

AC 2010-159: TECHNOLOGY AND LEARNING OBJECTS IN THE ENGINEERING TECHNOLOGY CLASSROOM

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Technology and Learning Objects in the Engineering Technology Classroom

Abstract

There was a time when using technology in the classroom meant showing PowerPoint slides. In recent years there has been a dramatic increase in different technologies and computer applications that have enabled instructors to provide additional learning outside the classroom, to provide videos of teacher classroom instruction as well as additional lectures beyond the classroom, and the ability to hold “remote” extra help classes.

However, following the same pedagogical approach as used in a traditional face to face classroom setting is not the best use of this technology. Too often, faculty use some of the newer technologies to video their entire classroom lecture, with the idea that students will learn by viewing an hour or two worth of material. A better approach is to combine these technologies with the concept of learning objects, which are digital resources that can be used and re-used to support student learning.

This paper will describe the implementation of a learning object model in an upper division circuit analysis course within an Electrical and Computer Engineering Technology program. The course is taught face to face, and the instructor had been teaching it for over 12 years. By utilizing the learning object model, assessments of each learning object were developed, relating each learning object to various student work – homework, lab reports, tests and presentations. PowerPoint was used to create the material for each learning object, and both Multisim 10.1 and Mathtype 6.5 were used to create the visuals and equations. Camtasia Relay was used to create the videos for each learning object, and they were stored in the school portion of iTunes University. A course management system (Moodle) was used to establish out-of-class communication among students and between the instructor and students. The instructor also used Moodle to post links to the learning object videos and to provide additional support materials.

Examples of these learning objects will be shown in this paper, as well as the problems and the amount of effort involved in developing and creating these learning objects. The paper will also describe the assessment of this concept related to increasing student learning.

Introduction

Instructional delivery and the use of technology have changed over the years. Faculty need to identify effective strategies that could improve and strengthen academic programs in order to meet the learning needs of all students, especially the Net Generation students¹. While technology at one time meant an overhead projector, over the last decade typical technology use in the classroom revolved around PowerPoint slides of class lessons. However, there have been recent advances, both in software, hardware and Internet delivery that allow a next generation of videos to enhance learning in the classroom.

Many of these advances started with the need to provide classroom education via distance learning. Specialized classrooms were setup with video equipment, either to tape the lectures and distribute them asynchronously or to provide synchronous video and student feedback. Over the last several years, content management systems, such as WebCT or Blackboard, have been used to provide lecture materials, examinations, homework, grading and chat ability for the students.

Our institution had been using these types of systems (WebCT) for its distance learning classes, as well as providing video for classroom instruction. Recently, applications such as Camtasia[®] and Relay have been used to “tape” lectures, by allowing the user to merge the video of PowerPoints and writing on tablets with the audio. This, along with the use of small wireless microphones, provided the instructor with a simpler method to deliver classroom lectures online. In addition, our university changed to an open source content management system, called Moodle.

A majority of the courses taught at our university are still face to face, so the question revolved around how to use distance learning technologies in a face to face classroom setting. The answer was to combine the use of the content management system (Moodle) and a variation of the classroom lecture videos, using Relay, and deliver these videos via iTunes University. The videos, rather than being entire classroom lectures, were small 5-10 minute segments of a lecture. These were called learning objects.

Learning Objects

A learning object was defined by The IEEE LTSC (IEEE Learning Standards Committee) as any entity, digital or non-digital, that may be used for learning, education or training.² Learning objects are a new way of thinking about learning content. Traditionally, content comes in a several hour chunk. Learning objects are much smaller units of learning, typically ranging from 2 minutes to 15 minutes, and can be defined as “an independent and self-standing unit of learning content that is predisposed to reuse in multiple instructional contexts”.³ L’Allier further refines this definition of a Learning Object as the smallest independent structural experience that contains an objective, a learning activity and an assessment.⁴

Learning objects, as a self-standing unit of learning, should include an objective, a learning activity, and an assessment.⁵ The learning objects created for this course included the first two elements, with an additional example as a self assessment.

Course Description

The material described in this paper was developed for a third year circuit measurement course for the Fall, 2009 semester. The Electrical and Computer Engineering Technology program (ECET) at the university was an upper two year program until recently, and this course, Circuit Measurements, was the first course that the transfer students took. This course has always been taught face to face, and the instructor had been teaching it for over 12 years. It consists of a one hour lecture and two hour laboratory.

The topics in this course are those commonly found in a Circuit I course, and include

- Error Analysis
- Ohm's, Kirchoff's Laws, Voltage and Current division
- Independent and Dependent Sources, Mesh Analysis
- Nodal Analysis
- Thevenin/Norton and Maximum Power Transfer
- Superposition and Source Transformation
- First Order Response
- AC Steady State Analysis
- Frequency Analysis

Each bullet represents a single class period (except for First Order Response, which was discussed over two class periods). The laboratory work followed the classroom discussion topics.

Students had been using PSpice version 9.1 (demo version), and were switched to National Instrument's Multisim 10.1. While Multisim is fairly easy to use, there is still a small learning curve for the students, and the instructor decided that laboratory and lecture time should not be used to educate students on this product. There were two lab periods that were devoted to incorporating Word, Excel and PowerPoint into producing written and oral technical reports, as well as graphing laboratory results. While students had some understanding of these applications, they were not knowledgeable about some of the more advanced features that were taught. While the students learned these features by actually participating in computer exercises, the past experience by the instructor was that many of the students forgot how to use these features.

Creation of Learning Objects for this Course

The first step in creating the videos, which were based on the learning objects, for this class was to create a listing of the learning objects. From the nine bullets representing the lecture topics, 23 learning objects were identified, including three learning objects for the Multisim application and three for the technical communication applications. Once these learning objects were identified, a series of PowerPoint slides were created for each non-computer based learning object. The methodology in creating these videos allowed the instructor to use the actual application (Multisim, PowerPoint, Excel or Word) to demonstrate the specific features or uses.

For example, the learning objects related to the class lecture on Thevenin/Norton and Maximum Power Transfer includes:

- Thevenin/Norton - Introduction
- Thevenin/Norton – Solving for Independent Source circuits
- Thevenin/Norton – Solving for Dependent Source circuits
- Thevenin circuits and Multisim

In addition to creating the definition of each learning object, various assessments were assigned to each learning object, including homework assignments, lab reports and exam questions.

There were two products that were used to record the videos – Camtasia Relay (by Techsmith) and a wireless microphone. Camtasia Relay is a very simple method to record live lectures, whether they are the result of using PowerPoint slides or the result of using a computer application. There are two parts to Camtasia Relay - the Recorder, which captures audio, on-screen activity, and keyboard/mouse input, and the Server, which handles processing and publishing. A number of faculty members use Camtasia Relay, and they can create multiple profiles (for different classes), which identifies the type of format to be used (whether you are publishing to iTunes University or to YouTube, for example). The author has used the application Camtasia prior to Techsmith's developing Camtasia Relay. While Camtasia is a very powerful program, it is complex. Camtasia Relay is transparent to the user, and all you need to do is log into the system, click on a button, record, and then press a hotkey to stop the recording. You can review the video prior to uploading to the Camtasia Server.

The wireless microphone that the author used was by Revolabs. The advantages of this microphone are that it is small and can be placed on a lapel or shirt pocket. The sound quality is excellent, and is comparable to a high quality fixed microphone.

Prior to this semester, the author tried to use Camtasia Relay and the wireless microphone to record videos during the actual class lecture. The concept was that recording and delivering the lecture simultaneously would eliminate any additional development time for the videos. The problems associated with that concept were:

- Only a portion of the lecture involved PowerPoint. When an instructor is at the blackboard, or involving students in a discussion, the recording is at best poor, and there are no visuals.
- The length of the recording is the length of the class, which typically was 75 minutes. The experience by the author is that videos, especially for the current generation, should be no longer than 5-10 minutes.

The author next tried to utilize Camtasia Relay, the microphone, and a tablet (Adesso CyberPad) to record the learning objects, none of which were longer than ten minutes. The thought was that utilizing the tablet would be much faster than creating individual PowerPoint slides, since you would be recording the video as if you were writing on a board. However, the quality of writing, as well as drawing graphs, was poor, and the resulting videos were very difficult to view on either the university's iTunes U webpage or on its YouTube webpage.

The 23 learning objects for this course were created by using PowerPoint 2007, Visio 2007 for drawings, Multisim10.1 to create the circuits, and Mathtype 6.5 to create the equations. The average time to create each video is about 2 hours, including in most cases at least two retakes of the video. The majority of the time was involved in the creation of the slides and animation of the bullets or objects. All the development and creation of the video can be done by faculty, with no need to have external media services. The only other manpower needs was the uploading of the final product to iTunesU.

Each PowerPoint presentation started with the name of the learning object, and then a problem related to the specific learning object. There were at least 1-2 learning activities, related to the learning object. During the presentation, students were told that they could pause the video, solve by themselves, and then view the results by watching the rest of the video.

Student Assessment

A brief assessment was given to the students at the end of the semester, in order to identify their usage and interest in the videos. Prior to this assessment, the author noticed that whenever he was late in creating a video for the class, students emailed him asking when a new video would be available.

There were 18 students in the class, and 16 attended the last day, when the evaluation was given out. Table 1 summarizes the results of that assessment.

TABLE I
SUMMARY OF COMMENTS FROM STUDENT SURVEY ON VIDEOS

QUESTIONS RANGED FROM 1-5	
Average	
1. Use of Videos	4.2 (Means between Often and Very Often)
2. Found videos helping their understanding of the topics	4.0 (Means often)
3. Length of time for video	3.5 (Means between appropriate and short)

All 16 students said they watched one or more video, with the average usage being 8.2 videos. The fact that they did not view all the videos was not a concern. These learning objects were meant as an aide to the face to face discussions, and were not the only means by which the students learned these concepts. In talking to the students about why only a 1/3 of the videos were viewed, they said the used to videos to understand topics that they had difficulty with.

Preliminary analysis of exam grades between this semester and prior semester indicated an 14 point decrease between Fall 2009 and Fall 2008 students for the first test, but an eight point increase in the average test score for the second test, and a 17 point increase in the average test score for the third test. The questions for each test were similar between the semesters, and the results of the first exam seem to indicate that the Fall 2009 student body came into this course with less preparation than the Fall 2008 student body. Whether or not the videos helped in the understanding as the semester progressed, and whether students viewed more videos after poorer grades in the first (or second) exam, will need to be explored in future assessments.

Conclusion and Future Goals

Short videos, based on the concept of learning objects, can be an effective supplement to student learning in a face to face technology course. Students, based on a preliminary survey, used these videos during the semester, and felt it helped them understand the basic concepts. The author plans on continuing this methodology for the next sequence course in Electrical and Computer Engineering Technology, which will run in the Spring, 2010 semester. While the initial investment in time was considerable, the videos can be reused when the author teaches the course next year.

In reviewing what was done with these videos for the next semester there will be a more formal assessment, which will be a few brief questions, in the form of homework that will be posted on the course's Moodle page. These assignments should encourage students to view these videos. The initial set of videos had the title of the course in the beginning of each video. However, one of the key concepts in learning objects is reusability, and there have been discussions with the Electrical Engineering department to use some of these videos in their Circuits I course. Therefore, future learning objects will just have the title, not tied to a specific course. Finally, the second slide in all future slides will have more detailed learning objectives for this learning object.

Bibliography

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