriculum integrated instruction program within the College of Engineering over the last four years. This paper describes the ongoing collaboration between the NCSU Libraries and the Department of Chemical and Biomolecular Engineering to build information skills into the curriculum, detailing specific assignments and grading methods. This paper also looks at current trends and issues in information literacy education for engineers.

Introduction

What does it mean to be literate? The most common definition, the ability to read and write, is overly simple, implying that literacy is black and white; i.e., one can read or one cannot. It does not take much experience to realize that literacy is not a "yes/no" proposition; rather, it is a lifelong endeavor, with many levels of accomplishment. Kellner defines literacy in a broader fashion, stating that it "…comprises gaining competencies involved in effectively using socially-constructed forms of communication and representation. Literacies are socially constructed in educational and cultural practices involved in various institutional discourse and practices. Literacies evolve and shift in response to social and cultural change and the interests of elites who control hegemonic institutions."[9] Perhaps because of this evolving nature of literacy, academics and other professionals have borrowed the term and attached it to all sorts of skills as a way of defining an individual's aptitude in a particular arena. We now have, in our lexicon of literacies (to name just a few): technological literacy, media literacy, social literacy, and family literacy.

In academia, *information literacy* has received much attention from faculty and librarians, the latter group being its primary champion. The reasons for this are, of course, based on "…a fundamental change in industry, economy and society from a manufacturing/product basis to a service/information basis."[15] Kellner calls this change the "Great Transformation" and says that the associated revolution in computer, information, and communication technology "ascribes education a central role in every aspect of life."[9] As a result, colleges and universities have to prepare students for this society in which information plays a central role and the ability to navigate, retrieve and use information effectively is critical to one's educational, professional, and civic success.[14] Thus, "many universities now include information literacy, either explicitly or implicitly, among their graduate attributes/outcomes identified in teaching or strategic plans."[15] The importance of this skill is so widely accepted that it can very safely be stated that today, some form of information literacy education exists at every college and university.

Background/History

As long as there have been libraries, there have been librarians teaching people how to use them. This process of teaching was, for a very long time, almost universally referred to as "bibliographic instruction" (or "BI"), but this term, perhaps because of its book-centered etymology, is much less used now. Contemporary librarians talk about fostering "information literacy" and simply call this aspect of their work "instruction." This change from BI to information literacy was more than a simple shift in terminology, rather it was a shift in methodology and, most importantly, in purpose. Owusu-Ansah describes it in these terms:

"*What distinguishes information literacy as a more ambitious instructional engagement than conventional bibliographic instruction is its recognition and willingness to assert the need to go beyond teaching mainly retrieval skills, to addressing a more total research environment in the course of finding and using information/knowledge. ... Information literacy education ...seeks, however, to reach beyond that and place information itself into context by addressing social, economic, and legal as well as other concepts and issues related to such information. ...It aims at delving into issues of copyright, intellectual property, and plagiarism. Whereas bibliographic instruction provided a limited experience with the information universe, information literacy seeks to traverse the full length and breadth of that universe as it relates to the process of acquiring and using its products for learning and research. Such concepts and issues evaded bibliographic instruction sessions perhaps exactly because of their limited time and scope. Information literacy, as a contemporary response to a contemporary problem, implies, therefore, a commitment to a new way of doing things.*"[14]

Information literacy, then, is a response to the expansion of the information universe beyond the traditional brick and mortar research library. It seeks to prepare users to work in an environment that is often virtual, complex, dynamic, and seemingly limitless. Information literacy goes beyond the basics of how to use a particular tool to thinking about how to approach a particular problem. The information literate person is able to define the problem's scope, as well as the scope of where, in the information universe, regardless of location or format, the answers will likely be found. He or she understands that finding information is no longer the challenge; rather, it is in finding the *best* information from the best source available. They are able to recognize relevant information and absorb that information into their body of knowledge, making it their own, so as to communicate that knowledge, verbally, graphically, or in writing, giving credit where credit is due.

The challenge to become information literate is that there is a steep learning curve. In the current environment all aspects of finding information have become more complex. Certainly, part of this complexity lies in the *quantity* of content available, both free and fee-based. We argue, however, that the greater problem lies not in a user's ability to sift through large amounts of content (on the contrary, it seems we are all adjusting to this new reality relatively well), but rather in his ability to understand what he is looking at or working with. In other words, to understand the *context*. For example, a student may go from a library web site to a web-based database like Compendex, find a citation to an article, and then click on a link that takes him to the article, which is located on the web page of an e-journal to which the library subscribes. Librarians have worked to make this a relatively easy and seamless task, but it is a much harder thing to understand the context. A library web site, a database, and an online journal are three very different resources, but they are all accessed through the web browser, and they appear to be free. If one is not familiar with the print analogy these resources are based upon, it is an abstract concept to grasp. This lack of understanding becomes evident in students' writing and particularly in their citations, where a web site may be called a database or an e-journal referred to as a web site. One may ask (and librarians certainly will debate), do users really need to understand these differences? The answer from our perspective would be both yes and no. Ideally, the tools would be so good that users wouldn't have to understand this; they could focus solely on content, and not its packaging. However, we are not quite at that point yet. We are in a phase where an increasing quantity of resources are available electronically, and tools to integrate resources (full text linking, for example) are becoming more prevalent. Advancement breeds more complexity. Before computers, there were resources (books, journals) and tools to find them (card catalogs, print indexes). Now content and search tools are bundled together. For example, the Knovel Scientific and Engineering Database searches the full text of hundreds of science and engineering handbooks, and ScienceDirect searches thousands of electronic journals. With each advancement, each exciting new product, comes challenges for users to learn it and for librarians to explain it. At some point on this spectrum of technological advancement, the tide may turn, and resources and tools will become so integrated that searching will become cleaner and simpler and then, context may be irrelevant. For the time being, possessing a basic understanding of the milieu in which information is organized and accessed is helpful, as it contributes to a user's ability to effectively search for, evaluate, and cite sources.

This increasing complexity has also had an effect on students' understanding of proper citation and plagiarism. While students seem to understand the need for proper citation when it comes to print resources, that same awareness frequently does not carry over to their electronic counterparts. It has become commonplace to see work with text lifted directly from a source (oftentimes without even changing the font!) and citations containing no more than a URL. Students need to understand that cutting and pasting, while permissible in some contexts, is not acceptable in others. Engineering students, who may not have opportunities to write and cite in their core courses, can graduate without knowing citation styles other than humanities-focused MLA, or ever having to cite technical resources, data, or patents.

An additional pedagogical challenge comes from differentiating between what students know and what they think they know. Most students today and engineering students in particular feel so comfortable with information technology that they often think they are more adept at doing research than they actually are. Trussell explains, "Students arriving at college are often ill prepared to grapple with the information resources presented by the modern academic library. Compounding the problem is the fact that many students have come to believe that accessing and using information is simple, a belief supported by commercial marketing practices and popular usage of the Internet. …Popular usage maybe easy, but effective research usage is not."[18] Fosmire and Macklin agree and they contend: "…The bigger problem, however, lies in the fundamental belief that competence with technology and the ability to retrieve information are the same skill sets. In fact, they are not."[10] Students' inflated sense of confidence can even cajole faculty (especially those who aren't as comfortable with information technologies) into believing that they are already experts in this arena.

Changing Expectations

Historically, the acquisition of information skills has been something that was on the periphery of the curriculum – for example, a paper or other research project might be assigned in class, but when it came to actually doing the associated research, students would often be expected to figure it out on their own. As we know, the revolution in information technology of the mid 1990s changed all of that. With the information universe expanding exponentially and research skills becoming more important, faculty and librarians all over the country began collaborating on building an information literate student body, changing and formalizing instruction to meet a new student need.

Information literacy has found a natural home in the humanities, where writing and research have always played a part of the curriculum. In engineering this link has not been as easy to make, even though it is no less important that engineers be able to function in the new information society. Engineering curricula is still very textbook-centered, and this has an impact on students' preparation for working in an information economy. With most of their research experience occurring in a humanities or social sciences context, engineering students do not always understand research as something that "engineers do." Old attitudes die hard, and it is still a challenge to convince students that information skills are not only useful, but critical to their success. Rodrigues states, "Engineering students, in preparation for efficiently managing information during their careers, should be departing the university for industry with more than just an accumulation of textbooks and course notes to take with them."[16] Bracke and Critz support this, saying, "Science and engineering students need to master complex subject-specific resources that often require a sophisticated and diverse set of search skills. Competency is crucial to success in their chosen academic endeavors and will be applicable in their professional careers."[5] ABET, through its requirement that engineering programs graduate "lifelong learners", has given wings to the information literacy movement in engineering. Formalized library instruction provides universities with an easily documented and measurable way to meet the lifelong learning outcome.[1]

Information Literacy Education

In many settings, information literacy instruction takes place through generic orientation sessions, at a library service point (such as a reference desk or online chat service), or through an assignment placed in a course (such as a term paper). We believe that these types of interactions are not the most effective way to teach students information skills. Badke states, "Clearly one-shot and point-of-need training, while helpful in themselves, cannot hope to make a lifelong skilled researcher who can cross subject disciplines in the intelligent quest for the right information."[3] In the last five years, librarians have embraced the idea of *curriculum integrated instruction* as the best approach to achieving information literacy. In curriculum integrated instruction, assignments are embedded in core courses throughout the curriculum. The assignments are progressive (i.e., the sophomore assignment builds on what was learned the freshman year, and so on) and the goal is to build specific competencies. Curriculum integrated instruction is strategic and systematic. Callison, et. al. highlight some additional benefits: "Once the concept of curriculum integrated library instruction is accepted by teaching and library faculty, the benefits of instructional collaboration are numerous. Faculty can discover the extent of what the library and librarians have to offer their students. Library faculty can provide more effective service since they have an earlier awareness of research and assignment needs. Although these are significant benefits, the most important benefit of collaboration is the creation and presentation of a relevant, cohesive learning environment for the student."[6]

At North Carolina State University (NCSU), engineering librarians have been working since 2001 to fully integrate instruction into the engineering curriculum and have worked with faculty in seven of eleven departments in the NCSU College of Engineering. One of the early success stories was with the Department of Chemical and Biomolecular Engineering where information competencies developed by Nerz and Weiner were used to create assignments for each year of undergraduate study.[13] The assignments are detailed as follows:

Connecting in the Freshman Year: E101

Approximately 1200 first year engineering students take E101, *Introduction to Engineering and Problem Solving,* in sections of about 40 students each. Classes occur in classrooms equipped with computers for student use. This course provides an introduction to engineering as a discipline and profession. There is an emphasis on engineering design, interdisciplinary teamwork, and problem solving from a general engineering perspective. In addition, students receive an overview of academic policies affecting undergraduate engineering students as well as exposure to college and university-wide programs and services.

For the past 5 years, engineering librarians have attended each of the approximately 40 sections of E101 to make a presentation to first year students. The presentation, which typically occurs about five weeks into the semester, acquaints students with the engineering librarians as well as the Libraries' web site, basic catalog searching, and introduction to one or two key databases, and short discussion of the importance of proper citation. Although the presentation is reworked every year, at least half of the time is always dedicated to hands on searching by students. Presenters tie the presentation topic to research related to the students' Freshman Engineering Design Project, in which students are assigned to groups and are given a design project to complete, with the culmination of presentations and competitions at Freshman Engineering Design Day. Examples of typical design projects include the design of a trebuchet, water rocket, bubble blowing machine, material mover, fountain, K-12 outreach, pop-up book, etc. In some years the students have been assigned a paper documenting the engineering design process and describing their research efforts. In other years, students have been asked to make an oral presentation of the same content.

Connecting in the Sophomore Year: CHE 205

All sophomore chemical engineering students take CHE 205, *Chemical Process Principles*. This course involves engineering methods of treating material balances, stoichiometry, phase equilibrium calculations, thermophysics, thermochemistry, and the first law of thermodynamics. Students are introduced to equation solving packages and spreadsheets for solving problems related to chemical engineering calculations.

This class has a weekly 2-hour problem session in addition to the lecture sections. Librarians visit during the problem session to introduce students to important discipline-specific resources that chemical engineers typically use, including *Perry's Chemical Engineers Handbook, The Chemical Economics Handbook, Kirk Othmer Encyclopedia of Chemical Technology, and Chemical Market Reporter* etc. Students are also introduced to databases such as Compendex, and SciFinder Scholar. The presentation discusses APA citation format and gives students an opportunity to cite data sources. In this assignment, librarians point out to students that *where* information comes from can be just as important as the information itself. Knowing the vastness of the information universe, a piece of data they find in *Perry's* could, in all likelihood, be found somewhere else, but that other source will not have the authority that *Perry's* has, and that is why, as future chemical engineers, they must know about these sources.

The assignment below is given to students following the library presentation. Typically they are given 2-3 weeks to complete it.

CHE 205 Library Assignment

1. Select a chemical substance from Table B.1 in your textbook that begins with the same letter as your first name or the nearest possible letter (for example Andy -> Aniline). Find and report the following data for this substance in references other than the course text or CD, and properly cite the references. The information should be neatly organized so that the reader can easily review the information as well as the citations. Complete units should be included where appropriate.

(a) Basic physical properties for the chemical (specific gravity, molecular weight, normal melting and boiling points, Antoine constants, heat of vaporization, heat of fusion, heat capacity). If you find that some physical properties are missing for your chosen chemical, choose another species with complete physical properties.
(b) Examples of how the chemical is used in different industrial applications or in industrially important reactions
(c) Toxicity data
(d) Environmental hazards
(e) At least three companies that manufacture this product
(f) Worldwide demand or sales for this chemical; and
(g) Unit pricing ($/kg, $/gal, etc.) (Note: this should reflect bulk pricing, not pricing of small units from Fisher Scientific, etc.)

2. From the textbook index, select a technical topic that begins with the same letter as your last name or the nearest possible letter (for example Brent -> Bubble point). Find three papers (not web sites) in the recent literature that deal with this topic. Copy and paste their citation information and abstracts. Find these three papers, photocopy or print out their first pages, and attach them to the homework.

Connecting in the Junior Year: CHE 395

Juniors take CHE 395, *Professional Development Seminar*. Student learning objectives include:

a) Demonstrate skills that reflect the broader professional qualities necessary for success in their careers, including

- ethics and professional responsibilities
- oral communications
- activities in team structures.

b) Write clear professional documents, including technical reports, summaries, and/or research papers.

c) Demonstrate a broader knowledge of leading edge chemical engineering or other disciplines, and/or obtain a more advanced knowledge of chemical engineering or other scientific fields.

An engineering librarian visits the class early in the semester to talk about the assignment (below). This assignment is much more open-ended than those in previous years. A good deal of the librarian's time in the classroom is spent talking about how to approach the problem. Students begin thinking in a multi-disciplinary way, and, to support this, they are introduced to databases for subject areas outside of engineering.

So far the class has been taught twice, using different models. In the first offering, the course focused on a single technology area – biotechnology – and students were rotated through functional teams such as technology, regulatory, and marketing. Teams were given various scenarios and asked to respond from the perspective of their functional area. A typical assignment is shown below:

CHE 395 Assignment
Scenario: Possible Side Effects of an Existing Drug

You open the *News and Observer* and an article on the front page catches your attention:

Merck cites 'class effect'

COX-2 pills risky, Vioxx maker says

By MARC KAUFMAN, The Washington Post

WASHINGTON -- The makers of the arthritis drug Vioxx, which was taken off the market last year, said Wednesday that they think all medications in its class carry the same increased risks for heart attack and stroke as their drug.

At the opening of an unusual three-day meeting of a Food and Drug Administration expert advisory panel, Merck & Co. officials said all COX-2 inhibitors, such Vioxx and Pfizer

Inc.'s Celebrex and Bextra, appear to increase cardiovascular problems in some patients.

The company's statement speaks to the central question at the meeting: whether there is a dangerous "class effect" for all COX-2 drugs, and, if so, what the agency should do.

Sales of the drugs, hailed in the late 1990s as a breakthrough in treating arthritis pain and aggressively advertised to patients, could be restricted or stopped as a result of the meeting.

… (the rest of the article is attached)
Source: Kaufman, Marc, (February 17, 2005). Merck cites 'class effect'. *The News and Observer,* A3.

Your company, Altanova, produces 1 or 2 prescription drugs in the COX-2 class. These drugs are not your biggest sellers, but they do generate healthy profits for the company.

Your team has been asked to prepare a 3-5 page white paper presenting the relevant background and issues from the perspective of your functional group. In addition, your team should summarize relevant strategy and planning issues related to the given scenario. Each team will make a 10 minute presentation to the CEO and to the other Vice-Presidents on March 17th, 2005. You can (and should) communicate with the other functional teams to ensure consistency and to share information.

In a subsequent offering of CHE 395, the students were allowed to select their own technical topic and prepare a 15-page paper and 15-minute oral presentation on their topic.

Connecting in the Senior Year: CHE 450

CHE 450 is the first of a two semester senior design sequence. In the fall semester, students learn about cost and profitability estimation, equipment sizing and costing, equipment sizing, heuristics for selection of separation processes, and heat exchanger network synthesis. They begin using computer simulation design and cost estimation programs. In October they are assigned to a senior design project which they will continue through the end of the spring semester. In the spring semester (CHE 451), students continue work on these comprehensive design problems which involve the interplay of economic and technical factors in process development, site selection, project design, and production management. A short list of representative projects is shown in the table below.

Typical Senior Design Projects
NCSU Department of Chemical and Biomolecular Engineering

"Traditional" Simulation-Based Plant Design Projects
- Optimization of Ethylene Oxide Production

Pharmaceutical-Based Projects
- Ethanol from Transgenic Sweet Potatoes
- Industrial Production of Beta-Lactam Antibiotics
- Citric Acid Production
- Generation of Fine Particles Using Supercritical Based Processes for Pharmaceutical Purposes
- Vaccine Production Expansion
- Facility Design: Bulk Pharmaceutical Manufacturing and Packaging

Food Science-Based Projects (Multidisciplinary)
- Carbohydrate Replacement Using a Soy Protein Derivative

Polymer or Other Materials-Based Projects
- CO_2 Assisted Depolymerization of Poly(ethylene)terephthalate

Electronic Material or Nanoscience-Based Projects
- Microfluidic Device for the Detection of *V. cholerae* in Drinking Water
- A Novel Design and Manufacturing Process for Dye-Sensitized Solar Cells

Green Engineering-Based Projects
- Biodiesel Synthesis from Waste Oils
- Elizabeth City Glass Recycling
- Residential Applications of Hydrogen Fuel Cell Technology
- Glycerin From Biodiesel
- Green Biodiesel Process Design

Student-Proposed Projects (students wrote a proposal and found a faculty or industrial sponsor for their own project):
- Design of a Continuous Process for Lotion Manufacturing
- Development of a Miniature UV-NIR Spectroscopy Apparatus to Detect Chemical Warfare Agents on a Real Time Basis

Senior design has always been an obvious fit for information literacy training because of the necessary research component associated with the design process. In CHE 450, librarians created an assignment for students to document their research process and to ensure that important sources of information are not omitted. The assignment, called the "research map," is very similar to a traditional library pathfinder, and is shown below. Through the research map, students reapply previous lessons (approaching a complex information problem, using core resources, thinking in a multidisciplinary way, citing sources) in a different context, and gain some experience in new areas, such as writing annotations, and working with patents and standards.

CHE 450 Assignment: Research Map

Topic definition and scope notes of the research map: Provide 1-2 paragraphs describing the topic (to be expanded in part B), the breadth and depth of coverage, and the audience this research map is intended for. Explain how this research map relates to your senior design project.

Introduction of topic: Write a one-half to one page summary of the topic that was researched.

Books available on this topic: Search the NCSU Libraries' online catalog (http://catalog.lib.ncsu.edu) and the WorldCat database (access from: http://www.lib.ncsu.edu/searchcollection/databases/) for books on your topic.

Part 1: Subject Headings

Provide a listing of Library of Congress Subject Headings recommended for use with this topic.

Part 2: Resources

Provide a listing (5-10 items) of relevant texts, conference proceedings, and major reference sources (handbooks, encyclopedias, dictionaries). Cite these books in APA format. Include a brief annotation with each item, describing what the book covers and why you recommend it. **Do not include generic reference sources such as *Encyclopedia Britannica* or *Webster's Dictionary*.**

Journals and Journal Articles

Part 1:

From the NCSU Libraries list of databases, http://www.lib.ncsu.edu/searchcollection/databases/, select 3-5 of the most important databases to use in searching. List these databases and provide a sentence or two describing their content, the dates they cover, and whether online access to the full text of articles is available.

Example: *This database covers business literature (scholarly and mainstream) as well as a lot of chemical industry trade literature. It includes full text of articles from 1997 to the present, and citations and abstracts of articles from 1986-1997.*

Part 2:

For each database, provide a listing of recommended phrases or keywords to search in that database. Also provide a listing of recommended subject terms (also called "descriptors" or "index terms") to use in that database.

Tip: *remember to search in multiple subject disciplines. You may want to consider many aspects of your topic (such as engineering, environmental, or business) and this should affect the search terms you use.*

Part 3: Recommended resources
From your research in the databases you identified, provide a listing of at least 5 highly relevant articles associated with your topic. Cite these articles in APA format, and provide an annotation with each.

Internet Resources

Part 1: List 2-4 recommended Internet search engines and the URL for accessing each search engine. When evaluating search engines, consider the following: quality of results returned, how many pages the search engine indexes, and whether the engine provides advanced searching options.

Part 2:
Provide a listing of at least 3 recommended phrases or keywords to search in these databases.

Part 3: Recommended resources
From your research in the search engines you identified, provide a listing of 3-5 of the best web sites associated with this topic. Web sites should be evaluated for accuracy, authority, perspective, purpose, currency, completeness, and relevance. Cite these web sites in APA format. Provide a brief annotation for each item, explaining why it is relevant.

Engineering Standards

Search the IHS Standards database (available from the Libraries' list of databases at: http://www.lib.ncsu.edu/searchcollection/databases/) for relevant standards. Provide a listing of critical standards associated with the research topic. Cite the standards in APA format (use the format for books). Provide a brief annotation for each item, explaining why it is relevant.

Patents

Search the USPTO web site (http://www.uspto.gov) and find 2 relevant patents on your search topic. List the patent number, title, assignee and classification codes associated with the patent.

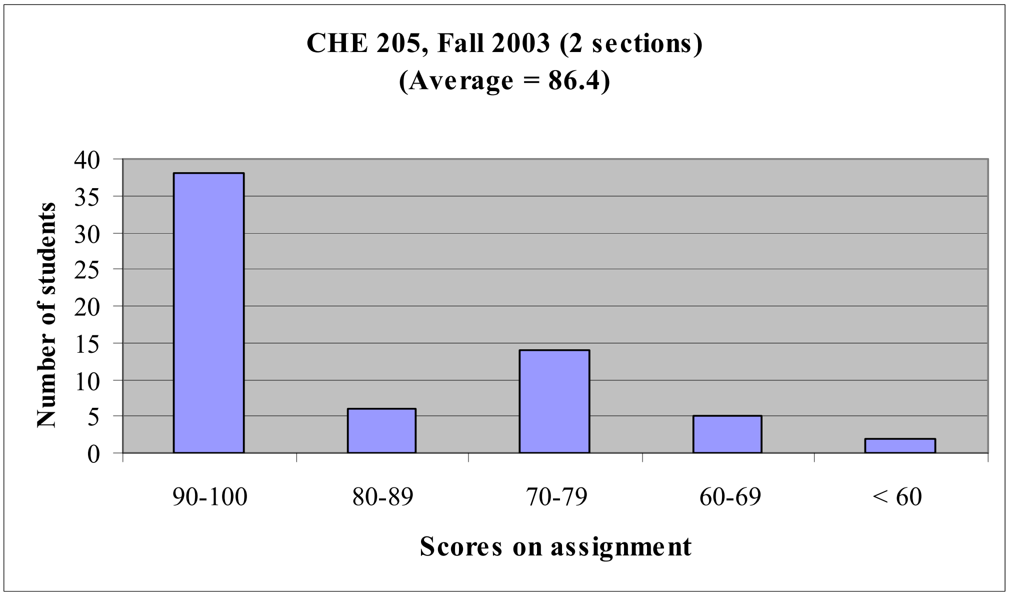
Assessment and Results:

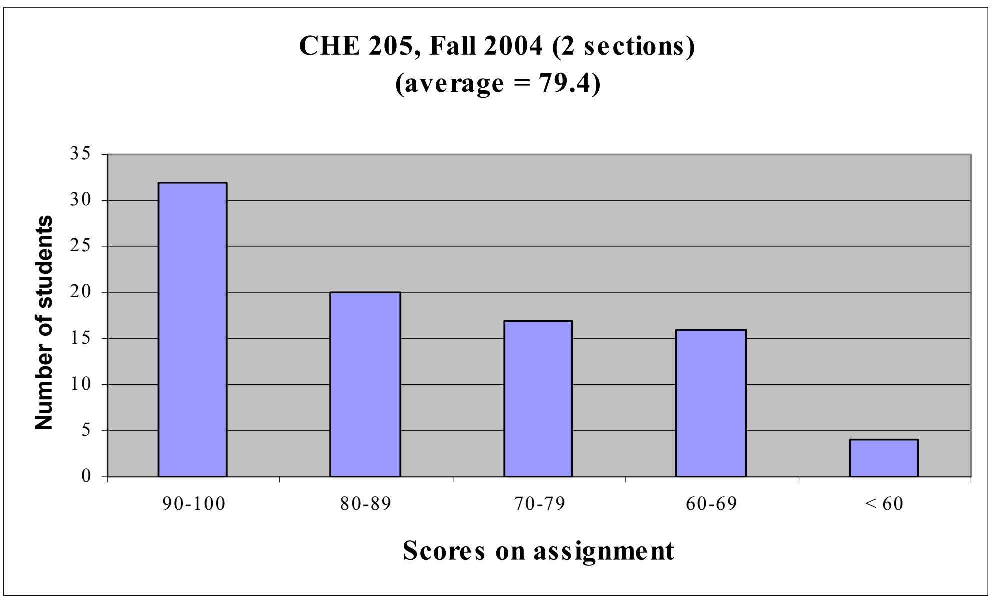
Assessment is, of course, an important part of any instructional program. It is also the part that can be easily overlooked -- or at the very least, viewed as secondary -- during the demanding and intense implementation phase of a big project. In a curriculum integrated instruction program, assessment methods need to be planned (and any associated tools created) from the very beginning, and considered a part of the whole concept.

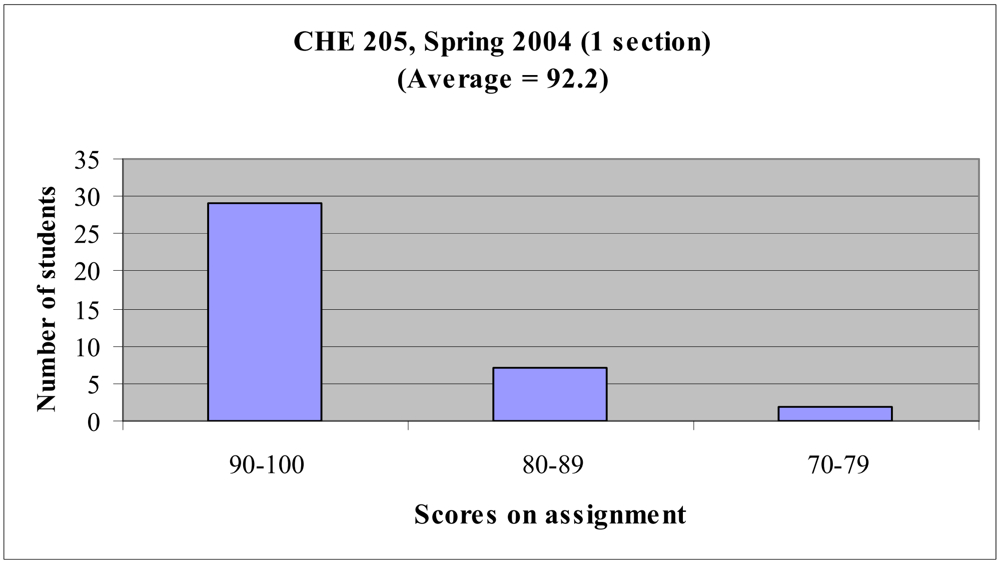
In looking at assessment for the curriculum integrated instruction program, NCSU engineering librarians first needed to define the "who," "when" and "what" of assessment. In terms of who, it was decided that data would be gathered at the sophomore and senior years. It was felt that assessing freshmen would not yield accurate data, because of the wide deviation in the level of information skills with which students enter the university. By sophomore year, it is hoped that some baseline has been established based on the content delivered in E101. In the early stages of implementing the curriculum integrated instruction program, it quickly became evident that every engineering department has a core course at the sophomore and senior levels that an information-oriented assignment would fit into. However, this is not always the case with the junior year. Since maintaining consistency across departments is a central philosophy of the whole program, no assessment is performed at the junior year. The need for assessment at the senior year was clear – this is the most desirable data, as it will provide information about the skills students are leaving the university with, and, once the program matures, it will provide the data to give a fuller picture of student information literacy.

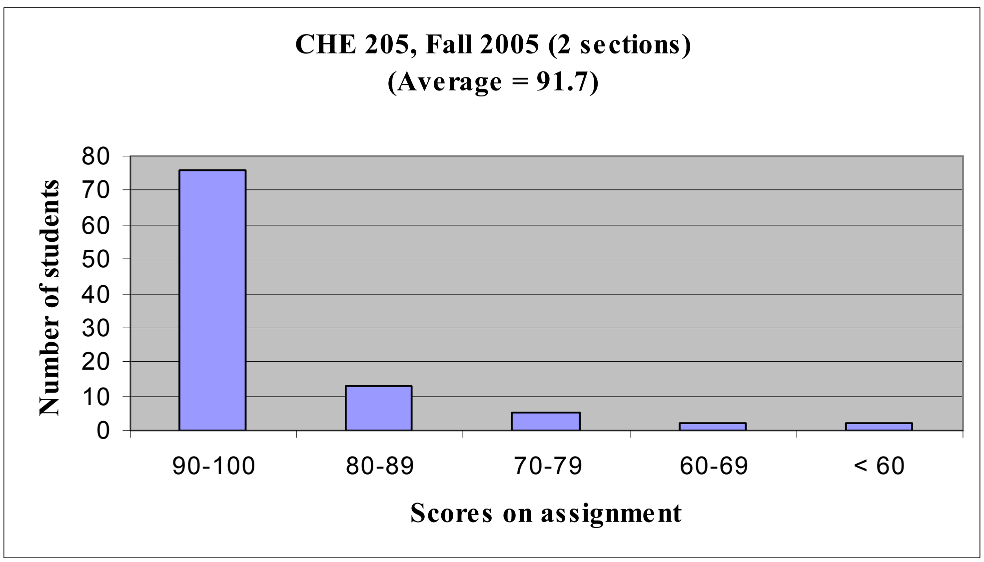
In keeping with that philosophy of consistency, the "when" was easily applied – every time the core sophomore/senior courses were taught, assessment would be applied. For CHE 205, this has meant both fall and spring most years; for CHE 450, it is fall semester only.

The "what" of assessment can be defined in many ways (and has been at NCSU). To this end, plans for assessing things like effectiveness of teaching, specific learning outcomes, etc. are underway. Since the purpose of the curriculum integrated instruction program at NCSU is to create information literate engineers, the first and foremost "what" of assessment is to measure the degree of information literacy. To define information literacy, in 2003, Nerz and McCord created an information literacy rubric.[12] This rubric is used to grade all assignments in the program, which allows for consistency in grading across courses and departments. The assignments, in turn, are carefully crafted to meet defined competencies and to be relevant to the course at hand. Using this structure, assignment grades can be used to determine students' progress and information literacy level. This first method of assessment has been applied throughout the program as it has been implemented thus far. Data has been collected for the CHE 205 and CHE 450 since the assignments were added to the courses. Data for CHE 205 is shown below (Note: data for CHE 450 is unavailable at this time).


CHE 205, Fall 2003 (2 sections)
(Average = 86.4)
Number of students
0
5
10
15
20
25
30
35
40
90-100
80-89
70-79
60-69
< 60
Scores on assignment


CHE 205, Fall 2004 (2 sections)
(average = 79.4)
Number of students
0
5
10
15
20
25
30
35
90-100
80-89
70-79
60-69
< 60
Scores on assignment





The figures above show that the average grades are generally trending upward --Fall 2004 is a bit anomalous because one section had a large number of low-scoring papers – almost 40% of the class scored lower than 69. This pulled the average down markedly. The other Fall '04 section had grades more consistent with the general progression, with an average in the high 80s. The steady decline in C, D, and F grades is promising; it is hoped that in future semesters, no student will get a grade lower than a B on this assignment.

Conclusion

This paper describes the highly successful collaboration between the NCSU Libraries and the Department of Chemical and Biomolecular Engineering. By linking information competencies to existing (or new) assignments related to class material, instructors and librarians have moved beyond decoupled instruction which is quickly forgotten, to "just in time," need-based content. From anecdotal experience, it appears that the CHE 205 assignment has the most impact on students because it is this assignment that they remember and talk about in the ensuing semesters. Once these students reach their senior design course, the majority of them are now prepared to face the extremely difficult and open-ended research problem that their project imposes. This is a marked difference from the information literacy level of previous years.

However, challenges still exist. Students rarely see the big picture when it comes to their education and "Why do I need to know this?" is a question with which every faculty member is all too familiar. Undergraduates don't think about lifelong learning. They are so focused on the end-product (getting a grade, passing a course, earning a degree) that they tend to see education as something with a discreet beginning and ending. It is only natural that this viewpoint would be applied to their education in information literacy as well. Students seem to most identify with the black and white definition of information literacy rather than the more evolutionary reality.

At NCSU, CHE 205 students often think they have learned all they need to know about information by the end of the course, and are surprised to see assignments in the years following. If the true success of an information literacy program is in creating lifelong learners, then helping students to see this broader context is a component that cannot be overlooked. It is important to provide this context as the assignments are given and one of the aspects we need to consider next is how best to articulate this within the assignments. This will help to round out the experience for the students, further strengthen their critical thinking skills, and reinforce the importance of process in solving complex problems.

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