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Engineering Information for Non-engineers: A Case Study in Interdisciplinary Application of the ACRL Framework

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Engineering Information for Non-Engineers – A Case Study in Interdisciplinary Application of the ACRL Framework

As Washington State University becomes increasingly interdisciplinary, the need is increasing for collaboration between librarians and instructors to introduce non-engineering students to technical literature. Understanding technical literature is challenging even for the very engineers who are versed in the vocabulary and procedures of their discipline. Hence, training non-engineer students to use this literature is a substantial challenge. Over the course of several years, the ACRL framework for information literacy in higher education has been integrated into the engineering curriculum. Over this time several core lessons have emerged: 1) understanding the role and significance of publication authority, 2) appropriate contextual use of the information, and 3) embracing the iterative nature of research. Transferring these lessons to non-engineering courses has been successful when working with an honors English course and an interdisciplinary Capstone Design course. Non-engineering students in these classes received basic information literacy training during the first year of coursework with potential for review in a non-engineering upper division discipline-specific course. Kolb's experiential learning cycle was applied to the in-class instruction to appeal to multiple learning styles. Traditional information literacy instruction focuses heavily on the use of books, peer-reviewed articles, and newspapers while engineers typically rely on sources including patents, standards, and reports. Key findings include an essential focus on the different types of technical literature, authority, and discoverability when teaching technical information to non-engineering students. Using the ACRL framework as a guiding document for information enabled the incorporation of technical literature into the in-class assignments for non-engineers.

Introduction

As technological sophistication continues to increase at Washington State University there is an increasing need to rely on interdisciplinary teams to solve increasingly systemic challenges. While the term interdisciplinary has been discussed since the 1920s [1], the use of interdisciplinary courses continues to increase and a great need exists for collaboration between librarians and instructors to broaden literature use. Interdisciplinary research has been described as "the purposeful weaving together of two or more disciplines […] in order to reach a new understanding, create a new academic end product or advance research [2]" or as an "…integrating of the different disciplinary approaches to solve a common problem or issue…[3]".

Challenges abound. Interdisciplinary researchers often have difficulties in "…discovering authoritative information sources [4]". Which seminal work is to be trusted when the conclusions are seemingly opposing from different fields? This issue and the importance of authority are presented in the Association of College and Research Libraries (ACRL) Framework for Information Literacy in Higher Education. The ACRL Framework includes a specific frame for authority: "Authority is constructed in that various communities many recognized different types of authority [5]" which is key when working with students across disciplines.

When starting an interdisciplinary research project, it is essential that students can "…identify an information need and understanding the underpinnings of where to locate that information

provides a solid foundation for being successful in the information probing, gathering, sifting and consolidation process[6]". Other challenges in completing interdisciplinary literature research include:

1. learning the disciplinary culture and language;
2. research communication;
3. finding seminal works;
4. information gathering through discipline specific databases; and
5. staying abreast of publications [6].

Part of entering an interdisciplinary environment includes using the types of literature that are customary for that discipline and setting. It has been shown that academic engineering faculty rank scholarly journal articles as the most critical information form [7], which likely has guided traditional library instruction to focus on journal databases. However, in a survey by Waters, Kasuto, and NcNaughton [8] corporate engineers responded that the most important types of information were standards and technical reports. Although the skills of literature searching are transferable to databases and general search engines, students should not only be able to find the information but be able to apply the knowledge efficiently to accomplish a specific purpose [9]. To effectively use information students should have an ability to use a variety of information types, assess the relevance and credibility of the source, and then apply the information to their project regardless of discipline.

In an effort to address these challenges posed by the interdisciplinary milieu, a case-study was conducted to apply the ACRL framework to a traditional English course and then an interdisciplinary Capstone Design course in entrepreneurship. The instructional methodology is presented for each case along with results and conclusions.

Instruction Methodology – English Course

The instructor of a first-year English course in the honors college approached the library with a need to use technical information. The writing course has the theme of "Science Fact, Science Fiction" in which the students explore a singular invention and how it has changed over time. Some of the items students have researched include saddles, toilets, drinking straws, and microscopes, to list a few. During this assignment, students look at a variety of information sources including books, articles, marketing materials, and informal sources such as websites and interviews.

Based on curriculum mapping within the library system, it was known a priori that student information literacy instruction primarily focuses on monographs and periodicals. In response, instruction was initiated with the goal of developing a 50-minute lecture to inform students of the technical literature available, including patents and standards, differentiate between the forms, and how the information might apply to their research project.

The technical literature instruction was scheduled for after the students had received instruction on the library catalog, finding articles, and archives. At this point in their research students have a broad understanding of their product.

The course instruction on technical literature was developed using Kolb's experiential learning cycle [10]. The Kolb experiential learning cycle was chosen for the development of the lesson to meet four different learning styles. The four learning styles are; assimilators, who learn better when presented with sound logical theories; convergers, who learn better when provided with practical applications of concepts and theories; accommodators, who learn better when provided with "hands-on" experience; and divergers, who learn better when allowed to observe and collect a wide range of information [10].

To fulfill the four different learning styles Kolb includes four parts that develop understanding of a topic in different ways (Figure 1, left panel). While the Kolb experiential learning style described here starts with the concrete experience, the cycle can begin at any stage. To fulfill the accommodators the concrete experience is where the learner is "…involved in experiences and dealing with immediate human situations in a personal way [10]'. The diverger learning style is best fulfilled by the practice reflective observation where they focus on the understanding of ideas and situations by observing and describing them [10]. During the abstract conceptualization, stage assimilators can focus on using logic, ideas, and concepts to understand the topic [10]. Finally, the convergers learning style is best fulfilled by active experimentation focusing on activity influencing the situation and emphasizes practicing application [10]. While Kolb's experiential learning cycle is shown in four defined learning stages, it is assumed that most learners learn in more than one way and can be fulfilled by more than one stage of the cycle.

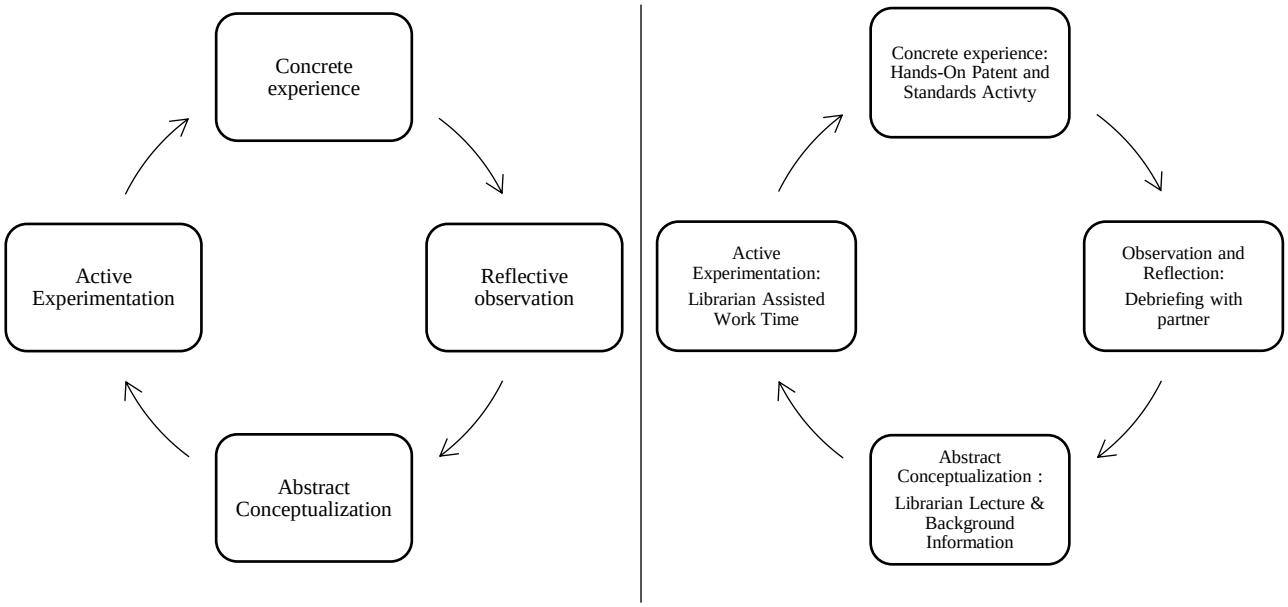


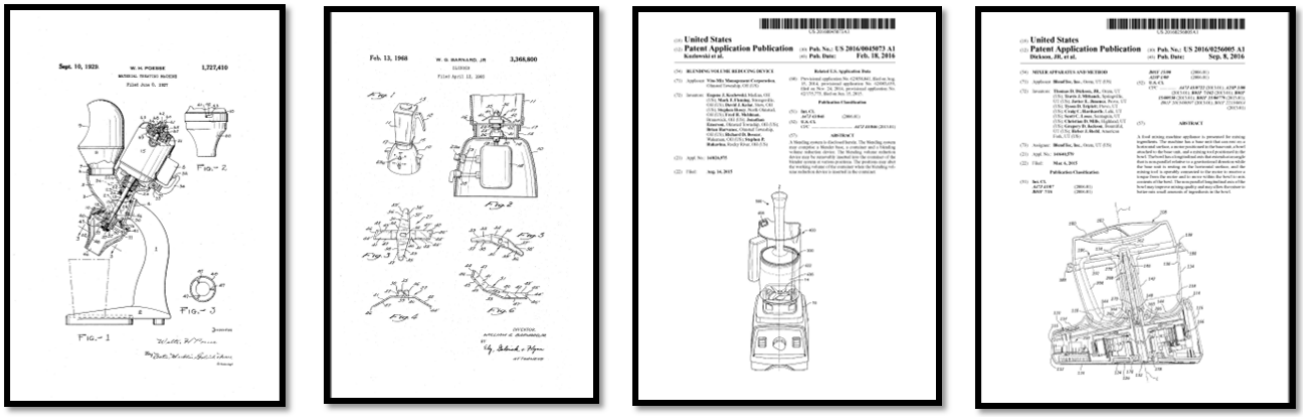
Figure 1: (left panel) Kolb's Experiential Learning Cycle. (right panel) Kolb's cycle adapted for information literacy.

Applying the Kolb cycle to instructing non-engineering students about technical literature includes a patent and standards hands-on activity, instruction on searching, and then librarian-assisted work time (Figure 1, right panel).

The instruction section was developed to start with the concrete experience of looking at and understanding the parts of patents and standards through worksheets (Appendix A and Appendix B). When introducing the worksheet many students are already with the parts of an scholarly article from prior information literacy and there is usually little explanation required. While little explanation is required for the worksheet the patents and standards have by preselected patents for in-class use by students to make sure that each one has components that can be answered by the worksheet. The patents selected for the exercise included unique products that the students are unlikely to have encountered before to increase interested in the understanding of the parts of the patent. Example patents used include a "high five machine", an ice cream cone rotating machine, and a wind-powered bicycle. Similar to constricting the patent choices, standards presented to the students apply to everyday items the students are likely to have interacted with or have preexisting knowledge. Example standards include a baby monitor, clothing chest, and a child's scooter from ASTM. Each student is given a patent or standard and worksheet and allowed to work independently for 5-10 minutes.

Once the students have completed their worksheet, the student's complete reflective observation by debriefing with a student with the opposite information type. Part of the reflective observation is also included on the worksheet when the students are asked to describe what other sections, besides the background, of the patent might be useful in understanding the development or creation of the product. Similarly, there is a question included in the standards worksheet that asks the students to reflect on the potential utility of a standard during a research project. Finally, students are asked if there are references included in the patent and after finding that many do have references to other patents, this leads students to ask different or deeper questions regarding the object they are researching. After the partner debriefing, the librarian debriefs the class while focusing on sections of importance including date, background, and claims.

To fulfill the abstract conceptualization, the librarian gives a 10-minute presentation coupled with a searching demonstration. The presentation focuses on the types of patents and standards, background, and an example of the product evolution over time (Figure 2).



1927
Material Treating Machine

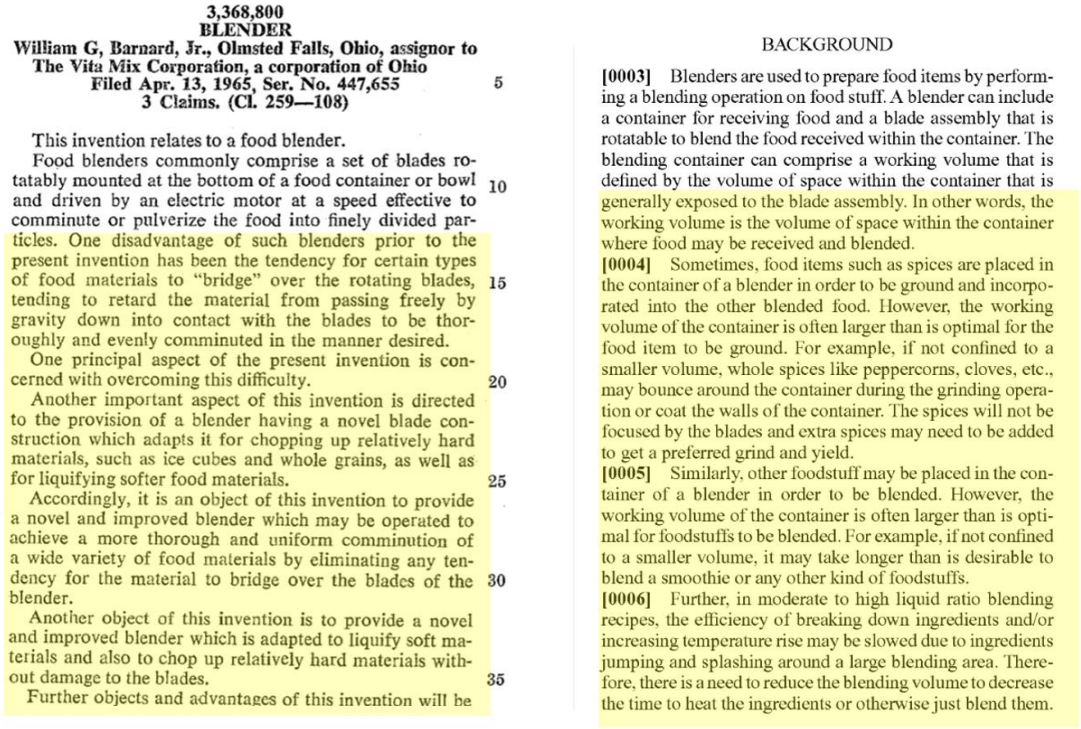
1965
Blender

Feb. 2016
Blending Volume Reducing Device

Sept. 2016
Mixer Apparatus and Method

Figure 2: Patents throughout history, example blender

Additionally, during the presentation the librarian points out the claims differences in two patents, Figure 3.



3,368,800
BLENDER
William G, Barnard, Jr., Olmsted Falls, Ohio, assignor to The Vita Mix Corporation, a corporation of Ohio
Filed Apr. 13, 1965, Ser. No. 447,655
3 Claims. (Cl. 259—108)

This invention relates to a food blender.

Food blenders commonly comprise a set of blades rotatably mounted at the bottom of a food container or bowl and driven by an electric motor at a speed effective to comminute or pulverize the food into finely divided particles. One disadvantage of such blenders prior to the present invention has been the tendency for certain types of food materials to "bridge" over the rotating blades, tending to retard the material from passing freely by gravity down into contact with the blades to be thoroughly and evenly comminuted in the manner desired.

One principal aspect of the present invention is concerned with overcoming this difficulty.

Another important aspect of this invention is directed to the provision of a blender having a novel blade construction which adapts it for chopping up relatively hard materials, such as ice cubes and whole grains, as well as for liquifying softer food materials.

Accordingly, it is an object of this invention to provide a novel and improved blender which may be operated to achieve a more thorough and uniform comminution of a wide variety of food materials by eliminating any tendency for the material to bridge over the blades of the blender.

Another object of this invention is to provide a novel and improved blender which is adapted to liquify soft materials and also to chop up relatively hard materials without damage to the blades.

Further objects and advantages of this invention will be

BACKGROUND

[0003] Blenders are used to prepare food items by performing a blending operation on food stuff. A blender can include a container for receiving food and a blade assembly that is rotatable to blend the food received within the container. The blending container can comprise a working volume that is defined by the volume of space within the container that is generally exposed to the blade assembly. In other words, the working volume is the volume of space within the container where food may be received and blended.

[0004] Sometimes, food items such as spices are placed in the container of a blender in order to be ground and incorporated into the other blended food. However, the working volume of the container is often larger than is optimal for the food item to be ground. For example, if not confined to a smaller volume, whole spices like peppercorns, cloves, etc., may bounce around the container during the grinding operation or coat the walls of the container. The spices will not be focused by the blades and extra spices may need to be added to get a preferred grind and yield.

[0005] Similarly, other foodstuff may be placed in the container of a blender in order to be blended. However, the working volume of the container is often larger than is optimal for foodstuffs to be blended. For example, if not confined to a smaller volume, it may take longer than is desirable to blend a smoothie or any other kind of foodstuffs.

[0006] Further, in moderate to high liquid ratio blending recipes, the efficiency of breaking down ingredients and/or increasing temperature rise may be slowed due to ingredients jumping and splashing around a large blending area. Therefore, there is a need to reduce the blending volume to decrease the time to heat the ingredients or otherwise just blend them.

Figure 3: Patent Claims Example

The instruction focuses on searching for patents through Google Patents. When introducing patents to students the Index to the United States Patent Classification System aids in understanding the terminology and subclasses for advanced searches. Another search strategy that the students have learned is following articles forward and backward which is transferrable to patents. Within Google patents, students can see the patent citations and the cited by.

A short background on standards development and the purpose of standards in society is presented. Most of the student research projects are ordinary consumer products with applicable standards in the ASTM database. Students are instructed that one standard might not cover the entire product and individual standards would then need to be sought out.

To finish the session, students are given the rest of the class time to research their product with librarian assistance. Most of the students leave class with one patent related to their product. Some areas where students struggle include choosing products with multiple components that are not covered by one patent and standard or they are overwhelmed with the amount of technical information.

Instruction Methodology – Entrepreneurship

Washington State University has a current emphasis towards entrepreneurship by students and faculty. Out of this need, a senior capstone program has been developed for engineering and business students. Students start in the entrepreneurship program during their third year and continue in the program until graduation. The students in the program are divided into groups of two to six students. Although the business students in the course are responsible for the finances, marketing, and promotion of the product, many attend the technical literature meeting to understand the product development. Both the business students and the engineering students receive information literacy instruction during their first year in an English course and history course. Outside of their first-year courses, both engineering and business students receive information literacy instruction regarding discipline-specific databases and literature from subject librarians.

The entrepreneurship program requires that the teams meet with both the engineering and business librarian, collecting signatures from both to cover the technical information and market information regarding their product design. Before coming to the meeting, the students provide a brief explanation and background of their product design. Along with developing their idea they also compete in a business competition at least once during their time in the program.

As stated above many of the students have had information literacy instruction within their discipline, but during the product design many ideas fall into multiple subject areas. The topic discussed during the consultation is to understand the proposed design of the product and need for the product. After the basics functionality of the product are understood the students are referred on the databases and online locations of information. Database and online locations vary greatly depending on the type of product the students are developing but some examples are Web of Science, IEEE Xplore, UpToDate, SciFinder, Google Scholar, and company or government websites. Along with exploration of databases, specifics of database are covered to ensure effective searching included limiters, Boolean searching, and finding full-text. One area that needs reiterating during the consultations is the different types of information, including reviews, conference proceedings, patents, and standards.

An area of frustration for students is finding that their product design currently exists. Other frustrations include being overwhelmed with information and the use of standards in the design of their product. To combat the frustration of currently existing products is shifting the perspective to using patents to finding information regarding manufacturers, exploring the claims in current patents to better what the patent covers or how a product has changed throughout time, and looking at the references section for other patents and/or sources of information. Many time finding a patent similar to the students' current idea reinforces the iterative nature of research and thinking about the problem in a different context. When looking at patents related to their design, it is made to clear to the students that the librarian cannot provide legal advice and that they need to contact the Office of Commercialization.

Secondly, to help students with the overwhelming amount of information and the different places to find information the librarian focuses the attention on limiters in databases and the types of information they might include in their searching. While the students have received information literacy during their first two years, the focus has usually been on peer-reviewed articles. Business students are not as familiar with review articles, reports, and conference proceedings.

Finally, engineering and business students have little to no experience with standards. Taking the background information in to account, relevant standards are located prior to the consultation. While the students are presented with a standard that fits their potential product, standards resources are also covered. Included in the overview of standards is the use of consumer safety standards and standards referenced by federal code.

Discussion

With universities increasing interdisciplinary research and courses, there needs to be interdisciplinary information literacy to help students solve increasingly sophisticated projects. Interdisciplinary information literacy while still focused on the use of scholarly articles needs to also introduce students to a more diverse set of skills regarding information types, assessing authority, and accessing information outside their discipline to better strengthen their flexibility through their academic careers but also in the workforce. Diverse skills can be developed through collaboration between subject librarians, faculty, and instructors. Through partnerships interdisciplinary information literacy help students have a transformational college experience.

When introducing students to technical literature it is important that it be introduced at a time of need for the student, either a project or an assignment. While timing of the instruction is important the other factors that help student retain the information about technical literature includes understanding the role and significance of publication authority, applying appropriate contextual use of the information, and embracing the iterative nature of research. While these skills are not engineering specific, they do have specific meanings within the field of engineering research and literature.

Interdisciplinary information literacy instruction must give students the confidence to explore all types of information regardless of discipline. Within academia, students should be able to practice information exploration in low risk situations to increase their confidence long-term.

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Appendix A

Parts of a Patent

Title: Date of patent:

Is this patent: Design Patent or Utility Patent

Does the patent include references?

After reading the “Background of the Invention” or “Discussion of Prior Art” section, please state why the product is different from prior versions or is responding to a need:

What other sections of this patent might be useful in understanding the development or creation of the product?

How many claims does the patent include?

How would you cite this patent? (Format: Last Name, First Name. "Patent name." Patent #. Day Month Year.)

Appendix B

Parts of a standard

Title:

What is the copyright or date of issuance?

What is mentioned in the introduction of the standard?

Give a short summary of the standards scope:

How might this standard be useful in a research project?

Does the standard include references?

How would you cite this standard? (Author, Title, Publisher, Place of Publication, Date)