AC 2007-1381: FOSTERING STUDENTS TO BE LIFELONG LEARNERS WITH SCIENCE LITERACY, INFORMATION FLUENCY, AND COMMUNICATION SKILLS

Jung Oh, Kansas State University-Salina

Jung Oh is an Associate Professor of Chemistry at Kansas State University at Salina. She earned her B.S. from Sogang University in Korea and a Ph.D. from UCLA. She was an ASEE postdoctoral fellow at Naval Air Warfare Center Weapons Division. She was 2004 Wakonse Teaching fellow and 2006 Peer Review of Teaching fellow at K-State. Her interests in scholarship of teaching include cross-curricular innovation.

Alysia Starkey, Kansas State University-Salina

Alysia Starkey is an Assistant Professor and the Technical Services/Automation Coordinator at Kansas State University-Salina. She earned her B.S. in Psychology from Fort Hays State University and obtained a MLS from the University of North Texas. Alysia develops instructional programs for the Kansas State University-Salina library.

Beverlee Kissick, Kansas State University-Salina

Beverlee Kissick is a Professor and Director of Libraries at Kansas State University-Salina. Beverlee earned three degrees from Kansas State University at Manhattan: B.S. in Sociology, MS in Curriculum and Instruction, and a Ph.D. in Educational Technology Library/Media. Beverlee is known for her presentations on Practical Humanities and Information Literacy.

Fostering Students to be Lifelong Learners with Science Literacy, Information Fluency, and Communication Skills

Introduction

How do we teach students to be lifelong learners? This paper shares a glimpse of how a science course instructor, librarian, and writing center staff have collaborated toward a common goal based on individual and collective teaching/learning outcomes. Science literacy, information fluency and communication skills are critical foundations for students in engineering technology programs to become lifelong learners. One of the assignments from a university general education chemistry course, taken mostly by students in engineering technology programs involves an integrated three-step process including a discipline-specific pre-lab activity, general/customized information literacy instruction, and communication skills development. This paper describes how the collaborating team has learned from each other's reflections to make the assignment a meaningful learning experience.

Librarians and faculty have been traversing on parallel paths during the past few decades. The rapid explosion of technological integration into nearly every aspect of daily life has merged the separate paths into one. Writing centers and libraries recognize their roles as centers of learning and the importance of collaboration.[1] Librarians, writing center staff and faculty must now travel in tandem in order to prepare students to become successful members of today's society. In the rapidly changing educational environment, this three-way collaboration and conversation creates new opportunities for lifelong learning, an essential 21st century skill. If students are to effectively contribute to today's workforce, it is imperative that they are capable of communicating, receiving, and evaluating the barrage of information from multiple directions. Highly toned information literacy skills are the key to unlocking the potential for lifelong learning.

The collaborators have chosen to focus on four of the TAC of ABET Criterion 2 Program Outcomes.[2] Those four outcomes suggest engineering technology program graduates should demonstrate:

- a mastery of the knowledge, techniques, skills and modern tools of their disciplines (2.a.)
- an ability to apply current knowledge and adapt to emerging applications of mathematics, sciences, engineering and technology (2.b.)
- an ability to communicate effectively (2.g.)
- a recognition of the need for, and an ability to engage in lifelong learning (2.h.)

If we expect students to engage in lifelong learning, questions to ask include how and where do we:

- learn to teach our students to be lifelong learners?
- communicate that outcome with the students?

In 2006, the association of college and research libraries (ACRL) developed information literacy standards for science, engineering and technology.[3] These standards are based on ACRL's information literacy competency standards for higher education.[4, 5] ACRL defines information literacy as "a set of abilities to identify the need of information, procure the information, evaluate the information and subsequently revise the strategy for obtaining the information, to use the information and use it in an ethically and legal manner and to engage in lifelong learning". One of the five standards by ACRL states; "the information literate student understands that information literacy is an ongoing process and an important component of lifelong learning".[3]

ABET criteria[2] and the American Chemical Society's committee on professional training (undergraduate professional education in chemistry: guideline and evaluation)[6] are two of three disciplines reviewed by ACRL for information literacy in science, engineering, and technology standards development. Chemistry, the central science, is an important component of many disciplines and a critical core science foundation course for engineering technology programs.

Information literacy and lifelong learning are interdependent with one another. They are viewed as major elements of working life today and unquestionably in the future.[7] Accrediting agencies and universities embrace lifelong learning as an important criterion for student learning outcomes in various programs. However, doing so without also mentioning the need for the integration of information literacy into all levels of a discipline curriculum is futile. In today's workforce, (where how you performed a function at your job last week isn't necessarily how you will perform it a week from now) knowing how to locate reliable information is essential.

Collaboration and Assignments

The concept of collegiality is discussed as one of most challenging and meaningful components of a successful collaboration relationship between teaching faculty and teaching librarians.[8] ACRL's information literacy web site presents many resources and ideas including collaboration examples from various schools.[9] ACRL points out carefully defined roles, comprehensive planning and shared leadership as requirement of successful collaboration. Respect for each party is important in order to reach the common goal, fostering successful student learning.

A chemistry teacher and librarians at a regional university have been collaborating since 2001. The focus of the collaboration is the integration of information literacy (or information fluency as preferred term by the collaborators) instruction into the existing course curriculum. The opening of a writing center at the campus in 2005 allowed for the chemistry instructor to broaden collaborative efforts in context-sensitive information fluency instruction.

The three-way partnership involving the course instructor, librarian and writing center staff uses general education introductory chemistry course assignments as a basis for their collaboration. The assignments are:

- a pre-lab search summary integrated with a context-sensitive information fluency lecture conducted prior to an inquiry lab on “chromatography”. The assignment includes required consultations with a librarian and the writing center.
- a search on “chemicals in consumer products” to evaluate their benefits and precautions.

In the “chromatography” report, students are expected to search for information on “chromatography” using electronic databases, the Internet, and/or print references, in order to learn how chromatography is used in various fields. Results are reported in a written summary in which students explain their search path, indicate the time spent researching information, provide a brief summary of information found, explain reasons for choosing sources and, reflect on their learning experience. In the “chemicals in consumer products” report, students are asked to find information about the chemicals they use everyday and to evaluate benefits and precautions of using certain chemicals.

The first stage of the assignment is the information fluency instruction with details as to the location and proper use of information resources within the course context. Students start with a pre-writing invention worksheet, which also serves as a brainstorming tool. This worksheet assists students in “pre-search” activities and serves as a recording journal of search processes. During the second stage of the assignment, students share the search report draft with the librarian during individual conferences. The librarian provides feedback and guidance on the student’s overall search process. The third stage involves a visit to the writing center. Students receive feedback on their summary report draft and complete any necessary revisions.

This assignment is designed for maximum flexibility; allowing students to research a chemistry concept within the realm of their respective disciplines. This not only leads students to further recognize how chemistry plays a role in their future career, but it affords them an opportunity to familiarize themselves with the professional literature and information repositories of their field.

Outcome and Assessment

The collaborator’s assessment process has evolved around interdependent overall pedagogical goals of each contributing unit (course instructor, librarian, and writing center staff). Student learning outcomes are assessed using the pre-writing invention sheet, report draft and the revised report on the learning process. The collaborators have refined the project process, the assignment guidelines, and the grading rubric based on reflective dialogues. For example, a librarian constructed a tailored chemistry section guide on the library web site to ensure students’ initial navigation stemmed from reliable resources. Base on collaborators’ reflective dialogues, the course instructor revised the student assignment guidelines and developed a pre-writing invention worksheet; a format which is more commonly used in writing courses than science courses.

Developing assignments based on collaboration allowed the group to link and communicate various course, program, university, and accreditation agency outcomes.

Table I shows how the chemistry instructor aligned her teaching objectives and student activities with the university's student learning outcomes, TAC of ABET program outcomes, and ACRL outcomes expected by the collaborating librarian.

Table 1. Faculty/Librarian Objectives and Student Learning Outcomes
Chemistry Assignment Example – Chromatography

Chemistry Faculty Objectives and Student Activities	University Student Learning Outcomes	TAC of ABET Eng. Technology Program Outcomes Criterion 2	ACRL Standards and outcomes
Integrate discipline specific pre-lab with science literacy, information literacy and communication skills to foster lifelong learning. Students search for information about how a particular technique is used in their majors, to write a report on their learning process reflecting on subject/discipline (chromatography/ chemistry), information management, time management, and thoughts on application for their life.	Knowledge Critical Thinking Communi-cation Diversity Academic and Professional Integrity	a. mastery of know-ledge, techniques, skills, modern tools b. adapt to emerging applications of mathematics, science, engineering and technology. g. communicate effectively h. recognition of the need for, and ability to engage in lifelong learning k. commitment to quality, timeliness and improvement	2.2.d. Constructs a search strategy using appropriate commands 3.1.a-c. Reads text, restates concepts in own words, quotes appropriately ACRL: Association of College and Research Libraries

The collaborators have surveyed student information fluency (or literacy) perception and confidence from 2004 to 2007, including pre and post survey in 2006. Table 2 on the following page presents the compiled survey outcomes. Overall awareness of library instruction, computer literacy, critical thinking, communication, ethics, and lifelong learning as information literacy components has steadily increased. The students' view of information literacy as part of lifelong learning has increased from 33.5 % to 69.1 %. However, relatively low responses of the ethics component indicate the need for further communication and instruction on teaching students to use information in an ethically manner. In spring 2006, 90% of the students answered in their post confidence survey that they were "very or somewhat" comfortable searching for information without given references, to evaluate the web resource, to use the database effectively, and to provide proper citations for a source.

Table 2: Student Perception Survey: Changes over Periods
Question: What does the term "Information Literacy" mean to you?
(Mark all that apply.)
A. Library Instruction B. Computer Literacy C. Critical Thinking
D. Communication E. Ethics F. Lifelong Learning

	Fall 04 Library (n=373)	F 2005 CHM Chemistry (n=30)	Sp 2006 CHM Pre (n=23)	Sp 2006 CHM Post (n=20)	Sp 2007 CHM Pre (n=23)
A Library Instruction	36.7 %	48.1 %	55.6 %	80.0 %	87.0 %
B Computer Literacy	47.7 %	66.7 %	77.8 %	80.0 %	91.3 %
C Critical Thinking	40.8 %	55.6 %	66.7 %	70.0 %	78.3 %
D Communication	36.2 %	40.7 %	74.1 %	75.0 %	78.3 %
E Ethics	19.0 %	14.8 %	37.0 %	65.0 %	39.1%
F Lifelong Learning	33.5 %	40.7 %	55.6 %	65.0 %	69.1%

The guiding goal of seamlessly integrating information fluency instruction into course curricula was accomplished via the development of the relevant course assignments and the project implement process. Previous semesters served as trial and preparation for conclusive integration. In spring 2004, the librarian offered the in-service lecture tailored to chemistry course assignments. In spring 2006, the course instructor/librarian team shifted to the transition toward total integration. Using materials prepared by the librarian, the instructor presented the details as to the location and use of information resources after which students would then sign up for individual conferences with the librarian to further strengthen their information literacy skills.

This integrated process produced two distinct advantages for the librarian collaborator. First, having the course instructor present the information not only integrates information literacy directly into course content, but it also solidifies the importance of the process in the students mind. The other advantage was the individual time students spent with a college librarian. This time allowed students to receive one on one training on the professional information resources available within the specific discipline (e.g. IEEE, Compendex, Applied Science and Technology Index). Many students had never been introduced to an academic database before, so time was also spent discussing the disadvantages/ advantages of peer reviewed resources and the Internet. A distinct improvement as to the quality of information students selected to assist in completing their assignment was shown in their final report. Table 3 compares the reported time students spent on the 'chromatography' assignment.

Table 3: Comparison of student self-statements on the time spent for "Chromatography"

	Time Spent	Collaboration	Instructor Observation
2003	1.5 hours		Over period, quantity of cited reference has increased; quality of search resources and path has improved.
2004 (Sp)	2.9 hours	Library In-Service Lecture	
2006 (Sp)	4.7 hours	Information Fluency lecture by faculty: Library and Writing Center face to face consultation.	
2006 (F)	8.7 hours		

Conclusion

As noted in the tables presented, student answers from the information fluency (or literacy) perception and confidence surveys are promising. However, we need to be cautious whether students are able to demonstrate information fluency skills and engage in lifelong learning beyond a mere self statement. Motivation is a key component in obtaining information fluency skills and participating in lifelong learning. It often takes time and patience to locate reliable information. Students should become familiar, and preferably proficient, in the use of the reliable information resources available for engineering professionals before graduation. Technological proficiency in the operation of professional literature database places these resources within a graduates "comfort zone" and increases their motivation toward revisiting them when an information need arises.

One student from a 2006 chemistry class mentioned the following in a report after searching for information using the IEEE database: "My initial thoughts of chromatography and electronics were that the only correlation would be manufacture of chromatography devices. I was surprised to find that the use of chromatography is becoming so instrumental in the reliability of electronic components and in particular semiconductor devices." When students are able to communicate similar experiences in their reports, it is apparent that instructional goals for students to be lifelong learners equipped with science literacy, information fluency and communication skill are met by students learning experiences.

The cross-curricular endeavors have amplified teaching effectiveness of each unit and have strengthened the collegial communication. The collaborators have learned from each other's reflections to make the assignment a meaningful learning experience not only for students but also for themselves. With respect and understanding for each other's role in student learning, the collaborators demonstrate their ability to engage in lifelong learning and foster students to be lifelong learners.

[1] Elmborg J.; Hook S. Ed. Centers for Learning: Writing Centers and Libraries in Collaboration. American Library Association 2005

[2] Criteria for accrediting engineering technology programs. October 2006, retrieved December 10, 2006, from ABET Web site: http://www.abet.org/forms.shtml

[3] Information Literacy Standards for Science, Engineering and Technology. American Library Association. 2006, retrieved February 26, 2007 from American Library Association Web site: http://www.ala.org/ala/acrl/acrlstandards/infolitscitech.htm

[4] Introduction to information literacy. February 2006, retrieved June 22, 2006, from Association of College and Research Libraries Web site: http://www.ala.org/ala/acrl/acrlissues/acrlinfolit/infolitoverview/introtoinfolit/introinfolit.htm

[5] Presidential committee on information literacy: A final report. January 1998, retrieved June 22, 2006, from American Library Association Web site:
http://www.ala.org/ala/acrl/acrlpubs/whitepapers/presidential.htm

[6] American Chemical Society (ACS), Committee on Professional Training, 2003, Undergraduate Professional Education in Chemistry: Guidelines and Evaluation Procedures, retrieved December 10, 2006:
http://www.chemistry.org/portal/a/c/s/1/acsdisplay.html?DOC=education\cpt\guidelines.html.

[7] Durisin P. Ed. Information Literacy Programs: Successes and Challenges. New York: Haworth Information Press. 2002

[8] Kraat S. B. Ed. Relationships between Teaching Faculty and Teaching Librarians. New York: Haworth 2005

[9] Information literacy in action: collaboration, retrieved February 2007, from Association of College and Research Libraries Web site:
http://www.ala.org/ala/acrl/acrlissues/acrlinfolit/infolitresources/collaboration/collaboration.htm