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Re-tooling Information Instruction Delivery and Assessment for the Freshman Engineering Class: the Good, the Bad and the Ugly

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Re-tooling Information Instruction Delivery and Assessment for the Freshman Engineering Class: the Good, the Bad and the Ugly

Abstract: Engineering librarians at West Virginia University taught the majority of the freshman engineering students in both semesters of the 2011/12 academic year. Three in-class sessions were developed and delivered to over 800 students. Students were requested to complete online assessments to measure their information literacy knowledge pre- and post-instruction. The instructors were generally positive about the experience and were happy with the papers produced. One consistent complaint from instructors was they had to give up three class sessions. The librarians were concerned that more students did not take assessments connected with class sessions. During the course assessment and revision process for fall 2012, librarians worked with instructors to devise ways to deliver the same amount of information without using three class sessions. The librarians taught one session during week three, offered an out of class experience (OCE) in the library instruction room during weeks five, six, eight and nine (multiple sessions were offered to accommodate student schedules) and provided one online module on Intellectual Property to be completed in weeks ten to eleven. Paper or online pre- and post-assessments were provided for each session to see what was known at the beginning and the end of each session. Students also completed a graded plagiarism tutorial and quiz. The assessment results have been much better. This paper will focus on the changes in the information sessions and delivery methods, provide assessment data for each area, and chronicle the steps taken to set up this successful collaborative effort with the engineering instructors.

Introduction

The opportunity to teach library information literacy skills to all freshman engineering students in ENGR 101, Engineering Problem Solving I, began in spring 2011. Planning effective teaching modules required collaboration with the Assistant Dean of Freshman Experience in the engineering college and the freshman engineering professors to define content, identify logistic problems and solutions to those issues, and address the inherent challenges of teaching both freshmen and engineering students. Because of these different filters, the class was developed in consideration of the ABET and ALA/ACRL/STS standards[1]. Additionally, ENGR 101 has evolved over time through continued collaboration with the ENGR 101 professors.

In spring 2011, an Information Literacy grant was given to the Assistant Dean of Engineering. This grant enabled the two engineering librarians to develop curriculum to be included in all ENGR 101 classes to address library information literacy. During the 2011/2012 school year the engineering librarians reached over 900 students. During the 2012/2013 school year the engineering librarians reached over 1,000 students. In the fall 2011 implementation, the engineering librarians visited all sections of ENGR 101 three times. Although professors were enthusiastic about including library information literacy skills in ENGR 101, they did not want three class periods spent teaching information literacy, so the number of classroom visits was reduced for the 2012/2013 academic year.

As part of the ongoing collaboration with the ENGR 101 professors, during the summer 2012 two librarians, one administrator, and two professors met to discuss how the information literacy

would be integrated into the fall sections of the course. The pre- and post- test formats were kept to allow data collection for program assessment, but the lesson plans were modified to incorporate a variety of content-delivery platforms and methods.

Because of the feedback from the professors last year, three sessions were presented as before, but only one during class time. The in-class session covered an introduction to information. The second session was held as an "Out of Class Experience" (OCE) at the Evansdale Library. During this time the librarians showed the students how to use information tools, and students completed a worksheet requiring them to use information tools to identify books, articles, and technical reports related to an assigned topic. The third session covering Intellectual Property was developed into an eCampus (Blackboard) online module.

Developing the Curriculum

According to the fall 2012 syllabus in eCampus, the goal of ENGR 101 is to teach students "to think like an engineer" and to "provide a solid foundation in fundamental skills needed for beginning engineering students to succeed academically and professionally prepare for challenges in a technologically changing world."

Engineering students need to be provided with relevant information; and classes and assignments must be viewed as a means to a goal. In fact Hsieh and Knight[2] showed that Problem Based Learning "(PBL) has proved to be a superior tool that bridges the gap between theory and practice in engineering education." Additionally, the goal of lifelong learning is part of "Criteria For Accrediting Engineering Programs" ABET Student Outcomes Criterion 3i.[3], Strife, et al[4] incorporated the ACRL/STS standards[1] with the ABET Criteria into Oakleaf's table[5]. A new table was created and appears as Appendix A. Table 1 is included to show what the outcomes were for these freshmen. Quigley[6] describes the differences between lecture and active learning formats in the engineering classroom. He found that the more interactive classes were more interesting for the students. He also warned about introducing too much content. Holmes[7] describes an interactive model for a library instruction section for a large enrollment engineering course. The library session was geared specifically for Rensselaer's engineering class. At West Virginia University, ENGR 101 does not have one project but multiple projects throughout the semester. Bracke and Critz[8] point out that engineering students have "active hands-on participation in their learning experiences." Additionally engineering students need basic information skills as well as evaluative and searching skills. At its best, the information would be highly relevant with time-saving devices.

In addition, reaching freshmen presents its own inherit challenges. Freshmen are just learning how to function in a university setting. Coombes and Anderson[9] point out that among other things "for online learning to be a satisfying and successful experience for students, information and expectations need to be transparent."

Large classes present additional challenges. Vander Meer, et al[10] emphasizes the importance of active learning and interactive exercises even with large class environments. Verlander and Scutt[11] found that active learning including interactive teaching methods are effective with large lecture groups.

In order to create a relevant learning environment the engineering librarians provided (1) a lecture with class exercises, (2) an OCE with a participatory worksheet with relevant areas, and (3) an eCampus module with an independent learning environment. eCampus also provided a way to manage testing. Many of the exercises were geared toward the students' production of technical reports throughout the semester. Accountability was addressed by testing in eCampus, including information literacy questions on the midterm; for the OCE,sign-up forms, attendance checks, and worksheet completion helped provide accountability for students. Outcomes for engineering students included knowing how to evaluate an article, being able to appropriately cite an article, being familiar with four source databases for engineering research, understanding plagiarism and how to avoid it, and being able to identify four types of intellectual property.

ALA/ACRL/STS Standard	**Outcome**
Standard 1. The information literate student determines the nature and extent of the information needed.	Distinguishes different types of information.
Standard 2. The information literate student accesses needed information effectively and efficiently	Completes exercises using different information types: books, technical reports, articles and handbooks. Learns how to cite in MLA format. Familiarity with four source databases. Finds information in a handbook.
Standard 3. The information literate student critically evaluates the procured information and its sources, and as a result, decides whether or not to modify the initial query and/or seek additional sources and whether to develop a new research process.	Evaluates information using ABCD mnemonic.
Standard 4. The information literate student understands the economic, ethical, legal, and social issues surrounding the use of information and its technologies and either as an individual or as a member of a group, uses information effectively, ethically, and legally to accomplish a specific purpose.	Knows four types of intellectual property. Understands the difference between common knowledge and not so common knowledge. Understands plagiarism and how to avoid it. Incorporates citations in technical reports.
Standard 5. The information literate student understands that information literacy is an ongoing process and an important component of lifelong learning and recognizes the need to keep current regarding new developments in his or her field.	Recognizes the importance of using library information and the need to keep current with this ever changing and expanding field.

Table 1. Standards and Outcomes.

Developing the eCampus Modules

Because of the arduous task last year of uploading each session's links and quizzes into each eCampus section individually, the librarians asked for access to the class template for all of ENGR 101. Partly because of this request, the Assistant Dean for Freshman Experience appointed a professor to be in charge of reorganizing the grade book and assignments for the entire class. The professor, in turn, had a student assistant do the technical uploading of documents to the eCampus template. Decisions about the content, format, and dates had to be decided before the meetings. It was possible to migrate some quizzes and links into the new template, but some of the content for the Intellectual Property module had to be broken up and converted to PDF files. The student and librarian succeeded in inputting all the information into the course template in two two-hour sessions. While this was not an enormous time savings, it did allow all the work to be completed before the semester began. For the spring 2013 semester, the librarians were invited to December discussions about the class. The librarians were able to put the material into the course template for integration into the overall class template.

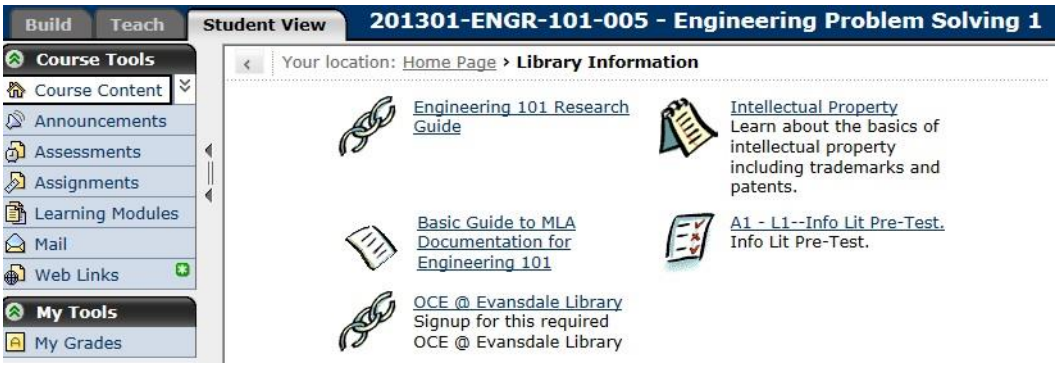

Figure 1. eCampus. ENGR 101 Library Information Course Content.

Developing the IP Module

The Intellectual Property module in ecCampus was composed of six sections and introduced students to the basic concepts of intellectual property, how intellectual property can affect an engineer, trademarks, and patent searching. The first section directed the student to read an article on eReserve by Rockman[12] which describes intellectual property concepts useful to engineers. The second section provided an introduction to intellectual property via Power Point presentation. The third section involved an exercise identifying trademarks. The fourth section provided an introduction to patents. The fifth section involved an exercise for searching patents, and the sixth section required student to complete a quiz on intellectual property which included questions from the reading as well as from the other sections of the module. Unfortunately, some course sections did not use eCampus consistently, so data was only able to be obtained for four of the seventeen sections of the course from fall 2012. The average score for the four class sections was 12 of 15.

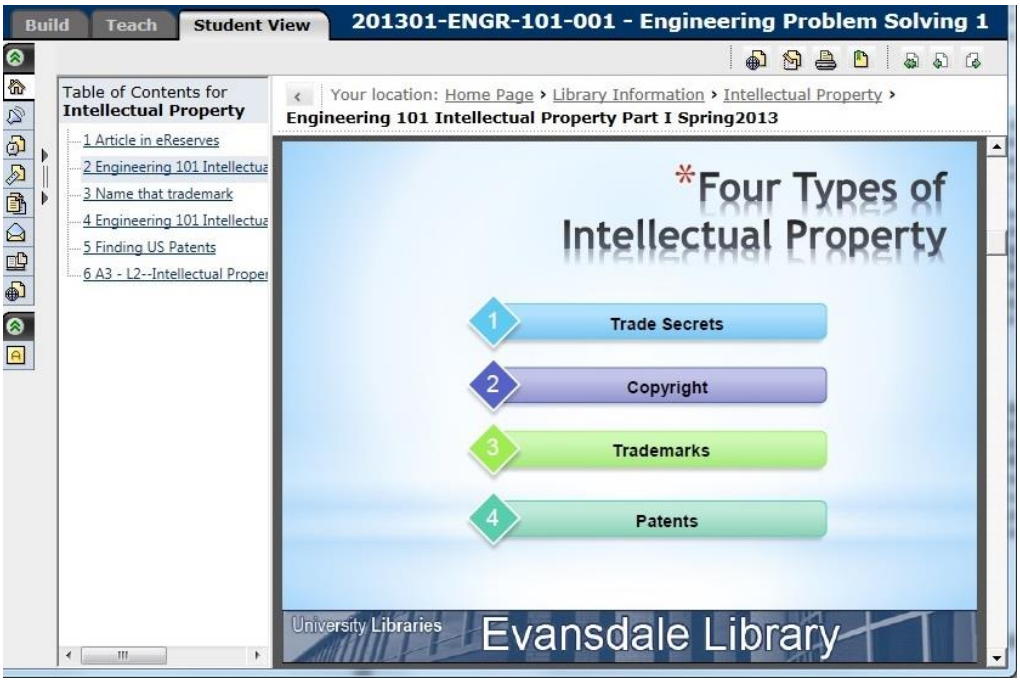

Figure 2. eCampus. Intellectual Property Module.

In-Class Session

The in-class session, called "Introduction to Information," covered not only basic library information but also an introduction to the proper use of information. Parts of the session included basic library webpages (including LibGuide); an exercise about when to quote a source; a discussion about the worldwide web resources and Wikipedia; the importance of evaluating resources as well as a mnemonic device to remember evaluation keys; a class exercise to identify different types of citations as well as parts of a citation; and a brief introduction to Summon (WVU libraries' discovery service).

Each student had a computer and was encouraged to follow along with the librarians as they navigated the library website and located various resources. During spring 2013 this segment was also used as an opportunity for the students to sign-up for the OCEs. Since the sign-up was in the LibGuide, the students had a chance to find the LibGuide for ENGR 101and complete a task using it. During the "Quoting Sources" section librarians introduced the concept of common and not common knowledge. Examples were given and students were called on to say whether something did or did not need to be cited (e.g., the high sugar content in candy would be common knowledge, but the exact amount would not be common knowledge.) In order to introduce resource evaluation, the ABCD mnemonic device by LaGuardia[13] from Harvard was employed, A—Authority, B—Bias, C—Currency, D—Documentation. Finally, citations were introduced. First the different types of formatting (MLA, APA, Chicago) for an article were illustrated, highlighting the different placement of parts such the date placement. Then students were shown different citations and were asked to identify the different parts of the citation (e.g., who is the author?) and also the source (article, book, conference proceeding, government document). Finally, a few searches were demonstrated using Summon, with students invited to search at the same time.

The OCE Assignment

To promote an understanding of life-long learning and to provide opportunities for students to engage with practicing engineers, learn about the various engineering disciplines, and improve their student success skills, the Freshman Engineering Program requires first year students to attend activities such as department visits; lectures given by distinguished alumni, practicing engineers, and industry representatives; student success seminars; and other activities related to a facet of engineering. These "Out of Class Experiences (OCEs)" comprise a small portion of the grade in each first year engineering course.

An "Information Tools" presentation and assignment was developed as a required OCE for ENGR 101. Students attended an interactive work session at the Evansdale Library. Following short presentations describing how to use available tools to search for information, students searched for information on a specific topic using a variety of source types. Thirty-two topics based on the Evansdale campus library collection were selected (and checked against subject headings) so that each student had an individual search topic. For each topic the student searched for a book, journal, technical report, and journal article. Additionally, the student had to search for graph in a specific book (either in paper or electronic format.)

The book section highlighted the use of the libraries' online catalog and the use of subject headings. Initially, the librarians thought students could locate a physical book. As the classes evolved it was decided to emphasize electronic books, both due to time constraints and the increased availability of electronic resources in proportion to those in print. . Finding a journal on their subject was likewise eventually dropped because of lack of time. For the technical report section, the librarians highlighted both the U.S. Department of Energy's Information Bridge as well as the Society of Automotive Engineers (SAE) Digital Library. The Engineering Village's Compendex served as an introduction to finding articles on a topic. Facets were demonstrated as well as following links to full text articles. Knovel was highlighted to show how technical information could be retrieved from full text resources. Students then had to find a graph in a book which was available electronically as well as in paper. Most students were able to complete the assignment in class, if not; they were given several weeks to complete the assignment. (For a copy of the worksheet see Appendix B.) Areas for improvement for the OCE included reducing the number of questions and using exclusively electronic resources for the assignment. In spring 2013 students provided citations in a fill-in-the-blank format in MLA order.

Signing up for OCE

The librarians decided to employ the survey function in the course LibGuide to handle sign-ups for the OCE. The librarians had two primary reasons for employing the LibGuides. First, seating was limited to 30 in the library's classroom and most ENGR 101 sections had 45 students enrolled. Students could not be signed up by section, but rather by times they were available outside of class. Second, the LibGuide provided librarians with the ability to set up and change the registration process as needed. Often setting up a survey or registration requires going through several levels of library bureaucracy (including webmasters and systems departments), and the LibGuide could be handled directly. As shown in Figure 3, a form template was created

in which students would enter their name, email address and section. The OCE times were listed, and then the student could choose a first and second choice from a dropdown menu. These responses were sent to the librarians and the administrative assistant who compiled the list for the time periods and sent confirmation emails. To accommodate classroom capacity and student schedules, a total of 40 OCEs was scheduled for fall 2012. In spring 2013, fifteen OCEs were scheduled to accommodate over 1000 students. Evening sessions were very popular with the students.

Figure 3. LibGuide OCE Sign-up Form.

Plagiarism Avoidance Tutorial

The University administration as well as the Engineering college administration consider academic integrity important to students. In fact, section #3 of the Engineering Student's Creed states that engineering students must "uphold the highest standards of academic integrity." West Virginia University's Student Conduct Code Article III.B.1.a defines plagiarism[14]. To this end, professors believe that a section on plagiarism is essential for ENGR 101.

During fall 2012 the students took the library's Plagiarism Avoidance Tutorial (PAT) which had been developed in house by the library's Directory of Instruction and Information Literacy. At the end of the PAT a quiz was administered electronically. The score from the PAT quiz was included as an additional quiz. The eCampus module linked to the PAT which was hosted on the Libraries' website. Each student was directed to register and pick a library administrative email for score reporting.

While it had been hoped to get results, the scores were often not reported accurately because of a software glitch. The librarians hope to be able to create their own PAT for fall 2013. For spring 2013, they incorporated some of the topics from the PAT into the "Out of Class Experience."

Quizzes

In fall 2011, there was not significant "buy-in" from the professors using eCAmpus. In fall 2012, since eCampus was emphasized more in class, students took more quizzes, and there are more results to share. All the assessments were called quizzes; however, they were not all handled identically. Two quizzes were designated as pre- and post-tests that indicated whether the students had learned something from the library instruction. The pre-test was given before the librarians came to the in-class instruction session and established a baseline for information literacy. The post-test was administered in fall 2012 at the end of the semester and in spring 2013 as part of the mid-term. More results were expected from the spring 2013 cohort, but some professors did not report student scores on the information literacy questions to librarians.

The pre- and post- tests were comprised of 20 questions, but worth 15pts. The same quiz was given to the students at the beginning of the class and at the end of the class. Three questions covered plagiarism, three questions were about citations, four questions covered searching databases, five were on evaluating or choosing sources, and five covered intellectual property.

The other eCampus quizzes tested whether students had learned something from the in-class lecture and the IP module. The quiz covering material presented in-class, included identifying parts of a citation (10 pts). The quiz for the IP module was scored as a quiz and tested the reading as well as the Power Point sections. The class quiz was eliminated in spring 2013, and the professors were given information literacy questions to include in their weekly quizzes.

Results from Pre and Post Tests

An analysis of test scores was performed. Of the 17 sections in ENGR 101, 14 sections could be included in this analysis. Additionally, only 350 of 503 scores could be analyzed because some students failed to take either the pre-test or post-test. Overall the results of 350 [503 minus 150] participants from the post-test showed a statistically significant increase ($p = 0.001$) in the number correct over the pre- test of 1.5 points. The average score of the pre-test was 10.5 (total 15) and the average score of the post test was 12. Individual sections showed gains of between .5 points and 2.5 points.

Quizzes on Citations and Intellectual Property had overall average scores of 14 (of a possible 15) and 11.5 (of a possible 15) respectively. These quizzes did not involve a pre- and post-test aspect.

Conclusion

While the gains appear small, they are significant. While several topics were familiar to some students before the course started, students increased their information literacy during the semester. In addition to the significant pre- post- test score increases, faculty observed improved

use of appropriate sources and citations in student technical reports. While the librarians were able to obtain data on student performance, it appeared that some students did not take the on-line quizzes as seriously (and put forth the same level of effort to do well) as they did the "regular" in-class quiz. Observation of student behavior seems to indicate that they view online quizzes as busy-work or other homework, but not as significant to their grade as in-class quizzes or exams. It also appears that students calculated that not completing the on-line quizzes would not adversely affect their final grade.

Recommendations

Based on an informal assessment of the procedures used in the fall, additional changes were made in spring 2013 in the delivery and, most importantly, in the assessment of student learning. The pre-test was given as an online assessment during the first week of class with improved student participation over the previous year. All instruction by the librarian was scheduled to be completed by midterm and the librarians provided questions on information literacy, intellectual property, plagiarism, and citations as post-test questions to be included on various semester quizzes and the midterm exam.

Because midterm assessment data for spring 2013 was not extracted and provided to the librarians in a timely manner, this process must be addressed for fall 2013. The plagiarism piece will be recreated for inclusion in fall 2013. Little participation was noticed for the Intellectual Property module for spring 2013. Additional attention must be focused toward motivating students to complete this module in future semesters. The librarians will investigate if a separate course shell can be used for engineering freshman information literacy. Walsh[15] from the University of Buffalo (UB) has worked with an online workbook that all undergraduates need to complete before they graduate. The first subject-specific module was for engineering. Perhaps a version of this option could be developed, expanding it as a requirement before the completion of and freshman engineering course. That way the data would collect in one place that would not interfere with the instructor's grade book and the librarians would get the information needed to make a proper assessment. The dialog with professors and the assistant dean continues.

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Appendix A: Shared Learning Standards & Outcomes

ACRL Information Literacy Competency Standards for Higher Education	ALA/ACRL/STS Information Literacy Standards for Science and Engineering/Technology	ABET Criteria for Accrediting Engineering Programs
Standard 1. The information literate student determines the nature and extent of the information needed.	Standard 1. The information literate student determines the nature and extent of the information needed.	Engineering programs must demonstrate that their students attain an ability to identify, formulate, and solve engineering problems.
Standard 2. The information literate student accesses needed information effectively and efficiently.	Standard 2. The information literate student accesses needed information effectively and efficiently	Engineering programs must demonstrate that their students attain and ability to use the techniques, skills, and modern engineering tools necessary for engineer practice.
Standard 3. The information literate student evaluates information and its sources critically and incorporates selected information into his or her knowledge base and value system.	Standard 3. The information literate student critically evaluates the procured information and its sources, and as a result, decides whether or not to modify the initial query and/or seek additional sources and whether to develop a new research process.	Engineering programs must demonstrate that their students attain an ability to design and conduct experiments, as well as to analyze and interpret data.
Standard 4. The information literate student, individually or as a member of a group, uses information effectively to accomplish a specific purpose.	Standard 4. The information literate student understands the economic, ethical, legal, and social issues surrounding the use of information and its technologies and either as an individual or as a member of a group, uses information effectively, ethically, and legally to accomplish a specific purpose.	
Standard 5. The information literate student understands many of the economic, legal, and social issues surrounding the use of information and accesses and uses information ethically and legally.	Standard 5. The information literate student understands that information literacy is an ongoing process and an important component of lifelong learning and recognizes the need to keep current regarding new developments in his or her field.	Engineering programs must demonstrate that their students attain an ability to communicate effectively.
General Definition: The information literate An information literate individual is able to: • Determine the extent of information needed • Access the needed information effectively and efficiently • Evaluate information and its sources critically • Incorporate selected information into one's knowledge base • Use information effectively to accomplish a specific purpose • Understand the economic, legal, and social issues surrounding the use of information, and access and use information ethically and legally	Information literacy in science, engineering, and technology disciplines is defined as a set of abilities to • Identify the need for information • Procure the information, • Evaluate the information • Subsequently revise the strategy for obtaining the information • Use the information • Use it in an ethical and legal manner • Engage in lifelong learning.	Engineering programs must demonstrate that their students attain a recognition of the need for, and an ability to engage in, life-long learning.

From: Oakleaf, Megan. "Are They Learning? Are We? Learning and the Academic Library." Library Quarterly. 81(1). 2011.
and Information Literacy standards for Science and Technology
http://www.ala.org/ala/mgrps/divs/acrl/standards/infolitscitech.cfm

Appendix B: OCE Worksheet

Engineering 101 Library Project

Your assigned topic: _____

----------FIND A BOOK ON YOUR TOPIC----------

- Go to the Research Guide for Engineering 101
- Click on "Books" Tab
- Choose MountainLynx link in the "Search for Books at WVU" box.
  - Search for your topic as a "Subject Heading"
  - Fill in the following information for a relevant book

Author Last Name: _____ Author First Name: _____ Author Middle Initial: ____

Title of Book: _____

Place of Publication: _____Publisher Name: _____Year of Publication: _____

- Why is this source good for your topic?

----------FIND A TECHNICAL REPORT ON YOUR TOPIC----------

- Go to the Research Guide for Engineering 101
- Click on "Technical Reports" Tab
- Choose a Resource—Information Bridge or SAE Digital Library
- Which database did you choose? _____
- Find a technical report on your topic. Write the citation here:

Author Last Name: _____ Author First Name: _____ Author Middle Initial: ____

Document Title: _____

Government Publication Number: _____

Place of Publication: _____Publishing Agency: _____Year of Publication: ___

- Why is this source good for your topic?

----------FIND AN ARTICLE ON YOUR TOPIC----------

- Go to the Research Guide for Engineering 101
- Click on "Articles" Tab
- In the "Featured Databases" or "Databases & Indexes" Box:
  - Choose Engineering Village—EiCompendex
- Find an article on your topic. Write the citation here:

Author Last Name: _____ Author First Name: _____ Author Middle Initial: ____

Title of Article: _____

Title of Journal: _____Volume: ____Issue : ____(Year): _____Pages:_____

- Why is this source good for your topic?

----------FIND A BOOK SELECTION----------

- Using *Eshbach's Handbook of Engineering Fundamentals* find a graph illustrating the motion of an arrow (projectile)
  - Section in book where found_____
  - **Draw the Graph illustration the Projectile motion** including the coordinates of projectile any time after projection :