

STUDENT ACCEPTANCE OF ONLINE TEXTBOOKS ACROSS MULTIPLE ENGINEERING COURSES

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Abstract

In this study, our goals were to examine the implementation and effectiveness of online textbooks in three different undergraduate engineering courses. We compared students' attitudes and performance using surveys with Likert and open-ended questions conducted at three time points during the academic quarter. In one course, ME 422 (Mechanical Controls), we compared students' attitudes and performance with a control group that used only the printed textbook. Linear regression analyses for this course indicated significant differences between the online and printed textbook groups, with consistently more favorable scores in attitudes in the latter group. These differences were apparent from the first survey and became more pronounced over time. Significant differences were also found across the three online textbook courses on multiple survey items measuring students' usage and attitudes ($p < .001$). Our findings suggest that student interaction with and attitude toward online textbooks differed based on the extent of complex technical interactions involved. The qualitative comments for the most technical course in the study (ME 422) indicated that the user interface and technical difficulties with entering symbolic solutions to the online environment were problematic. In contrast, students enrolled in IME 421 (Manufacturing Organizations), which covered general theory and used more case studies, had more favorable attitudes toward the online system. The remaining course, ME 302 (Introduction to Thermodynamics), while technical, did not typically require more than numerical solution input to the online environment, and showed responses that were generally intermediate between the other two courses. The findings were interpreted with a Technology Acceptance

Model methodology and a follow-on study identified several specific technical ease-of-use issues related to negative student attitudes toward online textbooks.

Introduction

Despite the tremendous growth in the availability and implementation of online textbooks (also known as e-textbooks and digital textbooks), little is known about their impact with respect to student usage, attitudes, and learning outcomes, especially in engineering education. It should be noted that there is a distinction between an 'e-book', which only includes a digital version of a printed book, and an 'online textbook', which is a more advanced online learning environment that includes digital text as well as enhanced online supplemental course materials and course management tools. This study specifically examines the implementation and effectiveness of online textbooks in three different undergraduate engineering courses.

In undergraduate engineering courses, online textbooks have the potential to provide rich learning environments, which include traditional textbook content plus online assessment tools (e.g., individualized homework questions, quizzes, automatic grading), enhanced multimedia content, and interactive simulations. Moreover, online textbooks are appealing to both students and instructors for their reduced cost, portability, and smaller environmental footprint. Despite the relative benefits of online textbooks, however, concerns about them include poor user interfaces, inconsistent or nonexistent standards among textbook publishers, restrictive licensing, limited range of available textbooks, and growing pains associated with learning new technologies.

In order to provide insight into students' attitudes and usage regarding online textbooks, we examined the following questions:

What is the extent to which students use online textbooks when assigned?

What factors influence students' opinions and attitudes toward online textbooks?

We examined these questions by implementing online textbooks in three undergraduate engineering courses: IME 421 Manufacturing Organizations, ME 302 Introduction to Thermodynamics, and ME 422 Mechanical Controls. Our selection of these three courses to study is based on convenience; i.e., each course was taught by one of the co-authors using an online textbook published by the same publisher. Furthermore, we shared a common interest in evaluating the online textbook's effectiveness. The following are course descriptions from the university course catalog:

IME 421 Manufacturing Organizations (3 units)

IME 421 is a senior level Industrial Manufacturing Engineering course that includes three one-hour lectures a week. Topics include theory and principles for manufacturing organizations and how they achieve a competitive advantage, implement strategic planning and operations management in a rapidly changing environment. Activities include team-based projects and case studies.

ME 302 Introduction to Thermodynamics (3 units)

ME 303 is a sophomore or junior level Mechanical Engineering course with three one-hour lectures each week. The overall objective of this course is for students to develop an ability to logically define and solve problems involving work, heat, and energy. This includes a clear understanding of the definition of a thermodynamic system, the concept of a

thermodynamic state, determination of fluid properties for liquids, ideal and real gases and fluids with phase changes. The student will learn how to synthesize these concepts through application of the first law of thermodynamics to both closed and open systems, and develop an understanding of the limitations placed on processes and heat engines by the second law of thermodynamics. Student activities include class meetings, weekly homework assignments, and quizzes and examinations throughout the term.

ME 422 Mechanical Controls (4 units)

ME 422 is a senior level Mechanical Engineering course with three one-hour lectures each week plus one three-hour lab once a week. Topics cover numerical modeling and control of physical systems such as motors, hydraulic systems, etc. Design of mechanical, hydraulic and electrical systems using time response, frequency response, transfer functions, and computer simulation are covered. Student activities include attending lectures, weekly homework assignments and weekly lab exercise and reports.

The three courses varied in their technical complexity, with IME 421 being the least technical and involving more conceptual knowledge, ME 302 being both technical and conceptual, and ME 422 being the most technical (for example, reliance on symbolic equations and use of advanced mathematics). In addition to our comparison of online textbooks in the three different courses, ME 422 conducted a comparison of students' attitudes and performance between a treatment group (online textbook) and a control group (printed textbook only).

Background and Literature Review

E-textbooks are an accelerating trend in culture and education and are being aggressively marketed by publishing companies [1]. Some publishers expect online textbooks to outsell paper textbooks in the near future [2].

Difficulties in the past with access and interface have been improved with newer technologies such as the iPad, Nook, Kindle and a wide variety of tablet PCs. Furthermore, new business models make e-textbooks more attractive to authors and publishers [3]. In 2012 five universities (the University of California, Berkeley; Cornell University; the University of Minnesota; the University of Virginia; and the University of Wisconsin) implemented a pilot program to purchase e-textbooks in bulk directly from publishers so that students can buy them at discounted prices, creating a kind of educational wholesale warehouse. The software allows students to highlight, take notes and underline and was inspired by an initiative at Indiana University with 5,300 students participating, saving an estimated \$100,000 [4].

While initial e-books were published on CDs that included the original text plus some multimedia content, the current trend by major publishers is to make access available to e-textbooks online, usually on a website hosting many of the publishers' other books. This move to an online environment also brings up issues related to internet usage in general by students and instructors. Many studies have assessed the use, effectiveness and perception of the internet for education in general. These studies find issues related to confidence in student abilities to navigate the internet, varying levels of internet access, confidence in the quality of the information found on the internet, preference in reading text on a computer screen compared to a paper book, perception of ease of use, and perception of effectiveness [5]. Studies have assessed the changes in student acceptance of internet-based learning over time and show that acceptance is growing as "web natives" move into secondary and higher education [6]. Today's students are not automatically excited about the idea of using online textbooks and, often with no prior experience using e-textbooks, they prefer paper textbooks when given the choice [5] especially when the e-text is simply a digital reproduction of the paper textbook [7, 8, 9]. McFall [9] notes that instructors must take time to train students to

use the new software and students are generally unwilling to explore features on their own. In other studies, students who used e-textbooks in one course chose a paper textbook when given the choice in a following course [10]. However, student acceptance results are more positive when the e-textbook offers features not available in paper texts. One example is a study where an e-textbook replaced a large dental reference book and provided additional multimedia content and search capability [11], and in another study the author developed an online textbook with social interactions such as shared annotations and bookmarks [12].

Wilson [13] found that altering the appearance or design of an electronic textbook does have an effect on its success and, specifically, that applying aspects of successful web design to electronic textbooks has a positive impact on their acceptance. Nelson [14] adopted a Technology Acceptance Model framework [15] and concluded that ease of understanding and ease of finding, i.e., issues related to on-screen design, readability, and navigation, are significant determinants of perceived ease of use and perceived usefulness, and that the lack of perceived usefulness is significantly associated with a recommendation to adopt a print version of the book. In order to be successful, electronic textbooks must incorporate principles of web usability design, and cannot simply replicate paper textbooks on electronic media. They must take advantage of the medium, and establish a clear relative advantage over the print version for students to embrace this medium more readily.

There are many potential benefits to wide adoption of e-textbooks. One example is the inclusion of rich multimedia content [16] to support students' varied learning preferences. Online textbooks with assessment tools can also facilitate more effective self-paced instruction which can also be useful in large lecture settings and in web-based instruction or distance learning settings [17]. Publishers can produce customized texts from various authors in small numbers [8]. Finally, online textbooks can

provide social interaction via messaging, chat rooms, wikis, surveys or peer ratings [18, 19].

Many studies have tried to assess if online textbooks have any effect on learning outcomes. A meta-analysis found no significant differences between the online versus the traditional learning environments, [20]. While Shepperd [10] reports differences in the amount of time students report spending reading online textbooks versus paper texts, several studies show no significant difference in learning outcomes between the two groups [19, 20, 21, 22, 23]. Among different subjects, digital textbooks were found to be more effective in language, dentistry, computer science, sociology and science classes and less effective in English (as a second language) and mathematics classes [24]. Few studies have addressed online textbooks specifically in the area of engineering education. However the major publishers in the U.S. are aggressively promoting online textbooks in this area and many colleges are adopting them for perceived pedagogical, economical or other reasons.

Methods

Location and Participants

This study was implemented during the 2009-10 academic year at California Polytechnic State University (Cal Poly) in San Luis Obispo. Cal Poly is a large, comprehensive university with approximately 16,000 students, and is part of the California State University system. The study was approved by the Institutional Review Board (IRB) and all participants consented to be involved in the study. Approximately 220 students participated in the study through three different courses. No students were enrolled in more than one course under study. Participation in the study was voluntary and uncompensated, and had no effect on the participants' grade. Assessments were performed in class by a study collaborator with the instructor intentionally not present. The students were told that the instructor would not have access to the original data and would only see a compilation of the results without student names attached. All students participated except for those absent during the assessments. Table 1 includes descriptive statistics for all study participants.

Table 1: Description of the student participants.

Course	N	% female	Race/ethnicity ^a , %					Year in school ^b , %			
			White	Afric.-Amer.	Asian/Pac.Isl.	Latino	Multi-racial	Soph.	Junior	Senior	Grad.
IME 421	59	27	56	1.7	19	12	10	1.7	49	41	8.5
ME 302	33	33	82	3.0	6.1	9.1	0.0	3.0	42	49	6.1
ME 422 - Treatment	55	5.5	71	1.8	7.3	11	0.0	0.0	0.0	100	0.0
ME 422 - Control	65	14	75	0.0	11	7.7	4.6	0.0	0.0	97	3.0

^a Remainder of participants either reported "other" or did not answer this question.

^b For the data analyses, sophomore and junior students were grouped, and Senior and Graduate students were grouped.

Study Personnel

The research team consisted of three instructors (one each for IME 421, ME 302, and ME 422), one evaluator, one statistician, and one data specialist. Each of the three instructors was responsible for developing course-specific outcomes, teaching their individual courses, and assigning relevant homework and quizzes from the online textbook. The evaluator was responsible for obtaining student informed consent and conducting data collection (i.e., surveys). The statistician conducted analyses of all quantitative data collected, and the data specialist was responsible for data entry and management. In addition, all study personnel were engaged in study design, coding of qualitative student comments, and interpretation of overall findings.

Textbook Usage

For the three comparison courses, online textbooks from the same publisher were required for all enrolled students. Each of the courses had a different instructor who had previously taught the course using the printed version of the textbook. The ME 422 and IME 421 instructors had also used the online textbook in at least one prior offering of their course. The ME 302 instructor had used an online textbook from the same publisher for an undergraduate engineering mechanics course. Thus, it can be said that all three instructors were familiar with the online textbook system and its use.

Following are descriptions of the online textbooks and how each of the instructors utilized the textbooks in their respective courses:

IME 421 Manufacturing Organizations. The online textbook provided a comprehensive suite of learning materials: entire textbook content, podcasts, case studies, contemporary video clips, online quizzes (with interactive review of correct answers that point to relevant portions of the textbook), a grade book, and simulation

tools that illustrate concepts and challenges that arise in engineering management situations. The course content is largely qualitative with many organizational issues having broad scope for interpretation and ample opportunities for students to debate complex issues.

ME 302 Introduction to Thermodynamics. The online textbook included printed textbook content, including all end-of-chapter problems, and additional sample problems with solutions. In addition, some sample problems were interactive in that variables may be altered by input and the resulting changes in the solution would be displayed either through text answers or by graphical solution. Select end-of-chapter problems were available to be solved by entering final text or numerical answers (without solution procedures) directly into the online textbook system, which then automatically graded the problem and provided immediate feedback to the student. Students were permitted three attempts at solving each problem without any time limitations (i.e., they may choose to review notes or read relevant textbook sections), although each attempt resulted in a reduction in the point value assigned to that problem. The homework assigned in ME 302 typically included some brief reading, online problems and traditional paper-based problems which were submitted to the instructor for grading. Homework was assigned approximately on a weekly basis, each containing 4-8 problems, and approximately 30-60% of the problems were completed online. The online textbook was never used during class meetings or for quizzes or examinations.

ME 422 Mechanical Controls. The online textbook included printed textbook content (i.e., chapters), sample problems, and online homework. In addition, the online textbook included interactive media, such as animations which allow students to change parameters and view graphs or animations of how the system responds to parameter adjustments. During lecture, the online textbook was used to show parts of the book on a digital projector, and the animations were used to illustrate new concepts.

The online homework (with automatic grading) was used as the only form of homework assignments. Most problems were algorithmically driven, that is; each student was shown the same problem statement with a slightly different set of numerical values. This feature is intended to discourage students from simply copying a classmate's work. When students submitted an answer, the website gave them instant feedback that included a link to relevant sections in the text after the first try, a hint after the second try and the correct answer after the third and final try. The website showed the complete solutions after the assignments were due. Six to eight problems were assigned each week. Students were advised to print out the problem statements, solve them on paper, and then enter their answers into the website for instant feedback.

For ME 422, a control group (65 students) used only a printed textbook, and the treatment group (47 students) used only the online textbook. The control and treatment groups were taught by the same instructor in consecutive academic quarters, using the same pedagogy and approach, and with similar lecture periods, assignments, and tests.

Data Collection and Analyses

The 2009/2010 surveys that measured textbook usage and attitudes, using a Likert scale, were administered at three times during the term (week two, midterm, and final (10th week) (Appendix I). Survey responses were examined for differences between the control and treatment sections (ME 422 only), across the three online textbook courses, and over time in each course, using mixed linear regression models taking repeated measures into account. A comparison of means between the two ME 422 'control' sections and the two 'treatment' sections showed non-significant differences for most questions across all time points; thus, the two sections of each group (control and treatment) were combined in further analyses. Based on comparisons of model fit using Akaike's and Schwarz's Information Criteria

[25], a compound symmetry covariance matrix was selected for modeling. Main effects of treatment, time, and treatment-by-time interaction were tested before and after adjusting for gender, year in school, race/ethnicity, and grade point average (GPA). Results were not meaningfully different with or without adjustment for these covariates. Here we present the results based on the adjusted models. The same procedure was used to evaluate differences across courses. Statistical analyses were conducted using SAS software (version 9.1, SAS Institute, Cary, NC). Finally, qualitative student comments were collected through open-ended questions in the surveys, which were then coded for common themes and analyzed. The survey used in ME 422 is summarized and shown in full in Appendix 1. Surveys for the other two courses differed slightly from this, but only the common questions between the three surveys (#1 through #12) and the open-ended comments were analyzed and compared.

Results

Here we first review the survey results for ME 422 alone, comparing between the control and treatment groups, and then for all three courses. The significant results are described in summary form below; detailed numerical results are shown in Appendixes II and III for the two comparative groups, respectively.

ME422 Control versus Treatment

Among 109 students in ME 422 (only those students who took all three surveys were included in this analysis), linear regression analyses indicated significant differences between the online and printed textbook groups, with consistently more favorable scores in the latter group for questions 2-10. For questions 6-9, significant group-by-time interactions indicate that these differences became more pronounced over time, generally with scores increasing (more positive) in the control group and decreasing (more negative) in the treatment group. For question 11, a decrease in mean

Likert Scale Questions

1. I reviewed [online textbook] materials on a weekly basis, outside of the classroom.
2. The [online textbook] materials are easy to navigate and use.
3. The [online textbook] interface did not interfere significantly with the process of studying problems and answering questions.
4. Reviewing [online textbook] materials has been an effective use of my time.
5. In addition to course lectures and notes, [online textbook] materials have been necessary for my understanding of ME 422 course concepts.
6. The [online textbook] assignments helped me learn the material as well as traditional homework assignments from a printed text.
7. [Online textbook] materials increased my understanding of ME 422 course concepts.
8. Use of [online textbook] materials has positively impacted my academic performance in ME 422.
9. For future students of ME 422, I would recommend the use of [online textbook] materials.
10. The [online textbook] materials have stimulated my interest in taking further courses in control systems.

Non Likert Scale Questions

11. How much time did you spend reviewing [online textbook] materials for course-related assignments and quizzes? Please approximate number of hours per week.

Not at all\Less than 1 hour\1-2 hours\2-3 hours\3 or more hours per week

12. How much time did you spend reviewing [online textbook] materials for your own interest? Please approximate number of minutes or hours per week.

Not at all\Less than 1 hour\1-2 hours\2-3 hours\3 or more hours per week

13. Which version of the textbook and [online textbook] materials do you prefer? Please check one.

- a. E-textbook and [online textbook]
- b. Binder-ready textbook and [online textbook]
- c. Hardcover textbook and [online textbook]
- d. Binder-ready or hardcover textbook (with no [online textbook])
- e. None of the above

14. If applicable, what specific components of the [online textbook] materials increased your understanding of ME 422 course concepts? Please mark your response on the page (you may choose more than one).

Assignments\Quizzes\Reading content\Simulations\Other\Not applicable

15. How could the instructor have used [online textbook] better to improve your understanding of the course material?

16. Please provide any additional comments regarding the [online textbook] materials. Please write your response on the page.

Figure 1: Summary of ME422 Survey Questions. In the actual survey, the name of the online textbook system replaced “[online textbook]”. In the survey for the control group in ME422, “textbook” replaced “[online textbook]”.

score for the control group and an increase in the treatment group was reflected in a significant group-by-time interaction, although mean scores overall were not significantly

different. Finally, only question 6 showed a significant variation with time. These results are summarized in Table 2

Table 2: Summary of significant findings for ME 422 comparing the control and treatment groups.

QUESTION	Significant finding by:		
	Group	Time	Interaction
2. The [online textbook] materials are easy to navigate and use.	X		
3. The [online textbook] interface did not interfere significantly with the process of studying problems and answering questions.	X		
4. Reviewing [online textbook] materials has been an effective use of my time.	X		
5. In addition to course lectures and notes, [online textbook] materials have been necessary for my understanding of course concepts.	X		
6. The [online textbook] assignments helped me learn the material as well as traditional homework assignments from a printed text.	X	X	X
7. [Online textbook] materials increased my understanding of ME 422 course concepts.	X		X
8. Use of [online textbook] materials has positively impacted my academic performance in [this course].	X		X
9. For future students of [this course], I would recommend the use of [online textbook] materials.	X		X
10. The [online textbook] materials have stimulated my interest in taking further courses in [this subject area].	X		
11. How much time did you spend reviewing [online textbook] material for course-related assignment and quizzes?			X

* n=62 for control, n=47 for treatment. Significant findings are highlighted and indicated with an ‘X’. Note that the specific name of the online textbook system has been replaced in this table with “[online textbook]”. In the control group, this text would simply read “textbook.”

Comparison Between All Three Courses

Among all 134 students using the online textbook (again, only students who completed all three surveys were included), significant differences were found across the three online textbook courses on all 12 survey items measuring students’ usage and attitudes. Scores were consistently highest for the IME 421 course and lowest for the ME 422 course except for question 11, which showed the reverse pattern (i.e., relatively most time spent

reviewing online textbook material). A significant effect of time was observed for questions 1, 2, 6, and 9. Mean scores decreased for all courses for these four questions, but a larger decrease in mean score for question 6 in ME 422 resulted in a significant group-by-time interaction. A significant group-by-time interaction was also evident for question 11; mean score among students in ME 422 increased over time whereas they decreased in other courses. These results are summarized in Table 3.

Table 3: Summary of significant findings across all three courses.

QUESTION	Significant finding by:		
	Group	Time	Interaction
1. I reviewed [online textbook] materials on a weekly basis, outside of the classroom.	X	X	
2. The [online textbook] materials are easy to navigate and use.	X	X	
3. The [online textbook] interface did not interfere significantly with the process of studying problems and answering questions.	X		
4. Reviewing [online textbook] materials has been an effective use of my time.	X		
5. In addition to course lectures and notes, [online textbook] materials have been necessary for my understanding of course concepts.	X		
6. The [online textbook] assignments helped me learn the material as well as traditional homework assignments from a printed text.	X	X	X
7. [Online textbook] materials increased my understanding of ME 422 course concepts.	X		
8. Use of [online textbook] materials has positively impacted my academic performance in [this course].	X		
9. For future students of [this course], I would recommend the use of [online textbook] materials.	X	X	
10. The [online textbook] materials have stimulated my interest in taking further courses in [this subject area].	X		
11. How much time did you spend reviewing [online textbook] material for course-related assignment and quizzes?	X		X
12. How much time did you spend reviewing [online textbook] materials for your own interest?	X		

* n=47 for ME 422, n=29 for ME 302 and n=58 for IME 421. Significant findings are highlighted and indicated with an 'X'. Note that the specific name of the online textbook system has been replaced in this table with "[online textbook]".

Surveys administered in all three courses included an open-ended question asking the students to comment on the online textbook. The majority of study participants did not respond, but a significant proportion did. The three instructors coded these comments for all three courses independently and compared the results. When there was a disagreement as to the proper code assignment, the instructors discussed the item until an agreement was reached. The codes used to categorize the comments are shown in Figure 2. The codes were mostly developed by the three instructors before the study began based on guesses as to what students may comment on. Additional

codes were added after the coding began to accommodate comments that were not anticipated.

Table 4 lists the frequency and type of comments received in each course over time. In general, negative comments outnumbered positive ones, and both positive and negative comments decreased with time, with the negative comments falling to a somewhat constant level. It is clear that ME 422 students had the most negative experiences with the online textbook, even when the number of respondents in each course is taken into account. Conversely, even with the largest sample size,

Positive comments:

- P1 Well-organized
- P2 Provides immediate feedback
- P3 Convenience
- P4 Lower cost
- P5 Helped learn subject matter
- P6 Complemented my learning style

Negative comments:

- N1 Assign more problems
- N2 Assign less problems
- N3 Provide more guidance on how to use [online textbook]
- N4 Provide more hints
- N5 Provide more specific solutions to problems, not just final answer
- N6 Limits instructor feedback
- N7 Hard to read on computer
- N8 Technical problems
- N9 Cost savings not enough of a benefit
- N10 Answer formatting problems
- N11 Prefer paper homework
- N12 Needs more hyperlinks, tables, charts, multimedia
- N13 Not an effective learning tool
- N14 Increased the amount of time to complete assignments

Figure 2: Codes used to categorize student comments regarding the online textbook.

IME 421 students had relatively few complaints, though certainly there were concerns among them as well over the term. ME 302 students had approximately the same number of negative comments compared with IME 421, but had half the sample size. If the number of negative comments per student can be taken as a measure of the experience of the students in a course, the courses would clearly rank (from least to most negative) in the order of IME 421, ME 302, and ME 422.

Figure 3 shows histograms for each comment code, over time and in each course (note that some codes are left out since they were never cited). It is clear that in ME 422, the negative comments focused on several problems, and some were persistent through the quarter. The major problems included: N5, N7, N8, N10, N13, and N14. ME 302 has a broad distribution of negative comments, several of which persisted through the quarter, but none of which stood out among the others. Finally, in IME 421, it can be seen that the negative comments fell into three categories, N7, N8, and N13, with N7 and N8 less cited over time and N13 increasingly cited.

Discussion

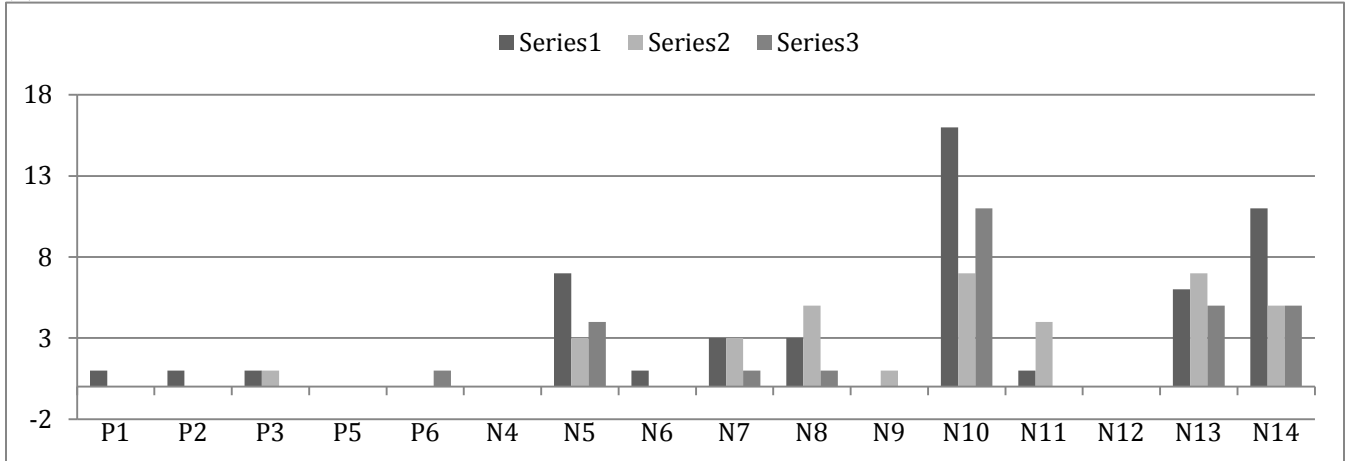
Interpretations of findings

The quantitative survey data was consistent with the coded qualitative comments, demonstrating better student attitudes toward the online textbook in IME 421, worsened student attitudes for ME 302, and lowest scores and more negative comments for ME 422. Thus, student interaction with and attitude toward online textbooks differed significantly with each course. It is not clear whether these variations are due to the publisher’s differences in implementation of the online textbook for each course (beyond the nearly identical user interfaces), or the instructor’s use of the online textbook in each course. However, our opinion is that the main cause is based on the extent of complex interactions within the course and how the online textbook accommodated this. Students enrolled in IME 421 (Manufacturing Organizations), which covered general theory, used more case studies, and relied mainly on readings and multiple-choice assessments, had more favorable attitudes toward the online

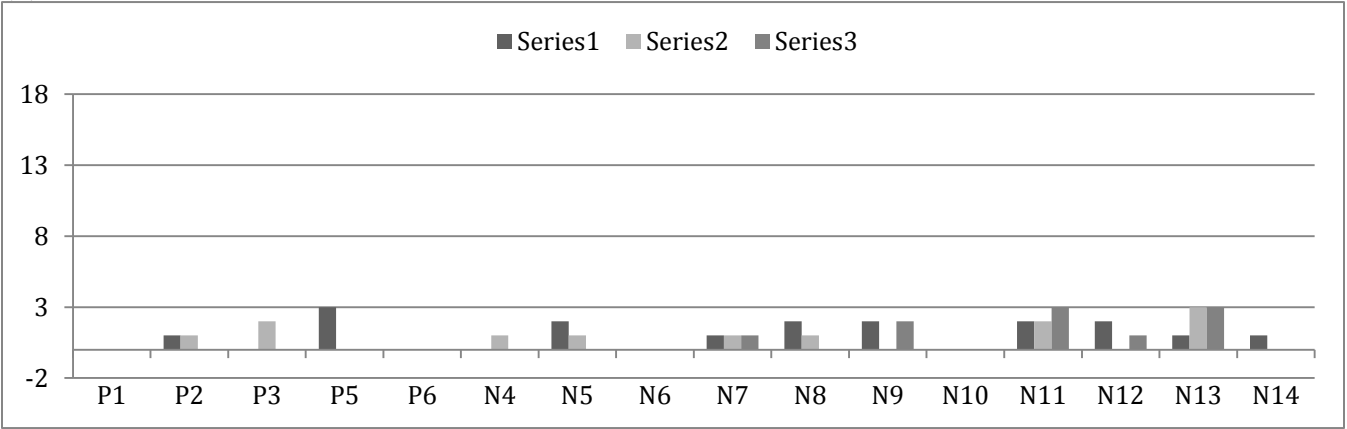
Table 4 – Frequency and type of comments over time in each course.

Survey #	ME422; n=47			ME302; n=29			IME421; n=58		
	1	2	3	1	2	3	1	2	3
# positive comments	3	1	1	4	3	0	1	0	2
# negative comments	48	35	27	13	9	10	15	8	8

(a) ME 422



(b) ME 302



(c) IME 421

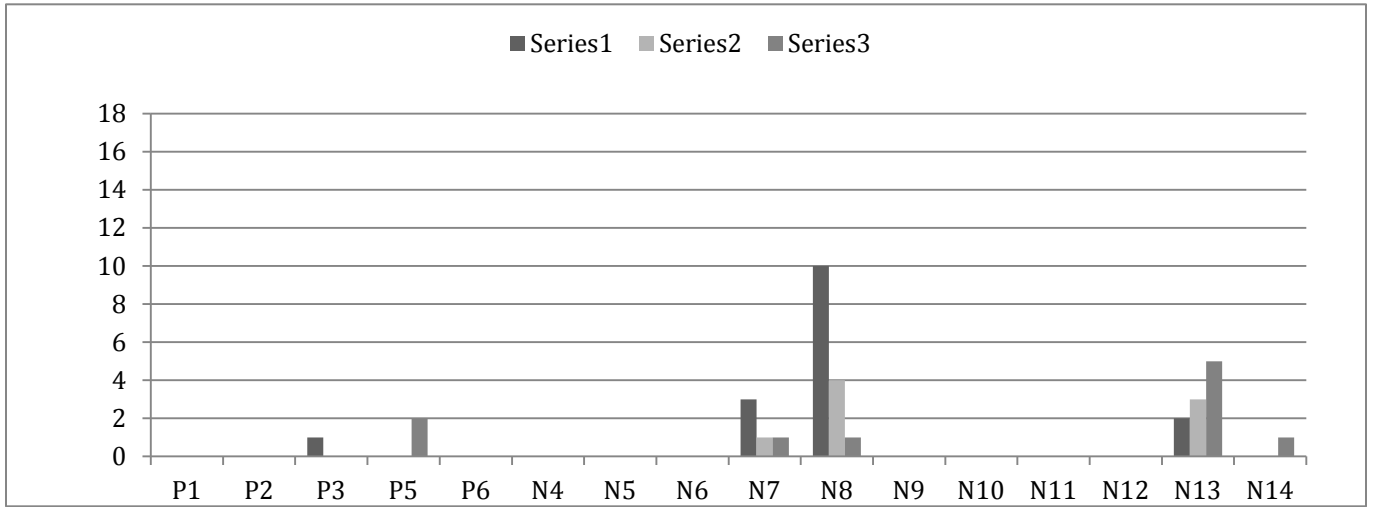


Figure 3: Histograms showing occurrences of each comment code. For each code, the cluster of three data bars represents surveys #1 (Series1), #2 (Series2), and #3 (Series3), from left to right in each cluster.

system, though certainly some complaints were consistently cited. ME 302 (Introductory Thermodynamics), while more technically complex in terms of the concepts and supporting mathematics, did not typically require more than numerical solution input to the online environment, and showed opinions and attitudes that were intermediate between the other two courses. The survey and qualitative comments for the most technically complex course in the study (ME 422 Mechanical Controls) indicated that the user interface and technical difficulties with entering symbolic solutions to the online environment were problematic and the main source of student complaints. Several comments reflected the students' negative view of the extra time used to complete assignments in the online textbook, the frustrations with technical problems or answer formatting, and the lack of feedback on the solution procedure (rather than simply an answer) in solving problems.

The qualitative comments indicate that students were consistently negative toward two problems: technical difficulties encountered with the online textbook (e.g., incorrectly graded problems, poor navigation in the web page, difficulty with inputting answers, narrow tolerance in answers to numerical solutions), and the increase in time for completing assignments and frustration level as a result of using the online textbook. These findings may be a result of the students' conception of what an "online experience" should be – perhaps based on their common interactions with websites and software applications – and the value they place on their time. Finally, it is interesting to note that for all three courses, even in IME 421, some students felt that the online textbook was not an effective learning tool (comment N13), which again may reflect their expectations for an online textbook.

We may interpret the students' opinion of online textbooks while considering the Technology Acceptance Model (TAM) as a framework [26]. TAM is an influential and widely studied model in information sciences of the acceptance and use of a new technology. Although Davis first introduced it in 1989, the model has undergone several refinements and newer models have been introduced (see [15], for example, for a recent review of the literature on TAM). In its simplest form, TAM suggests that the acceptance and use of a technology occurs when two conditions are met: (1) the perceived usefulness of the technology and (2) the perceived ease-of-use. In light of the model's suppositions, we can interpret the students' non-acceptance of online textbooks across all three courses in this study as failing one or both of these criteria. In the cases of ME 302 and ME 422, when the students' frequent comments regarding technical difficulties are considered, it is clear that the students did not perceive an ease-of-use with the online textbook, and that this, at the least, was detrimental to their acceptance of it. For IME 421, whose students experienced fewer technical difficulties, it appears that they did not fully accept online textbooks because it lacked perceived usefulness.

We find some support for these inferences in the survey results (Appendix III). Although we did not design the survey using the TAM as a framework, Questions 2 and 3 ask students about aspects of their experience related to perceived ease-of-use, and Question 8 clearly gets at whether students perceived their particular online textbook to be useful. Finally, Question 9 can be construed to be indicative of whether the online textbook was accepted. Correlations between Questions 2, 3, and 8 with Question 9 were determined and the results are shown in Table 5.

Table 5 – Pearson correlation coefficients between survey Questions 2, 3 and 8 with Question 9. Statistically significant correlations ($p < 0.05$) are shown in bold.

	All courses N = 120	ME 422 N = 45	ME 302 N = 22	IME 421 N = 53
Questions 2 & 9	0.5698 p < 0.0001	0.3830 p = 0.0094	0.2499 p = 0.2620	0.4671 p = 0.0004
Questions 3 & 9	0.6843 p < 0.0001	0.6028 p < 0.0001	0.5420 p = 0.0075	0.2680 p = 0.0524
Questions 8 & 9	0.8039 p < 0.0001	0.6107 p < 0.0001	0.8515 p < 0.0001	0.7041 p < 0.0001

The results show that, when all students and courses were combined, there was moderate to strong correlations between students' perceived ease-of-use and perceived usefulness with their acceptance (or not) of the online textbook. That is, Questions 2, 3, and 8 are all positively and significantly correlated with acceptance (Question 9). When each course was considered individually the results were similar, though some correlations weakened (ME 422: Questions 2 & 9, Questions 8 & 9; ME 302: Questions 3 & 9; IME 421: Questions 2 & 9), and some became non-significant (ME 302: Questions 2 & 9; IME 421: Questions 3 & 9).

Follow-on Study

Emergent themes from students' comments appeared to align with the Technology Acceptance Model; accordingly, we tested this preliminary interpretation with a follow-on study. The original study identified student complaints and overall levels of acceptance. But the connection showing which particular complaints affected the overall acceptance was unclear. The follow-on study was designed to identify the specific complaints that related to the negative acceptance. In the spring quarter of 2012, one of the authors (the ME 422 instructor) taught multiple sections of ME 212, Dynamics, using an online textbook. The course is relatively complex technically, probably most comparable to ME 302. The online textbook was from a different publisher, though the students (none of whom were from the previous study) interacted with the online textbook in

similar ways. Specifically, students were required to read content, complete pre-class assignments (for a small grade credit), complete homework sets, and take quizzes through the system. ME 212 did not require complex numerical or symbolic solutions to be inputted but only simple numerical answers within specified tolerances. Throughout the quarter, the instructor noted many of the same complaints from students regarding technical difficulties they were experiencing with this online textbook implementation, which gave us the idea to explore this issue in more detail.

A survey instrument was developed and administered to the 80 students enrolled in two sections of ME 212, 73 of which responded. Among the items asked in the survey was a proxy for the student's acceptance of this online textbook: "I recommend using [online textbook] again for this class next term." In addition, students were asked to what level each of 10 common technical problems affected their use of the online textbook. This list of problems included all those we encountered in the earlier study except the problem with symbolic solutions, plus others that we learned about through discussions with the students. Again, correlations between the proxy acceptance question with the 10 common problems were calculated and the results are shown in Table 6.

Table 6 – Correlation of proxy acceptance question with 10 common technical problems that students encountered with the ME 212 online textbook. Average student response is shown for each problem, and those showing a statistically significant correlation ($p < 0.05$) with the proxy acceptance question are in bold and the Pearson correlation coefficient and p-value are also given.

“If you encountered any of the following problems, to what level did the problem affect your use of [online textbook]?”

1=I did not have this problem, 2=Not significant, 3=Inconvenient, 4=Somewhat significant, 5=Very significant

Technical problem	avg. response	corr. coeff.	p-value
1. Web site down	1.6		
2. Could not log in	1.5		
3. Could not view content	1.8		
4. Could not enter answers	1.8		
5. Problem relating to significant figures	3.4	0.3218	0.0055
6. Correct answer was marked wrong	2.9		
7. Answer was entered but not recorded	2.0	0.2504	0.0326
8. Accidentally submitted answer before I finished	2.3	0.2353	0.0451
9. Web browser was not compatible with [online textbook]	1.6		
10. Could not find [online textbook] through publisher	1.4		

Based on the students’ perceived difficulties with each of the 10 common technical problems, it is not surprising that three of the top four problems identified as the most problematic (as indicated by their average response scores) are significantly correlated with students’ acceptance of the online textbook. The correlations are weak, but significant nonetheless. The weakness of the correlations may reflect the students’ recognition of some benefits of the system. That problem 6: “Correct answer was marked wrong” was not significantly correlated with acceptance is somewhat surprising, especially given its high average response. This may reflect the fact that the instructor was able to go into the system, confirm the mistake, and give credit to students who entered the correct answer. These results provide us with a listing of technical problems that are perceived to be most detrimental to student opinions of an easy-to-use and useful online textbook. Although the results are drawn from a single course, it would seem that they are applicable to most technical courses with similar levels of conceptual and interaction complexity.

Limitations of Study

This study has presented findings that are of interest and use to instructors and instructional designers interested in exploring online textbooks. We caution, however, that several limitations to the study should be considered when examining the results. First, our experience is specific to the publisher we chose (which was in turn based on the printed textbook we had originally chosen). Most major publishers have or are developing online textbooks, and other instructors’ experience may very well be different from ours depending on the publisher’s design and implementation of the online textbook. Second, our study was a snapshot in time, and this time was early for our specific online textbooks. Indeed, even during the time of our study we saw improvements in the online textbooks implemented by the publisher, some of them based on the feedback we were providing, and there’s no doubt that improvements will continue. Thus, future instructors may find significant improvements in some areas that we identified as particularly problematic. Finally, we caution that our study

did not rigorously control for how each instructor integrated the online textbook into his course, or even the extent to which each one used it. We considered and rejected this control since it would be both extremely difficult to do and, even if done, would have introduced a further confounder in that it would have fundamentally changed our way of teaching. These and many other issues are important in order to develop truly generalizable conclusions from any study, and future studies should be conducted with the goal of drawing such conclusions.

Conclusions

Online textbooks hold promise for improving student engagement and learning, increasing access, and decreasing cost. Our study has shown, however, that the publishers have much work to do. While access (“learning anytime, anywhere”) and cost control has arguably been achieved, our students have repeatedly told us that these issues are secondary to their learning, the value of their time, and their understandable extreme aversion to frustration.

Among the pedagogical implications we draw are that:

Online textbooks seem at present to be more suitable to courses that require less complex, technical interactions in the content learning, and especially those that do not include symbolic solutions requiring specific formatting.

In reflecting on our results interpreted using the Technology Acceptance Model, we find that students are indeed rejecting online textbooks because of the lack of either the perceived ease-of-use or perceived usefulness. To overcome this, publishers should discover and address technical problems *before* an online textbook is published.

Among the common technical problems that we observed in this study, the three that seem to be most detrimental to student acceptance of

online textbooks are problems relating to significant figures in the answers, answers that are entered but not recorded, and students prematurely submitting an answer before he or she is finished.

Instructors adopting an online textbook should be careful in supporting the students in the learning environment by, for example, providing solution procedures in addition to the online feedback and extra time for technical difficulties (either at the student’s end or because of the publisher’s errors).

References

1. Wieder, B., 2011. “Publishers Struggle to Get Professors to Use Latest E-Textbook Features”, The Chronicle of Higher Education The Wired Campus website. Accessed March 2013 from <http://chronicle.com/blogs/wiredcampus/publishers-struggle-to-get-professors-to-use-latest-e-textbook-features/29683>
2. Rich, Motoko. 2012. "Textbooks That Professors Can Rewrite Digitally." The New York Times. The New York Times, 22 Feb. 2010. Web. 17 Sept. <<http://www.nytimes.com/2010/02/22/business/media/22textbook.html>>.
3. Kopytoff, Verne G. 2011. "E-Textbooks Get a Lift From Publishers." Bits Blog. NY Times, 23 Mar. Web. Accessed 17 Sept. 2012. <<http://bits.blogs.nytimes.com/2011/03/23/e-textbooks-get-a-boost-from-publishers/>>.
4. Slotnik, Daniel E. 2012. “Pilot E-Textbook Program at Five Universities Focuses on Bulk Savings, Not IBooks." The Choice Blog. NY Times, 20 Jan. 2012. Web. 17 Sept. <<http://thechoice.blogs.nytimes.com/2012/01/20/pilot-e-textbooks/>>.

5. Brunet, Darlene P. 2011. "Incoming Dental Students' Expectations and Acceptance of an Electronic Textbook Program." *Journal of Dental Education* 75.5: 646-52.
6. Nelson, Mark. 2008. "E-Books in Higher Education: Nearing the End of the Era of Hype?" *ECAR Research Bulletin*, vol. 2008, issue 1.
7. Dominick, James Lyon. 2005. "The In-situ Study of an Electronic Textbook in an Educational Setting." Diss. University of North Carolina at Chapel Hill.
8. Kropman, M., Schoch, H.P. & Teoh, H.Y. 2004. "An Experience in E-learning: Using an Electronic Textbook." In R. Atkinson, C. McBeath, D. Jonas-Dwyer & R. Phillips (Eds), *Beyond the Comfort Zone: Proceedings of the 21st ASCILITE Conference*, Perth: 512-15.
9. McFall, Ryan. 2004. "Evaluation of a Prototype of an Electronic Textbook." *Proceedings of ED-MEDIA, World Conference on Educational Multimedia, Hypermedia and Telecommunications*, Lugano Switzerland: 1530-535.
10. Shepperd, James A. 2008. "Evaluating the Electronic Textbook: Is It Time to Dispense With the Paper Text?" *Teaching of Psychology* 35: 2-5.
11. Peterson, D., Kaakko, T., Smart, E., Jorgenson, M. & Herzog, C. 2007. "Dental Students Attitudes Regarding Online Education in Pediatric Dentistry," *Journal of Dentistry for Children*, 74(1): 10-20.
12. McFall, Ryan. 2006. "Experiences Using a Collaborative Electronic Textbook: Bringing the 'Guide on the Side' Home with You." *Proceedings of the 37th SIGCSE Technical Symposium on Computer Science Education*, New York: 339-43.
13. Wilson, R., Landoni, M., Forbes, G. 2003. "The WEB Book Experiments in Electronic Textbook Design", *Journal of Documentation*, Vol. 59, Issue: 4: 454-77.
14. Nelson, K. and Webb, H. 2007. "Exploring Student Perceptions of an Electronic Textbook: A TAM Perspective." *AMCIS Proceedings. Paper 107.* [Http://aisel.aisnet.org/amcis2007/107](http://aisel.aisnet.org/amcis2007/107)
15. Sharp, J. H. 2006. "Development, Extension, and Application: A Review of the Technology Acceptance Model." *Proceedings ISECON (23)*, Dallas, §2522.ISSN:1542-7382.
16. Symanzik, Jürgen, and Natascha Vukasinovic. 2006. "Teaching an Introductory Statistics Course with CyberStats, an Electronic Textbook." *Journal of Statistics Education* 14.1.
17. Appleton, L. 2005. "Using Electronic Textbooks: Promoting, Placing and Embedding." *The Electronic Library*, Vol. 23, Iss: 1: 54-63.
18. Brusilovsk, P., Girish C., and Rosta F. 2004. "Social Adaptive Navigation Support for Open Corpus Electronic Textbooks." *Adaptive Hypermedia and Adaptive Web Based Systems*, 2004 ed. Vol. 3137: 176-89.
19. McFall, Ryan. 2005. "Electronic Textbooks That Transform How Textbooks Are Used.", *The Electronic Library*, Vol. 23, Iss: 1: 72-81.
20. Moore, J.C. 2002. "Elements of Quality: The Sloan-C Framework.", Needham, MA: Sloan-C.

21. Gabriel, Trip, and Matt Richtel. 2011. "Grading the Digital School; Inflating the Software Report Card." *The New York Times*, 09 Oct. Web. Accessed 17 Sept. 2012. <<http://www.nytimes.com/2011/10/09/technology/a-classroom-software-boom-but-mixed-results-despite-the-hype.html?pagewanted=all>>.
22. Dorn, Ronald. "Online Versus Hardcopy Textbooks." *Science* 315, March (2007): 1220.
23. Navarro, P. and Shoemaker, J. 1999. "The Power of Cyberlearning: An Empirical Test." *Journal of Computing in Higher Education*, Vol. 11(1) Fall: 29-54.
24. Seo, YoungMin, and YoungJun Lee. 2010. "Meta-Analysis on the Digital Textbook's Effectiveness on Learning Attitude." *Asia-Pacific Society for Computers in Education. Proc. of 18th International Conference on Computers in Education.*, Putrajaya, Malaysia: 489-91.
25. Wolfinger, R.D. and Chang, M. 2011. "Comparing the SAS GLM and MIXED Procedures for Repeated Measures." *Proceedings of the Twentieth Annual SAS Users Group Conference, SAS Institute Inc., Cary, NC, (1995).* Accessed at Http://support.sas.com/rnd/app/papers/papers_da.html on January 13.
26. Davis, F. D. 1989. "Perceived Usefulness, Perceived Ease of Use, and User Acceptance of Information Technology", *MIS Quarterly* 13(3): 319-40.

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Appendix I - 2009/2010 Survey Measuring Online Textbook Usage and Attitudes.

ME 422 Survey

For the purpose of this survey, [online textbook] materials include Assignments, Quizzes, Reading Content, Cases, Video Clips, Simulations, MP3 Files, Interactive Learning Resources, Flash Cards, and Crossword Puzzles.

1. I reviewed [online textbook] materials on a weekly basis, outside of the classroom.
 - a. Strongly Disagree
 - b. Disagree
 - c. Neutral (neither agree nor disagree)
 - d. Agree
 - e. Strongly Agree
2. The [online textbook] materials are easy to navigate and use.
 - a. Strongly Disagree
 - b. Disagree
 - c. Neutral (neither agree nor disagree)
 - d. Agree
 - e. Strongly Agree
3. The [online textbook] interface did not interfere significantly with the process of studying problems and answering questions.
 - a. Strongly Disagree
 - b. Disagree
 - c. Neutral (neither agree nor disagree)
 - d. Agree
 - e. Strongly Agree
4. Reviewing [online textbook] materials has been an effective use of my time.
 - a. Strongly Disagree
 - b. Disagree
 - c. Neutral (neither agree nor disagree)
 - d. Agree
 - e. Strongly Agree
5. In addition to course lectures and notes, [online textbook] materials have been necessary for my understanding of ME 422 course concepts.
 - a. Strongly Disagree
 - b. Disagree
 - c. Neutral (neither agree nor disagree)
 - d. Agree
 - e. Strongly Agree
6. The [online textbook] assignments helped me learn the material as well as traditional homework assignments from a printed text.
 - a. Strongly Disagree
 - b. Disagree
 - c. Neutral (neither agree nor disagree)
 - d. Agree
 - e. Strongly Agree

7. [Online textbook] materials increased my understanding of ME 422 course concepts.
 - a. Strongly Disagree
 - b. Disagree
 - c. Neutral (neither agree nor disagree)
 - d. Agree
 - e. Strongly Agree
8. Use of [online textbook] materials has positively impacted my academic performance in ME 422.
 - a. Strongly Disagree
 - b. Disagree
 - c. Neutral (neither agree nor disagree)
 - d. Agree
 - e. Strongly Agree
9. For future students of ME 422, I would recommend the use of [online textbook] materials.
 - a. Strongly Disagree
 - b. Disagree
 - c. Neutral (neither agree nor disagree)
 - d. Agree
 - e. Strongly Agree
10. The [online textbook] materials have stimulated my interest in taking further courses in control systems.
 - a. Strongly Disagree
 - b. Disagree
 - c. Neutral (neither agree nor disagree)
 - d. Agree
 - e. Strongly Agree
11. How much time did you spend reviewing [online textbook] materials for course-related assignments and quizzes? Please approximate number of hours per week.
 - a. Not at all
 - b. Less than 1 hour
 - c. 1-2 hours
 - d. 2-3 hours
 - e. 3 or more hours per week
12. How much time did you spend reviewing [online textbook] materials for your own interest? Please approximate number of minutes or hours per week.
 - a. Not at all
 - b. Less than 1 hour
 - c. 1-2 hours
 - d. 2-3 hours
 - e. 3 or more hours per week
13. Which version of the textbook and [online textbook] materials do you prefer? Please check one.
 - a. E-textbook and [online textbook]
 - b. Binder-ready textbook and [online textbook]
 - c. Hardcover textbook and [online textbook]
 - d. Binder-ready or hardcover textbook (with no [online textbook])
 - e. None of the above

14. If applicable, what specific components of the [online textbook] materials increased your understanding of ME 422 course concepts? Please mark your response on the page (you may choose more than one).
- Assignments
 - Quizzes
 - Reading content
 - Simulations
 - Other _____
 - Not applicable
15. How could the instructor have used [online textbook] better to improve your understanding of the course material?
16. Please provide any additional comments regarding the [online textbook] materials. Please write your response on the page.

Note that the specific name of the online textbook system has been replaced in this figure with “[online textbook]”. In the control group, this text would simply read “textbook.”

Appendix II - ME 422 Survey Results.

Mean question scores by treatment group* and survey administration, and p-values for group, time, and group-by-time interaction from mixed linear regression models. Statistically significant results ($p < 0.05$) are shown in bold type.

Question	Survey administration			p-values		
	1	2	3	Group	Time	Interactio
1				0.26	0.39	0.58
control	3.7	3.3	3.5			
	3.4	3.4	3.2			
2				0.001	0.21	0.06
control	3.3	3.5	3.5			
	3.1	3.1	2.6			
3				<0.0001	0.83	0.76
control	3.6	3.7	3.7			
	2.3	2.3	2.1			
4				<0.0001	0.91	0.36
control	3.5	3.5	3.6			
	2.6	2.6	2.4			
5				<0.0001	0.84	0.22
control	3.7	3.6	3.8			
	2.6	2.5	2.4			
6				<0.0001	0.02	0.0001
control	4.0	4.0	4.2			
	2.9	2.2	2.2			
7				<0.0001	0.49	0.006
control	3.6	3.9	3.9			
	3.0	2.9	2.7			
8				<0.0001	0.88	0.02
control	3.6	3.7	3.8			
	2.6	2.4	2.3			
9				<0.0001	0.78	0.002
control	3.8	3.8	4.0			
	2.3	2.0	1.9			
10				<0.0001	0.88	0.11
control	2.7	2.6	2.8			
	2.2	2.0	1.9			
11				0.67	0.58	0.009
control	3.6	3.5	3.4			
	3.2	3.7	3.8			
12				0.38	0.22	0.13
control	1.6	1.4	1.5			
	1.4	1.2	1.5			

* n=62 for control, n=47 for treatment.

Appendix III –All Courses Survey Results.

Mean question scores by course* and survey administration, and p-values for group, time, and group-by-time interaction from mixed linear regression models.

Question	1	2	3	Group	Time	Interactio
1				0.02	0.008	0.91
ME 422	3.4	3.4	3.2			
ME 302	3.4	3.3	3.0			
IME 421	4.0	3.7	3.6			
2				<0.0001	0.03	0.84
ME 422	3.1	3.1	2.7			
ME 302	3.7	3.8	3.5			
IME 421	4.2	4.2	4.0			
3				<0.0001	0.78	0.60
ME 422	2.3	2.3	2.1			
ME 302	3.2	3.4	3.0			
IME 421	3.8	3.7	3.8			
4				<0.0001	0.26	0.58
ME 422	2.6	2.6	2.4			
ME 302	3.1	3.4	3.0			
IME 421	3.8	3.7	3.7			
5				<0.0001	0.53	0.15
ME 422	2.6	2.5	2.4			
ME 302	2.5	2.7	2.3			
IME 421	3.4	3.5	3.6			
6				<0.0001	0.002	0.01
ME 422	2.9	2.2	2.2			
ME 302	3.5	3.5	3.1			
IME 421	3.8	3.9	3.7			
7				<0.0001	0.27	0.56
ME 422	3.0	2.9	2.7			
ME 302	3.1	3.2	3.1			
IME 421	4.0	3.9	3.9			
8				<0.0001	0.09	0.82
ME 422	2.6	2.4	2.3			
ME 302	3.1	3.0	3.0			
IME 421	3.9	3.7	3.8			
9				<0.0001	0.006	0.28
ME 422	2.3	2.0	1.9			
ME 302	3.2	3.3	2.9			
IME 421	4.0	3.7	3.8			
10				<0.0001	0.13	0.14
ME 422	2.2	2.0	1.9			
ME 302	2.2	2.5	2.1			
IME 421	3.2	3.2	3.3			
11				0.03	0.38	0.0004
ME 422	3.2	3.7	3.8			
ME 302	3.2	3.2	2.9			
IME 421	3.3	3.0	2.8			
12				0.01	0.56	0.06
ME 422	1.4	1.2	1.5			
ME 302	1.3	1.4	1.3			
IME 421	1.9	1.7	1.7			

* n=47 for ME 422, n=29 for ME 302, and n=58 for IME 421.

Appendix IV -Spring 2012 ME212 Dynamics Online Textbook Survey.

Description: This anonymous survey will be used to assess your perceptions of the online text as a component for this course.

Instructions: Answer the following questions related to the use of the online text in your ME212 Dynamics course spring 2012. Your responses are anonymous.

Q1. Overall what is your level of satisfaction with the online text website? (1 =Very satisfied, 2=Somewhat satisfied, 3=Neutral, 4=Somewhat unsatisfied, 5=Very unsatisfied)

Q2. List two things you like most about the [online text] website.

Q3. To what extent do you agree with the following statements about [online text website]? (1 = Strongly agree, 2=Somewhat agree, 3 = Neutral, 4=Somewhat disagree, 5=Strongly disagree)

	1	2	3	4	5
It is easy to use.					
It is easy to learn.					
It is user friendly					
It is easy to master					
It is very useful for this class.					
It helped me with study for exams.					
I hope other classes use it in the future.					
I recommend using it again for this class next term.					

Q4. If you encountered any of the following problems, to what level did the problem affect your use of [the online text website]? (1=I did not have this problem, 2=Not significant, 3=Inconvenient, 4=Somewhat significant, 5=Very significant)

	1	2	3	4	5
Web site down					
I could not log in					
Could not view content					
Could not enter answers					
Problems relating to the number of significant figures					
Answer was correct but marked wrong erroneously					
Answer was entered but not recorded					
I accidentally submitted my answer before I finished					
The web browser I was using was not compatible with [the online text website]					
I could not find the correct web page on the [online text] website					

Q5. Describe any other difficulties you encountered that are not listed above

Q6. Do you think that an online learning system could be useful to learn engineering subjects? (Definitely yes, maybe, neutral, probably not, definitely not)

Q7. How many hours a week did you spend reading the **printed** textbook?
(0-30 minutes, 30-60 minutes. 1-2 hours, 2-4 hours. 4-6 hours, 6-8 hours)

Q8. In addition to the reading quizzes, [the online text website] includes a full online version of the textbook. How many hours a week did you use the online version of the textbook (instead of the printed version of the textbook) to read, look up formulas, do homework, etc?
(0-30 minutes, 30-60 minutes, 1-2 hours, 2-4 hours, 4-6 hours, 6-8 hours)