Assessment of a Web-based Information Literacy Program for Industrial Engineers

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Abstract

Industrial engineering students require three distinct "types" of information. The first type is the subject knowledge traditionally taught through lectures and textbooks. The second type is in the use of software tools. The third type is locating and critically analyzing engineering literature. Most engineering curricula minimize formal classroom time to teach skills in types two and three. An example of the type two information requirement is the ability to manipulate spreadsheets, which is a necessary skill in Engineering Economy. An example of the type three information requirement is information literacy skills, which are a critical component of a graduate education. WSU requires an Engineering Research Writing class of all graduate industrial engineering students with a library component taught by the engineering librarian. Web-based lectures "captured" using Tegrity software are used at Wichita State University to teach spreadsheet and literature retrieval skills on a limited scale. Before expanding our offering of Web lectures it was necessary to test the effectiveness of this mode of instruction. The Engineering Economy and Engineering Research Writing classes were each separated into two sections in fall 2002. One section of each course received instruction in a traditional lecture setting. The other section was taught using the web lectures. Pre and post-tests were given before and after the instructional sessions to assess the instruction. This paper presents the method of the study, the specific results, and the implications for Web instruction in these areas.

Introduction

First semester Industrial Engineering graduate students at Wichita State University are required to take Engineering Research Writing. This is an eight-week, 1 credit course usually taken in a student's first semester. Over eighty percent of the students in this program are international.   They are typically ill-prepared to write graduate-level research papers having limited experience in performing library research. Even U.S. students are required to do very little writing and traditional research in their undergraduate programs. This course is taught by an adjunct faculty member and is taught as a workshop to give students plenty of practice writing at the graduate level.

The library component is an essential part of the research process. Informal surveys of the students indicated that in a class of thirty usually only 4-6 indicated they had written a "research" paper. About the same number had ever been required to do library research. This is consistent with the research regarding engineer's information-seeking behavior. Pinelli, et. al. talk about engineers' preference for relying on informal sources of information like peers and

trade journals over the formal journal literature [10]. Charles Lord explains that this is due, in part, to economic and time constraints [8]. While these informal sources serve practicing engineer's needs, they are not sufficient for academic work. Due to the need for more intensive hands-on instruction in writing fundamentals it became necessary to offer library instruction outside of class time. Different options were attempted before moving the lecture/demonstration portion online in summer 2002.

Dr. Whitman had been using Tegrity Web Learner studio to stream some content of his courses content for several semesters. Students in his classes had different levels of expertise in various software programs. By making short lectures available to students who needed additional help he saved class time to teach content rather than tools. Tegrity software "captures" a lecture and allows the capture of Windows applications as well. Tegrity vignettes can be accessed outside of class time and allow students who are already comfortable with their understanding of the subject matter to simply review or skip those web-based lectures. Those requiring initial knowledge of the topic can view the lectures outside of class.

The Literature

Much has been written about the effectiveness of Web instruction. Wallace and Mutooni concluded in 1997 that their students receiving web-instruction performed better than the students attending live lectures [11]. Chao and Stovel concluded that Web components enhanced learning in their case study [2]. In looking at library instruction specifically, Naomi Lederer's work on teaching research and critical thinking skills using interactive Web tutorials was consulted [6]. John Hickok at California State University, Fullerton is involved in a project using streaming video and interactive quizzes to supplement the traditional library tour and basic instruction [5]. What, however, would be the impact on student learning and teaching strategies if all of these pieces were brought together and a new program for teaching information literacy was undertaken at the upper-undergraduate and graduate level in industrial engineering?

A grant from the Engineering Information Foundation enabled Professors Smith and Whitman to formally assess the effectiveness of teaching using Tegrity lectures throughout fall 2002. The research was designed to answer several questions about this format of instruction. How effective is this form of instruction for teaching software tools? How effective is this form of instruction for teaching the critical thinking skills necessary to achieve information literacy as well as basic library instruction? What is the best method of teaching using this technology? Is this effective with both native English speakers and non-native English speakers? What supplemental tools or technology must be made available to enhance learning?

Method: Research Writing

The Engineering Research Writing course was randomly divided into two groups. Group one was required to attend a live lecture in the library's electronic classroom immediately following their second class session. Group two was required to view the six lecture sessions online. Both groups were given identical packets of supplementary handouts including a library assignment. A pre-test was administered through Blackboard to test basic library and information literacy skills. The librarian met with the entire class for twenty minutes to go over

the assignment after they had been completed and graded. A post-test, identical to the pre-test was then administered through Blackboard the following week.

The pre-test consisted of eleven short answer and multiple-choice questions and was designed to take approximately ten minutes. Questions included naming an engineering database, questions about the types of materials to be found in the Online Catalog. Three questions were designed to assess basic evaluative skills. Students were told that although their score on the test would not affect their grade, failure to take the pre-test would result in a one point reduction on the library assignment. Students were encouraged to take the post-test and several email reminders were sent.

The ten-point assignment allowed students to practice evaluating pre-selected materials and determine if they would use them in doing graduate level research. A final section allowed students to refine their search techniques in Compendex. They were then required to select a source using the same criteria they used on the pre-selected materials.

Student attitudes and experience data were gathered using a student data form and a survey. This information was gathered after all of the lectures had been viewed and the assignment completed.

The challenge in this class has always been attempting to teach basic library instruction and critical thinking skills to in-coming graduate students in two hours. All instruction and assessment was designed with the Association of College and Research Libraries Information Literacy Competency Standards for Higher Education as a guide (See table 1). Due to time constraints not all of the standards are covered in this one session. The primary emphasis in this course was on evaluating information sources [1].

Table 1: ACRL Information Literacy for Higher Education Competencies:

✓ 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

The Tegrity lectures were divided into six sections. The first part [7:58] instructs students on how to navigate the library's website, to download an Adobe Acrobat Reader, and how to access the library remotely. Part two [17:38] demonstrates searching in the Online Catalog. The concepts of Boolean operators, truncation, and controlled vocabulary are covered. As Dupuis indicates in 1997 the instruction was designed to teach search skills as tools to be applied to any database or search strategy [4]. Keyword searching using Boolean operators is taught as a concept and then the use is demonstrated in the Online catalog. The concept is then reinforced and students have the opportunity to practice in databases and Web searching. By using this method, it eliminates the need to teach every applicable database saving precious instruction time.

In part three [23:12] students are taught how to search for journal articles and conference papers in library databases. Compendex is used to demonstrate basic and advanced searching skills using the concepts taught in the catalog session. Sessions four [21:23] and five [19:59] focus on evaluating resources. Session four uses several electronic journal articles to demonstrate how to effectively use the *Evaluating Print Resources* checklist developed by Professor Janet Brown, WSU librarian when selecting scholarly sources. Examples included a popular magazine article, trade journal, and scholarly journal article. In session five *Evaluating Web Resources* was used to determine the reliability of two Web sites. One was a quality site that has fulltext research and reports. The other is a commercially produced site which had no freely accessible content. Session six [8:58] reviews the assignment and expectations. The total viewing time for all six sessions was 1 hour 39 minutes.

The live lecture session was one two-hour session held in the library's electronic classroom. The content of the lecture was identical to that of the Tegrity lectures. Even the same examples of journal articles and Websites were used. The main difference was that examples of printed articles were used. Students were able to "see" the articles in the context of the journal. Each student had their own terminal so they could follow along or practice their own searches. Students were encouraged to ask questions throughout the session.

A supporting Website was designed for use by both groups of students http://library.wichita.edu/aveng/cesp750d1.html. This site contained links to all of the lectures, the appropriate databases, and pdf's of all the instructional handouts plus some supplementary materials. Students were also provided with a packet of all necessary handouts, the library assignment and an introductory handout that gave the Website URL and technical information. The engineering librarian distributed the introductory packets in person in order to divide the class and answer any questions the students had about the library component.

Method: Excel

The Engineering Economy course was taught in two separate sections at the same time. One section was taught aspects of MS Excel during the live class time. The second section had lectures on MS Excel available online. Both groups were given a pre-test question requesting students to rate their skill level in MS Excel. A post-test question of self-assessment on skill level identical to the pre-test question was asked in the final week of the sixteen week course.

A thirty-five point assignment allowed students to practice the learned concepts from class using MS Excel. The assignment required students to enter data, use multiple worksheets, create a bar graph, and use engineering economy MS Excel functions with an objective of comparing project alternatives. Students were then required to select the best project(s) given the budget.

The Tegrity lectures were divided into six sections. There were five lectures developed for MS Excel. The first lecture (9:33) was on the basics including entering data, and absolute and relative cell references. The second lecture (16:26) was on basic charting techniques discussing simple bar chart creation. The third lecture (11:27) was on specific economic functions native to MS Excel. Another industrial engineering faculty created two lectures on using MS Excel for

linear programming, but that was not required for the engineering economy class. (Additionally, other classes informed students about the web lectures and students used them as refresher for their courses.) The other section took class time to present various excel concepts.

The instructors each had a different approach to Web learning. Dr. Whitman taught the sections on Excel similar to his approach in teaching a live class. Prof. Smith, on the other hand, had to make some adjustments to the material she used due to the limitations of the technology. Some of the problems encountered include: the more Windows applications that are used in a single lecture, the more technical difficulties one encounters; the streaming does not keep up with rapid clicking through applications or Websites. The matter of speed was addressed by attempting to slow movement through the Web down. Instead of showing print materials, e-journals were used as examples to avoid having to switch applications. A document camera is part of the Tegrity studio, but due to the problems encountered when switching applications, the camera was finally abandoned in the library component.

It is possible, however, that the limits of the technology forced a better means of instruction. In teaching students how to evaluate resources, using electronic journal articles forced students to look at the material in more depth. All of the physical clues that one has when looking at a printed articles in a journal are gone. The publishing information is not a flip of the page away, but must be sought out. Too often when teaching print resources students rely too heavily on physical clues like the number of advertisements and color to determine if an article is scholarly or not.

Results: Research Writing

The pre/post test scores for the Web and live groups indicate that there is negligible difference. The pre test mean for the live group was 7.08 with a post test mean of 8.64. The mean difference is an increase in score of 1.64 after the lecture. The pre test mean for the Web group was 6.58 with a post test mean of 9.12. The mean difference for this group was 2.53. Part of this difference can be explained by the lower pre-test average.

While the pre/post tests were designed primarily to assess the students' basic library skills, the library assignment is a better indicator of students' more complex information literacy skills. The average score on the library assignment was 9.69 for the live group and 9.25 for the Web group. Figure 1 shows a comparison of the groups' mean scores on each of these tasks.

Figure 1:

Comparison of Live vs. Web lecture
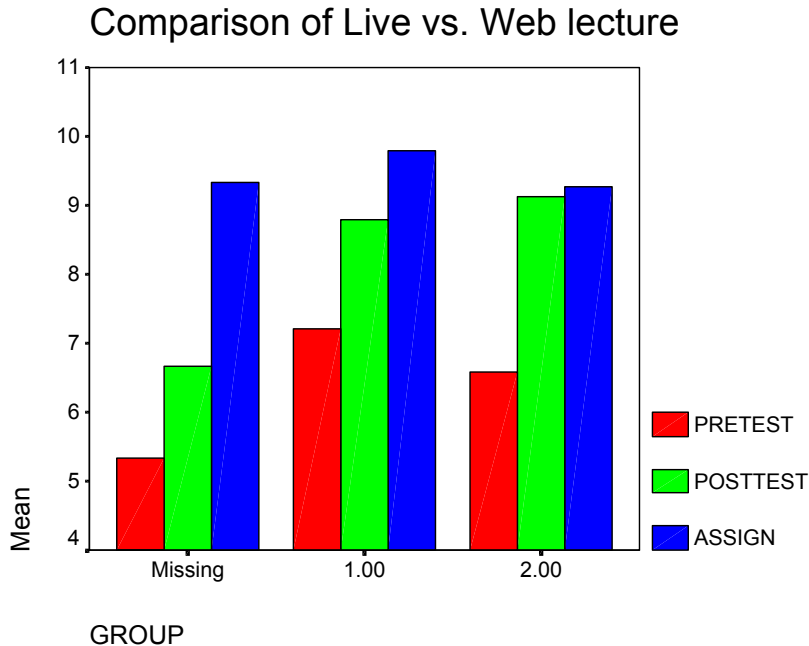
Group 1 is the live group and 2 represents the Tegrity group.

Results: Excel

The Excel pre/post test scores for the Web and live groups indicate that there is negligible difference. The pre test mean for the live group was 21.17 with a post test mean of 25.40. The mean difference is an increase in score of 4.23 after the lecture. The pre test mean for the Web group was 22.80 with a post test mean of 25.78. The mean difference for this group was 2.98. Part of this difference can be explained by the lower pre-test average. It is interesting to note that several (approximately ten percent) of the students assessed themselves lower in the post test than in the pretest. This is likely attributable to student awareness of their lack of skill after the homework assignment.

While the pre/post tests were designed primarily to assess the students' confidence in MS Excel, the homework assignment is a better indicator of students' practical skill level in MS Excel. The average score on the MS Excel homework assignment was 20.81 for the live group and 23.54 for the Web group. The higher web scores can be partially attributed to the higher initially perceived skill level of the web group.

Conclusions

All of the testing indicates that instruction using the Tegrity Web Learner Studio is an effective mode of instruction, especially when teaching basic skills like how to use tools like searching the library catalog and using Excel.

The survey data paints a different picture, of student's preferences, however. Of the forty-two students in the class, twenty-nine completed a brief survey regarding the library component of the course. 9 of the 16 respondents who viewed the Tegrity lectures had technical difficulties. One of those students attempted to view the lectures from three different computers

before she finally succeeded. All were able to resolve their problems either by changing locations, or with help from library personnel or their fellow students. Several complained about the sound level of the lectures which will be resolved before the spring semester. When asked which method of instruction they prefer; 5 prefer printed handouts and web resources with no lecture, 10 prefer the Tegrity lectures, and 14 said they would prefer live lecture. All said that they felt more comfortable doing library research after completing the library component of the class.

The engineering economy class web section was asked if they had actually viewed Tegrity lectures on various aspects of the class. As table 2 shows, 70 percent viewed the lectures dealing with Excel to aid in completing the homework, whereas a little less than 60 percent viewed a complete class session lecture (no class was held, the students were given a complete lecture on Tegrity) and the homework solution provided for that chapter. More than half the class viewed the lectures on these topics. Several students preferred the homework available on Tegrity, so as to work and view in their own pace. Several homework problems were still worked in class, but the complete homework set was available on line.

Table 2. Usage of Tegrity Lectures in Engineering Economy Section

	Excel	Chapter	Homework Solution
Viewed Tegrity	27	23	22
Population	39	39	39
Ratio	0.70	0.59	0.56

Rather than being a time-saver, the Web instruction students spent an on average, an additional half hour on the quiz and assignment. The amount of time recording lectures, preparing supplemental materials, and time assisting students was significantly more when using the Tegrity lectures. Several hours of time were spent answering email, phone calls and working with students one-on-one. As an instructor, one must be prepared to spend more time answering questions and working with individual students when teaching in a virtual environment.

Implications for the Future

Tegrity lectures will again be offered as one method of instruction for the library component of the Engineering Research Writing course. Based on student preference, a workshop will be offered as well. Students will be allowed to choose between the two modes. The Tegrity lectures will also be available to supplement the lecture. Better use will be made of Blackboard for all students. All of the content available from the Website will be included in Blackboard. Questions will be asked using the Discussion Board platform so that all of the students can benefit. This will also allow them to use the team approach that they use in their engineering courses.

One of the more confusing aspects of this project has been the pre and post tests. Despite being told several times that their scores on the pre/post tests would not affect their grades in the

course, there was still a great deal of concern expressed by several students.   In addition, many did not understand why the two tests were identical and would exit from the quiz after accessing it online. This then required the instructor to reset the individual student's quiz so they could re-attempt. More explanation will be given prior to students taking both quizzes in the future or eliminated.

Since the lecture is already broken into six sections, the assignment could be broken down into modular components as well. After viewing the lecture on searching a database, the student could stop and do the portion of the assignment on keyword searching. After viewing the lecture on evaluating print resources, the student could practice what they have learned by doing that section of the assignment. This is one way in which the Web learners might have an advantage over those attending the workshop. There is not a way to break up the workshop into this same model so additional consideration will need to be given before changing the assignment structure for either group.

Although, this method was successful with graduate students required to pass this course, how effective would it be in teaching undergraduates? Can this technology be used to develop an integrated approach to information literacy throughout the engineering program? Do students retain these skills, could these lectures be used as a refresher course when students need to do library research for other courses or their theses/dissertation?

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