

A Study of Interactive e-lessons Use in a Residential Construction Management Course

Scott D. Kelting, Ed.D., LEED AP, CGP
California Polytechnic State University
San Luis Obispo, California

Beth Jacobson, M.Ed.
Louisville, Kentucky

Eric A. Holt, CGP, CAPS
Purdue University
West Lafayette, Indiana

This paper reports on the features and content of recently developed interactive e-lessons designed for residential construction management courses. Information about the e-lessons' 10 different features and content is included in this paper. This study compared students' perspectives about the interactive e-lessons using surveys with ranked order, Likert-type and open-ended questions from three different quarters of the same residential construction management course at a four-year university. The authors conducted a survey to obtain the students' perspectives about the features they both preferred and found most effective. The survey also obtained students' perspectives about the interactive e-lessons compared with those found in books and non-interactive electronic readings. The paper presents and discusses the results of these student surveys. Survey results also provided insight on areas to improve the interactive e-lessons to make them more appealing and effective for future users. Preliminary findings suggest the primary area for improvement centered on the ways in which the e-lessons organized the content that resulted in students spending more time than they preferred on assignments. This paper aims to provide information and guidance to assist educators in developing the appropriate mix of features in the development of future e-lessons.

Key Words: e-lessons, instructional technology, residential construction, students' perspectives

Introduction

Individuals walking around school campuses often see today's students engaged with technology such as smart phones and laptops for both social and educational purposes. Higher-education students have been classified as "21st-century learners" or "digital natives" who: multitask and use images to convey content whenever possible, are digitally literate and mobile, assume computers are part of the life experience, crave interactivity, read images well, prefer visual and kinesthetic activities over reading and listening activities, desire random access, want to be challenged to reach their own conclusions, and need practical applications in real-world contexts (Rodgers, et al., 2006).

In an effort to enhance the quality of learning experiences for 21st-century learners, educators have begun to adopt a blended learning approach. Numerous models of blended learning are designed to integrate face-to-face and online learning to recapture the traditional values of higher education while meeting the demands and needs of the 21st century (Garrison & Vaughan, 2008). The implementation of e-lessons (also known as "online textbooks," "e-textbooks," "e-books," and "digital textbooks") is an emerging area in both higher education and related scholarly research. Both students and instructors have found e-lessons preferable for their low cost, smaller environmental footprint, and portability (Chen, et al., 2011).

The use of e-lessons is one method instructors have adopted in an effort to create a blended learning approach. However, research has recognized a common error in designing a new technology that mirrors older technology (Clark & Mayer, 2008). For example, some e-lessons appear to consist of a book's content simply transferred to a computer screen. Additional concerns about e-lessons include: "poor user interfaces, inconsistent or nonexistent standards among textbook publishers, restrictive licensing, limited range of available textbooks, and growing pains

with learning new technologies” (Chen, et al., 2011). Recent research deemed “cultural acceptance” one of the greatest barriers to e-lessons (Nelson, 2008). Even students categorized as “digital natives” regularly exhibit discomfort when transitioning to a digital format. However, these cultural barriers may eventually dissipate as new cohorts of students enter college (Chen, et al., 2011).

Chen, et al. (2011) studied the effectiveness of e-lessons and compared students’ attitudes and performance in three different engineering courses. They found students’ attitudes toward e-lessons to differ based on the technical nature of the course. Students enrolled in more technical courses indicated interface and technical difficulties due to entering symbolic solutions in the online environment. Students enrolled in less technical courses reported more favorable perspectives on the e-lessons, citing the advantage that they did not typically require numerical input. Many times less technical e-lessons are developed to have less numerical input features. The students concluded that e-lessons are more suitable for less technical courses and that instructors adopting e-lessons should support students in the new learning environment by allowing extra time due to technical difficulties (on the part of either the student or the publisher). The interactive e-lessons developed for the Residential Construction Management course in this study are not technical in nature.

Kelting (2011) researched students’ perspectives of 14 different delivery methods and combinations of methods students preferred and deemed effective. The instructor used the following teaching methods in the class: lectures, lectures with a personal response system, in-class activities and discussion, guest lecturers, labs, overall capstone projects, peer reviews, exams, quizzes, field trips, reading assignments, homework assignments, team activities, and student presentations. Reading ranked the lowest of all 14 delivery methods in both student preference and effectiveness. An outcome of Kelting’s (2011) research centered on developing interactive e-lessons through an easy-to-manage Web-based system. Interactive e-lessons are different than many non-interactive e-books that are simply digital versions of traditional textbooks. Kelting’s (2011) research recommended interactive e-lessons that included:

- real-world content with strong image support to increase comprehension of important concepts
- content broken into manageable segments to keep the learner engaged
- interactive questions embedded into the content to build the connection between prior knowledge and new content, to check for understanding, and to offer opportunities for students’ reflection on what they learned
- immediate, specific feedback to reinforce what students understand and to provide clarification
- assessments to determine whether students met lesson objectives
- definitions of key terms provided within the content to support student understanding
- videos, case studies, and unit engagers to connect lesson content with residential construction concepts
- flashcards to provide students with the opportunity to review key terms and calculations

Students have expressed preferences for the ways in which they receive information and the different features they find more effective and preferred for learning. This paper reports on the features and functionality of 30 interactive e-lessons; it also presents the students’ perspectives of the interactive e-lessons. Knowledge of students’ preferred methods of information delivery can help instructors customize their delivery of information to meet individual students’ learning preferences. Additionally, understanding students’ preferences may motivate instructors to move away from their preferred modes of information delivery to use others (Lujan and DiCarlo, 2006).

Based on Kelting’s areas for future research (2011), the authors generated the following research questions for this study:

1. Which features of the interactive e-lessons did students perceive as more effective in a second-year residential construction management course?
2. Which features of the interactive e-lessons did students perceive to prefer in a second-year residential construction management course?
3. Do students perceive interactive e-lessons as more engaging than textbooks?
4. Do students perceive interactive e-lessons as more engaging than non-interactive e-lessons?

Methodology

Performed over three separate quarters of the same residential construction management course at a four-year university, this study compared students' perspectives about interactive e-lessons using surveys using ranked order, the five-point Likert scale, and open-ended questions. The authors adopted a forced-ranking survey method to find out which features of interactive e-lessons students perceive as more effective and prefer—a decision resulting from the ceiling effect generated by the five-point Likert Scale used in other research on student perspectives (Kelting, 2011). For example, one study used the five-point Likert Scale to rate the students' perception of how various delivery methods helped with their communication and teamwork skills while enabling their understanding of the final project (Kelting & Hauck, 2010). The survey results led to a ceiling effect that made it difficult to pinpoint the differences between these delivery methods. However, this study used a five-point Likert Scale to find out whether the students perceived the interactive e-lessons as more engaging than textbooks and non-interactive e-lessons. To expand beyond the survey questions, the authors also used qualitative questions and informal group discussions at the end of each quarter to allow students to share their thoughts about the different features of the interactive e-lessons.

The instructor implemented the interactive e-lessons from CourseBuilder in an undergraduate residential construction management class as homework assignments to supplement the old hard copy textbook homework assignments. Each class used the e-lessons for one academic quarter prior to responding to the survey. The average class size was 22 students. The students were divided into six teams of four for both the lab assignments and the final project. They class met with the instructor 16 hours a week for a 10-week quarter in the winter and spring, and 20 hours a week for an 8-week quarter in the summer. Taught in a laboratory space dedicated solely to homebuilding education, the course combined components of the following four classes: Residential Methods, Estimating, Scheduling, and Contracts. The instructor used the following teaching methods in the class: lectures, lectures with a personal response system, in-class activities and discussion, guest lecturers, labs, overall capstone project, peer reviews, exams, quizzes, field trips, reading assignments, homework assignments, teamwork, and student presentations.

Upon completing the class in the winter, spring, and summer quarters of 2011, students completed a survey detailing which interactive e-lesson features they preferred and deemed most effective. The authors created the survey to obtain this student feedback so instructors of future classes could use the resultant information to focus on areas students ranked as the highest and improve on areas ranked the lowest. The survey was explained to the students and the definitions of "preferred" and "effective" were defined. Preferred was defined as "the way students like to learn" and effective as "the way students learn best". All students responded to the survey. The class was comprised of 24 students in winter 2011, 25 students in spring 2011, and 17 students in summer 2011. The summer 2011 class had 11 construction management majors and 6 construction management minors. Two of the minors were architectural engineering majors, three of the minors were architecture majors, and the other was a civil engineering major. The students completed the survey anonymously. The results of the students' perspectives appear in Table 1. The instructor developed the survey based on Kelting's (2011) areas for future research. It underwent a peer review process that customized it for the purposes of this study. The students listed the features of interactive e-lessons on a forced ranking scale of 1 to 10, with 1 being the highest. Students were also asked to rate how well the interactive e-lessons helped them engage with the material in comparison with non-interactive reading. Additionally, the students were asked to provide both positive and constructive feedback about their experience with the interactive e-lessons.

Interactive e-lessons

Based on Kelting (2011) and the needs of 21st-century learners, the authors generated content and developed interactive e-lesson features for the following topics: foundations, framing, structural hardware, mechanical and electrical features, plumbing, drainage planes, exterior cladding, energy efficiency and insulation, drywall, interior finishes, storm-water pollution prevention plan, jobsite safety, scheduling, estimating, and contracts. The instructor incorporated all these topics into 30 interactive e-lessons that had a deliberate organization and content aimed at creating an interactive environment for the users.

Organization and Interactive Content

After organizing the interactive content into lessons, each considered equivalent to a chapter in a textbook, the instructor organized the lesson content into units. Each unit contained one or more topics, and each topic covered a variety of subtopics. Below is an example of the organizational structure:

Lesson 5: Constructing the Foundation

Unit 1: Excavating the Slab Area

Unit 2: Preliminary Stages of Foundation Construction

Unit 3: Slab Construction

Topic 1: Utilities

Subtopic: Utility Layout

Subtopic: Utility Testing

Subtopic: Examples

Subtopic: Video—Locating the Placement of Piping

Topic 2: Pre-Slab Protection

Topic 3: Post Tension Layout

Topic 4: Slab Placement

Topic 5: Post Construction

Unit 4: Basements and Crawlspace

The above organizational structure allowed for the breakdown of comprehensive content into manageable chunks of reading with the goal of making the material accessible and engaging to students. The user could access the content from multiple entry points provided through hyperlinked lesson features. The instructor also presented real-world content in a variety of formats to promote interest and included photos or drawings to assist with increasing comprehension of important concepts. During the reading of process descriptions, students could view thumbnail sequences or see each sequence in an expanded view with short descriptions. Students had opportunities to click on “More” links throughout the content to access more in-depth information.

The instructor integrated a variety of pedagogical elements into the content. For example, the instructor established learning objectives to focus learners on the most important concepts, identified key vocabulary, and provided definitions as hyperlinks throughout the content. A sampling of this vocabulary served as the basis for pre- and post-tests. The instructor integrated videos throughout the lesson to provide connections to the real world of construction. Lesson scenarios provided students with the opportunity to complete a task by applying what they learned in the lesson to a situation they might encounter on the job. Lesson summaries and electronic flashcards provided students with the resources to review important key terms and calculations before completing the lesson.

The online format provided assessments, flash cards, real-world scenarios as case studies, and interactive questions. The assessments, flash cards, and interactive questions offered immediate, specific feedback to reinforce learners’ understanding and provide clarification as necessary. Interactive questions were embedded into the content. “What Do You Think” questions appeared at the beginning of each lesson to stimulate interest and engage students in the content of the upcoming lesson. At the beginning of each new topic, “Think About It” questions built the connection between prior knowledge and new content. The instructor integrated “Test Your Knowledge” and “Quick Check” questions throughout the content to check student understanding before the end of a lesson. Students received immediate, specific feedback. The feedback for each question included a reference back to the content. “Key Points/Make a Note” prompts encouraged students to reflect and summarize. The instructor provided a comprehensive assessment with immediate feedback at the end of each lesson. When applicable, the feedback directed the reader to the section containing the information necessary to answering each assessment question correctly.

Survey Results

Each of the five survey items is listed in numerical order below with a discussion of the authors’ analysis of the results.

Ranking of e-lesson Features

1. Based on your experience with the e-lessons, please rank the features of the e-lessons (in order from 1 to 10) based on the way you prefer to learn, with 1 being the highest and 10 the lowest.
2. Based on your experience with the e-lessons, please rank the features of the e-lessons (in order from 1 to 10) based on the most effective way for you to learn, with 1 being the highest and 10 the lowest.

This study performed the following steps to analyze the survey results of the ranking of delivery methods. First, the authors developed histograms for questions 1 and 2 and evaluated them for each aspect of the e-lessons in all three quarters. The histograms provided a visual means to ensure the authors did not provide bimodal responses. The evaluation of the histograms demonstrated there was general agreement for all delivery methods. The general agreement allowed the authors to sort the delivery method results from lowest mean rank to highest mean rank. The lowest mean rank represented the students' overall feature of choice. All three quarter survey results were combined. All 66 students responded to the questions above. A side-by-side comparison of the preferred and effective ranks appears in Table 1.

Table 1

Results of student perspectives of preferred and effective ranks

Preferred Rank	Delivery Method	Effective Rank	Delivery Method
1	Real-world content with strong image support	1	Real-world content with strong image support
2	Videos, case scenarios, and lesson engagers	2	Videos, case scenarios, and lesson engagers
3	Content broken into manageable segments	3	Assessments at end of units and lesson
4	Assessments at end of units and lesson	4	Interactive questions embedded into the content
5	Interactive questions embedded into the content	5	Immediate, specific feedback on the interactive questions
6	Immediate, specific feedback on the interactive questions	6	Content broken into manageable segments
7	Definitions of key terms provided within the content	7	Key Term pre- and post-tests
8	Flashcards	8	Definitions of key terms provided within the content.
9	Key Term pre- and post-tests	9	Clear learning objectives
10	Clear learning objectives	10	Flashcards

Interactive e-lessons compared with non-interactive reading

The results of the students' perspectives about how the interactive e-lessons compared with books and non-interactive e-lessons appear in Table 2. The following results were derived from the students' perspectives using the methodology stated above:

Table 2

Results of student perspectives of interactive e-lessons compared to books and non-interactive e-lessons

Questions	Scale for Student Responses					Mean Response	Quarter
	1	2	3	4	5		
3 Based on your experience, how well did working with the interactive e-lessons help engage you with the material compared with a textbook?	5.9%	29.4%	17.6%	29.4%	17.6%	3.24	Summer11
	4.0%	4.0%	16.0%	36.0%	40.0%	4.04	Spring11
	8.3%	12.5%	29.2%	41.7%	8.3%	3.29	Winter11
4 Based on your experience, how well did working with the interactive e-lessons help engage you with the material compared with an electronic reading that is not interactive?	17.6%	11.8%	23.5%	17.6%	29.4%	3.29	Summer11
	4.0%	8.0%	16.0%	40.0%	32.0%	3.88	Spring11
	8.3%	4.2%	29.2%	33.3%	25.0%	3.63	Winter11

Students' Feedback

The fifth survey question asked the students to provide both positive and constructive feedback about their experience with the interactive e-lessons. An informal group discussion also occurred at the end of each quarter. The students' responses were evaluated for common themes.

The positive student comments are summarized by the following themes:

- Interactive questions throughout the lesson and at the end of the lesson
- Videos
- Strong image support
- Content broken into manageable pieces

The constructive student comments are summarized below:

- Internet connectivity is difficult to obtain and is limited to certain locations.
- Students express frustration with the user interface learning curve of a new e-lesson computer program.
- The content needs to be organized better to make the reading process and Web page navigation less time consuming.
- Students would prefer to have a hard-copy book in addition to the e-lessons.

Discussion

The results of the study identified a ranked order of features the students preferred and found effective to answer research questions 1 and 2. The top six ranked items from the students' perspectives of both preferred and effective delivery methods referenced six preferred delivery methods:

- Real-world content with strong image support
- Videos, case scenarios, and lesson engagers
- Content broken into manageable segments

- Assessments at the end of units and lessons
- Immediate, specific feedback on the interactive questions
- Interactive questions embedded into the content

The authors recognize these features as perceived positively by the students and encouraged by the positive results of the interactive features. Real-world content with strong image support ranked first on both preferred and effective delivery methods.

The survey results ranked the following four features at the bottom of students' perspectives of both preferred and effective interactive e-lessons: definitions of key terms provided within the content, flashcards, key term pre- and post-tests, and clear learning objectives. Items 7 through 10 of Table 1 reveal the students' perspectives of their least-preferred features.

The study performed the following tasks to analyze the survey results for questions 3 and 4:

- Comparison of the values of the mean response for winter, spring, and summer 2011
- Evaluation of the mean response value (based on Olbina, 2008 p.55)

The study considered ratings with values of 4 and 5 were "positive," 3 "neutral," and 1 and 2 "negative" (Olbina, 2008 p. 55). The authors derived the following results from questions 3 and 4 using the methodology stated above:

When comparing how well the interactive e-lessons helped the students engage with the material compared to a text book, 50% of the students in winter quarter, 76% of the students in spring quarter, and 47% of the students in summer quarter thought interactive e-lessons helped engage them in the material compared with textbooks. 17.6% of the students in summer 2011, 16% of the students in spring, and 29.2% of the students in winter were neutral with the comparison of interactive e-lessons versus textbooks. 35.3% of the students in summer 2011, 8% of the students in spring, and 20.8% of the students in winter thought books helped them engage the material compared to interactive e-lessons. The mean response for all three quarters was above 3.52. The authors were surprised to find the mean response was neutral when the students compared how well the interactive e-lessons engaged them compared to textbooks.

When comparing how well the interactive e-lessons helped the students engage with the material compared to e-reading that is not interactive, 47% of the students in summer 2011, 72% of the students in spring, and 58.3% of the students in winter thought interactive e-lessons helped them engage the material compared to textbooks. 23.5% of the students in summer 2011, 16% of the students in spring, and 29.2% of the students in winter were neutral with the comparison of interactive e-lessons versus textbooks. 29.4% of the students in summer 2011, 12% of the students in spring, and 12.5% of the students in winter thought books helped them engage the material compared to interactive e-lessons. The mean response for all three quarters exceeded 3.6. The authors found no statistical significant differences between questions 3 and 4.

The mean response for all three quarters exceeded 3.6 on Question 4. The authors found no statistical significant differences between the responses to questions 3 and the responses to Question 4. Students did not perceive interactive e-lessons as more engaging than textbooks and non-interactive e-lessons. Students may feel neutral about the difference between the interactive e-lessons in this study versus non-interactive reading for several possible reasons. For one, the students in this study did not receive a hard copy of the material. The license for the e-lessons was for only one year, and the students expressed that they would like to have access to this material for the rest of their professional careers. Some students still preferred to read from a book.

One reason summer scores were low for questions 3 and 4 were because many students were going to school part time and working part-time. Many of their workplaces did not have good or any internet access and therefore the students could not access the e-lessons. Additionally, some students in the summer class were not on campus as much and used slower internet connection at home which lengthened the amount of time students spent completing the interactive e-lessons. The authors' think items 7 to 10 were ranked as least preferred and effective for several reasons. The learning objectives in the content were not interactive and took their own webpage. The students found having the learning objectives on their own web page to be cumbersome and time-consuming. The authors think the

students ranked the key term pre and post tests low because they were not graded, nor did the instructor tie these tests to the course exams. Similarly the authors think the key term definitions and flashcards were ranked low because the instructor did not incorporate these into the exams.

Conclusion

In general, the constructive qualitative responses were in line with the two qualitative findings of Chen, et al. (2011): frustration with the interface (poor navigation in the Web page due to the organization of the content) and the increased time for completing reading assignment. The authors have deemed the students' frustration with the organization of the content and the increased time to complete assignments as the main reason the student responses had a mean score for questions 3 and 4.

Based on the students' perspectives and their constructive feedback, the authors made the following modifications to the organization of the content within the interactive e-lessons. The lesson learning objectives, which were originally on their own separate Web page, now appear on their respective lesson introduction page. The unit learning objectives and the "Think About It" questions, also originally on their own respective pages, now appear on the landing pages for each unit. The self quizzes previously appeared randomly throughout the lessons at the bottom of some pages; the blue "self quiz" button was jumping farther down the page, and the users needed to scroll down to find it. The authors have now fixed this issue of the "Self Quiz" button, which is now in the correct location.

The authors may perform additional surveys to analyze the results of future students' perspectives of the different interactive e-lesson features for this course and others. Potential areas for further research would include a follow-up study to determine whether future students find interactive electronic reading lessons more or less engaging than those surveyed in this study based on the recent modifications listed above. Another potential area for further research would include a follow-up study to rank students' perspectives of different delivery methods with e-lessons as one of the delivery methods. The authors have recommended future research on the interaction between the e-lesson features and the different instructional delivery methods that are utilized in the classroom. The reviewers for the *ASC 48th International Conference Proceedings* commented that it would be interesting, for future research, to study the interaction between the e-lesson features and the different instructional delivery methods that are utilized in the classroom.

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