AC 2011-2370: INFORMATION LITERACY AS PART OF THE MATERIALS SCIENCE COURSE

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Information Literacy as part of the Materials Science Course

The Materials Science course is taught at an introductory level to a vast majority of engineering students at many institutions around the country. In one semester, it may be nearly impossible to cover all the information, with significant breadth and depth. To address this and give the students tools for lifelong learning, a project is assigned to students that include a paper and a poster. To give students research skills above and beyond Google or Bing searches, an information literacy session is integrated into the course. The instructor and the librarian collaborate to develop an exercise that provides the students with basic literature research skills, yet is focused on the outcomes required for this project. One of the two primary objectives in this collaboration with the library staff is to show students how to be more effective researchers. The other is to have students prove to themselves that a focused and directed search with library resources and methodology is easier and far more effective than randomly searching the web. Student surveys were also used to gage the impact on student's past, present, and future habits, as well as possible effects on their lifelong learning. Questions included personal comments on the sources of information which they selected, and insight on the value of the library session and the resources available through the library, including the personalized web page. The results yield continuous improvements to the information literacy experience and provide the students with research skills for the future.

The Materials Science course is taught at an introductory level to the vast majority of engineering students at many institutions around the country. In one semester, it may be nearly impossible to cover all the information, with significant breadth and depth. Therefore it becomes critical in this Materials Science course to give the students knowledge of the fundamentals of materials science and the tools for lifelong learning. Noting none are Materials Science majors, but students majoring in mechanical and industrial engineering, who at some point in their professional careers, will find the need to investigate problems or issues dealing with materials.

In this particular course, the instructor focuses on the 'language' of materials science, and the theme of 'processing, properties, microstructure', i.e., 'change one, change the other two'. With these ideas developed throughout the semester, students apply their knowledge to the literature search for a research project on an application and/or product of their choice. Built into this course is an information literacy activity to give students skills above and beyond Google and Bing searches. It is intended to expose them to a wide variety of technical resources to do effective and meaningful research for this project and ones in the future.

For most engineering programs this information literacy activity meshes well the ABET criteria[1], noting specifications in program outcomes, facilities, and support. ABET 2010-11 Criterion 3. Program Outcomes (i), (j) and (k) may be applicable. Quoting , "Engineering programs must demonstrate that their students attain the following outcomes: (i) a recognition of the need for, and an ability to engage in life-long learning, (j) a knowledge of contemporary issues and (k) an ability to use techniques, skills and

modern engineering tools necessary for engineering practice." The search engines, electronic data bases, value and uniqueness of paid subscriptions, surely fit the bill as modern engineering tools, along with a skill set to use them wisely. Using the library with its information infrastructure should be used to support scholarly activities of the students as it is put forth in Criterion 7. Facilities. Even this brief exposure in this Materials Science course reinforces the present and future value of information literacy skills and helps to "encourage professional development and professional activities" necessary in the engineering profession, again from Criterion 7. And as referred to in Criterion 8. Support, the students become acquainted with the support personnel (the librarians) and with the institutional services (the library). They are valuable assets to our students, and a necessary support service to our engineering programs.

OBJECTIVE OF STUDY

One of the two primary objectives in this collaboration with the librarian and her staff is to instruct students on how to be more effective researchers. The other is to have students prove to themselves that a focused and directed search with library resources and methodology is easier and far more effective than randomly searching the web.

The information literacy activity in this Materials Science course is comprised of four components:

1) topic selection (student's choice),
2) assignment outlined by instructor,
3) information literacy session prepared and presented by the librarian, and
4) information sharing and reporting by the students.

Topic selection

Students choose a topic on an application and/or a product matching their own personal interest. With the instructor's approval, they can proceed with the assignment. Approval is required for two reasons. The first is to keep students focused on a very specific topic, for example, the instructor will say *no* to 'materials used in a car' versus *yes* to 'the material used for the engine block', or if golf clubs are of interest, the instructor can suggest different parts of the club such as driver head, putter, or shafts of carbon fiber, titanium or steel. From experience, this step is well worth it because it avoids repeats in the poster session.

Assignment

The project is a research paper composed from information acquired in the literature search, and an accompanying poster presented in the poster session, which is held during the last week of class. Poster always seems to get done first, even though the requirements are stated in much more detail for the paper. The level of the technical literature is selected to match the capability of students just completing the Introduction to Materials Science course. It is highlighted in Table 1. The overriding message here is to have the students apply their knowledge and new vocabulary in materials science to educate themselves, and subsequently their peers. The vocabulary must be used correctly, with all new terms and concepts defined explicitly. The instructor gives verbal

instructions, which are stated as follows, “If you think, I will think, you don’t know what it means, write the definition in the text, footnotes, or glossary of your report.” Another way the instructor phrases the ‘spirit’ of the project to students is to say, “If I (instructor) was your boss, would I feel comfortable letting you work on this project? I have experience, but I expect you educate yourself based on the new knowledge you acquired in the course. Understand the literature you are quoting or referencing, and build on it!” This illustrates a lifelong learning skill applicable to any project encountered, by them, in their future professional life.

The contents and requirements for the paper are as follows. The *abstract* is 1-2 paragraphs in length and states the problem. It also contains the most pertinent facts or observations about the work, and the role of material science and engineering in your application and/or product. The *introduction* brings the reader up to speed on your topic and contains the general theory or principles in 1 page. The *discussion* section includes information supporting the theme of the course, ‘PROCESSING – PROPERTIES-MICROSTRUCTURE’, elucidated in your investigation in 5-8 pages of text plus figures using 12 point font and 1.5 line spacing. Some examples, to be included in the body of the report (and on the poster) are: schematic diagram or flow chart of the manufacturing process; primary variables in the process; the equilibrium phase diagram; the crystal structure; the basic polymer structure; typical micrographs of the structure; tensile strength; yield strength; effect of temperature; other principles discussed in class. In 1 page, the s*ummary* highlights the most important aspects of the project and the interrelationship of the ‘processing – microstructure – property’ in the application.

The poster presentation [2] is setup to have students share their work with each other in a relaxed, informal setting. In the spirit of peer-to-peer education, the students were asked to create a poster that would attract attention and draw someone in to talk to them about the ‘processing-properties-microstructure’ in their application and/or product. All sources of references must be cited including pictures, figures and tables. The posters carried few formal specifications, except the 20”x24” size of a single PowerPoint slide, and were professionally printed. Although some students were annoyed by this lack of specificity, it does promote individual creativity and diversity in appearance.

The list of references supports and documents the effort put into the literature search. Adding references to the posters creates a point of discussion amongst the students and allows students to compare ‘stories’ on their literature search. It also reinforces the value of the information literacy session as well as another exposure to more sources of technical information. Standard MLA referencing conventions are required in both the paper and poster.

The grading and categories for assessment of this project are summarized as follows. Paper is graded using the following percentages: 75% for contents of the report, 15% professionalism and appearance, 5% references, and 5% abstract. The poster and participation in the poster session is graded using these percentages: 30% technical content, 20% presentation, 50% student evaluation. Noting this project is worth 15% of the total course grade, the equivalent of an exam grade.

Information literacy class with librarian

The instructor and the librarian have collaborated to develop a 50-minute class that provides the students with basic literature research skills, which are focused on the outcomes required for this project. The librarian has developed a webpage with active links to applicable references, articles and databases, and books and media available at the college. The resources are summarized in Table 1, with the most widely used highlighted with boxes. An active link to this webpage is posted on the library's website as well as in the student's virtual classroom. Classroom instruction uses specific materials related examples to show students the different types associated with the various information sources. The ease of use is stressed, especially over Google and Bing, and time is allotted during class to be sure students try it for themselves, accessing information pertinent to their product or application.

Table 1. Summary of Webpage – Selected Materials Science Library Resources

Materials Science (Authored & compiled by librarian[3])

How to use this guide→ Home - Off Campus Access to Library Resources

The college community may access digital Library resources from off campus with their Library bar code and pin. Read more detailed instructions for off campus access.

Selected Materials Science Library Resources

**** Reference Tools** contains print and digital resources that provide an overview and starting point for your research as well as specific statistical and data resources.

Encyclopedia of Materials Science and Engineering - An overview of various materials for engineering.

Handbook of Materials Selection

ASM Handbooks Online - "ASM Handbooks Online features the complete content of twenty one ASM Handbook volumes plus two ASM Desk Editions."

Knovel Handbooks - Collection of searchable full-text science and engineering reference books. Many of the books are enhanced with interactive capabilities such as interactive tables, graphs, and equations.

**** Articles and Databases** provide links to specific to our Library databases which contain information on International Management issues. Many of the databases contain full-text articles. Student authentication is necessary for off-campus access.

Journals A-Z Search for journals, magazines and newspapers available through Library

Search Engines - Google scholar **http://www.google.com/scholar**
Provides access to scholarly citations and some full-text.

Databases

- **Compendex** -- 1970 - present, updated daily. Indexes and abstracts articles appearing in engineering journals, technical reports, and conferences.
- **Knovel** - Collection of searchable full-text science and engineering reference books. Many of the books are enhanced with interactive capabilities such as interactive tables, graphs, and equations.
- **Patents** - Search http://www.google.com/patents Search for patents by topic, inventor, or company.

** **Books** provides links to Library's collection of print and digital books, DVD's, CD's and videos as well as links to other libraries worldwide. Use Interlibrary Loan to access books from remote locations. Includes a link to "Search Google Books"

WILDPAC, the search engine for the Libraries, searches the print and digital collections provided by the college libraries. (Includes active link for college.)

** **Recommended Web Site** contains free web sites selected and recommended by the Librarians and faculty of college.

ASM International - http://asmcommunity.asminternational.org/portal/site/www/About/
Our first meeting in 1913 brought a handful of steel heat treaters together. Today, the members of ASM International continue to share information and ideas that advance the study, development and application of materials and processes.

Information sharing and reporting

Quality technical information leads to quality poster presentations and written reports. In the poster session, students were required to teach each other about their own product and/or application, drawing them in with an attractive poster and keeping their interest with solid technical information. The poster session runs for two hours (with breakfast provided by the instructor) and with formal presenter/evaluator schedules and evaluation sheets. From observation and instructor's experience, this formality allows the students to look for the vocabulary unique to materials science and for technical references cited in each other's work. For example, it is encouraging hearing students discussing the microstructures found in the ASM handbook or the properties of a polymer form a reference located in Knovel, and leaving Google images as a source to find really great pictures of their product and/or application. Papers reflected similar use of new and old vocabulary, references with proper citations, and complementary pictures.

SURVEYS
Student surveys were also used to gage the impact of a directed and focused information literacy activity on student's past, present, and future habits, as well as possible effects on lifelong learning.

Questions included personal comments on the sources of information which they selected, and insight on the value of the library session, and the resources available through the library, including the personalized web page. Fifty-four students participated in two sections of this course and fifty surveys were returned. Responses were grouped together and reflected in the general categories below. Qualitative results organized by most to least popular student comments with number of responses in parentheses. No quantitative survey was conducted.

Results / Responses
Question 1. *As you look back to the start of this project and work you did to put together the final posters and paper, please comment on the sources of information you used for your investigation.*

1a. Starting point for research

Frequency Stated	**Sources** (# of responses)
most	General library online; General databases; library sources (15)
	Google; internet
	Google search with specific sites (e.g. corporate education sites, professional society sites)
least	Wikipedia (realize not good) but dug deeper

1b. Sources of information

Frequency Stated	**Sources** (# of responses)
most	ASM Handbooks ; alone or accessed from web page link(17)
	Knovel Handbooks ; accessed from web page link (16)*
	CES Edupack Materials Selection software (Granta Design) ; available on lab computers (13)
	Google search with specific sites (e.g. corporate education sites, professional society sites)
	Industry sources form relatives, internships (5)
	Text book; on-line with WileyPlus (4)
	Journals (4)
	Google books (3)
	Google patents (3)
	Google scholar (2)
	Books, printed (2)
	Compendex (library search engine) (2)
	Interlibrary loan (1)
least	YouTube (1)

*****Some students had trouble with Knovel source in the course of their research, which appeared to be topic related, inexperience with the database, and dealing with the college's limited subscription or remotely accessing the database from an off-campus location.

Question 2. *Please provide your insight on the value of the library session and the resources available through the library. Thoughts on …..the web page? ..…most helpful? ……least least helpful? ……....suggestions for future sessions?*

2a. Overall Student Opinion

Frequency Stated	**Response** (# of responses)
most ↓	Spending a class period learning how to use the library resources was very helpful, good idea, useful (35)
least ↓	Gained skills- use of key words; familiarize with facilities and resources; search techniques with key words (3)

2b. Thoughts on …..the web page?

Frequency Stated	**Response** (# of responses)
	Library webpage with links to literature resource ** (15) Easy to use (6) → Hard to use (3)

** *Student comments:*
✓"It was also easier because I didn't have to go to the library and break my back carrying around borrowed books."
✓"The data is well organized and the articles are all about the subject searched for, unlike looking through Google."

2c..…most helpful?

Frequency Stated	**Response**
most ↓	Library web page ; general library online
↓	ASM Handbooks
↓	Knovel database (see note above *)
least ↓	Books, printed, from library

2d……least least helpful?

Frequency Stated	**Sources** (# of responses)
most	Library web page ; general library online (6)
	Library session did not help but good refresher (1)
least	Trouble with links but did not attend class (1)

2e……...suggestions for future sessions?

Frequency Stated	**Sources** (# of responses)
most	Better directions for accessing webpage remotely (6)
	Will use in further projects ***
	Will use it in the future
least	Better resources for plastics

*** Student comments:*

✓"I would tell future students to pay attention when you go to the library and learn to use the system because it was a huge help in the project. The internet has a lot of garbage and this site gets you to Knovel and other sources where you can find good information."

Question 3. *Take a moment to reflect on your experiences during our poster session and writing this paper. Please comment on your learning experiences.*

Frequency Stated	**Sources** (# of responses)
most	Learned a lot (39)
	Learned a lot from others / peers (20)
	Understand my material a lot better (11)
	Applied the concepts learned in class to a life situation (9)
	Use vocabulary learned in class (8) ****
	Improve presentation skills (5)
	Being able to go into depth in the paper (3)
least	Create a study guide from notes and book to understand topic

**** *Student comments:*

✓ "I liked how the poster allowed me to apply the terminology and knowledge gained from the materials science course. It also gave me the opportunity to present my research to fellow students who understood the terminology."

✓"After preparing for the poster session, writing the paper was a breeze!"

✓"The poster is a good presentation to do as well except I would recommend having the paper due first and have the student make a poster from their paper."

Miscellaneous insights from students

Favorite: ✓"This was actually one of my favorite projects that I have done so far in my college experience. It's not very flashy or hands on, but what I really liked about it dealt with how it was set up. First of all, this project was hinted on so early in the semester, it is very easy to take

advantage of the long time frame available to start gaining an interest for certain materials. I didn't necessarily take advantage of the time frame, but what else made it very interesting was that it was open to the student. Not once was there a guideline or an example of this poster project shown, which at first I hated because it meant I had to take so much more time to figure out what I can fit into it and what is more important than the other information that I got. Ultimately though, this created such a large array of projects from all of my peers, and that is what really made it stand out to me, everyone had something that looked fresh and original and not just a rehashed outline that was set to follow."

Insightful:✓" It was also cool to see how much we learned comparing our wanted posters to the new posters. " (Wanted Posters was an assignment during the first week of the semester.)
✓"Posters are good as time and effort put into them."
✓The paper was much easier to write for this class due to the resources that were available.
✓"I think this paper was very interesting to do, and to see how all the terms we have learned in material science all year come together. I think material science is a very interesting course and the paper was a great way to reflect on this year's learning."

Overall activity: ✓Numerous students …." relaxed setting made it more enjoyable to see everyone's work…" ……"a better way for students learn something new"….. "enjoyable learning in poster session."
✓"I feel like it was almost like a PowerPoint on steroids and it was fun designing the layout for it."
✓" I would recommend that the structure of this assignment remain the same for following years. It was a good way to get students involved in material research in an application of their interest."

SUMMARY AND CONCLUSIONS

The information literacy activity has given students a new awareness of the different levels and variety of technical resources available to them now and in the future. The just-in-time library instruction for this project, which had a significant impact on their course grade, got the student's attention. Responses to question #1a show the students utilized the web page (with links to resources) developed by the librarian and with the responses to question #2a, show the instruction was very helpful. As indicated by response in 2b, the web page was also relativity easy to use, unless you didn't attend the session. Additionally, the responses to question #1b indicate the students favored the links on the web page, noting the ASM Handbooks and Knovel database most useful and Google sources were 'qualified' with a specific sites such as Google Scholar, Books or an educationally oriented website sponsored by industry or a professional society. The student comments and responses to question #3 support the value of the overall activity, noting students clearly stated that they 'learned a lot' and 'learned a lot from others'. Although mixed into responses to several questions and student comments, students suggested that they would use the web page and technical resources again in the future. Recommendation by several students for more instruction on remotely accessing Knovel and other college databases from off-campus locations will be addressed in the next semester.

Collaboration between the instructor and the librarian shows promising results that the students are better technical researchers after completing the materials science course. They, themselves, comment on how much they learned and were able to share with their peers. Pushing the students to connect their course work to a forward looking project, i.e.,

literature research on an application and/or product of their choice, gives students skills to promote lifelong learning.

Future work will focus on one of the 'insightful' student comments, which allows the students themselves to see their growth in learning throughout the semester. In the development of future assignments, information literacy skills will most likely play a key role in their content. A more quantitative assessment study of student's growth through this information literacy activity should be implemented, possibly comparing the 'Wanted Posters' assignment [4] (mentioned in a student response) to the formal posters completed in this activity. And continued diligence to move students away from Google and Bing searches, can tap into their need for information, yet refocus their efforts toward accessing good quality technical information as they grow in their engineering careers.

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