Using Multimedia Online Learning Tools to Supplement the Classroom Instruction

Lulu Sun Ph.D.
Department of Freshman Engineering
Embry-Riddle Aeronautical University

Heidi M. Steinhauer Ph.D.
Department of Freshman Engineering
Department of Mechanical Engineering
Embry-Riddle Aeronautical University

Abstract

This paper introduces the use of multimedia tools to create an online self-study environment to supplement the classroom instruction in Graphical Communications. The topics in this course extend from hand sketching demonstrations to the solid model creation using CAD software such as CATIA. Webcam and Camtasia software were used to capture live examples and the recorded videos were placed on Blackboard. Multimedia tools provide students an efficient way to review the topics covered in the class, in that hand sketching and complex CAD models are often difficult to interpret through words and pictures alone. The positive survey results reflect an initial success of using multimedia tools to supplement the classroom instruction.

Introduction

Multimedia forms of obtaining information have been recognized in the last 20 years as a way to supplement classroom instruction. It has been widely adopted by students when available and has proved to be an efficient way to achieve students learning outcomes (Barrance and Heimcke, 1992, His and Agogino, 1994). Its value has been seen in both traditional and non-traditional learning environments. Students at the United States Military Academy needed greater control, flexibility, and utility as to when and how they learn course material. This was provided by network-based multimedia presentations and hypertext documents, primarily the classroom material (Carver and Biehler, 1994). Others have taken a more focused and integrated approach by developing topics related software to address a particular issue in students learning. The study of engineering dynamics is difficult with traditional classroom teaching tools since they cannot show motion therefore packages such as BEST (Basic Engineering Software for Teaching) Dynamics were produced (Flori, 1994). These individual initiatives can also be developed into university-wide multimedia instruction enterprises that provide media-based resources to assist faculty members across multiple disciplines (Chin and Frank 1996). However, the ability to distribute and share these resources were limited by the delivery system in the early 1990's and, for example, the freshman engineering graphics class at UC Berkeley was given an interactive

multimedia CD. The approach was extremely well received, even in this format, and helped with the understanding of the course material (Lieu, 1999). As increased internet bandwidth and new delivery systems became available, media-based teaching tools improved especially for engineering applications in which complex components and assemblies are often difficult to visualize. One such approach was EDICS (Engineering Design Instructional Computer Program) which took the students through a series of interactive screens that included media such as pictures, animations, videos, and even games (Jimenez, 2006). Multimedia courseware has also been used in teaching mathematics to increase the student's motivation when learning topics such as loci in two dimensions (Zaini and Ahmad, 2010). The value of a multimedia approach to supplement classroom learning is well understood however its implementation is still limited.

Graphical Communications is a core course taught to all the first-year undergraduates at Embry-Riddle Aeronautical University. It is designed to familiarize the students with the basic principles of drafting and engineering drawing, to improve three dimensional (3D) visualization skills, and to teach the fundamentals of a computer aided design. The students meet the instructor twice a week during this three-credit-hour semester course with each class lasting two hours. The first hour of each class is the scheduled lecture time after which the students are allowed to complete their assigned homework and ask questions as needed. The students learn the principles of orthographic projections and apply the principles to multi-view drawings by hand during the first four weeks of a fourteen-week semester. A 3D computer aided parametric modeling tool, CATIA, is then introduced after hand drawing, followed by auxiliary and section views, dimensioning, and tolerances. However, the students often struggle with visualization at the beginning of the semester; especially, how to complete an incomplete or missing orthographic view and the isometric view of the orthographic projections. If this lack of understanding continues the students will quickly fall behind and will have a difficult time transitioning to understanding the 3-D computer aided parametric modeling tool. The relatively short class time means that not all students get the immediate help they need. In addition, many of them do not follow up during office or tutoring hours for additional assistance. Since it is early in their university career they often are not mature enough to admit they are unsure of the material and need help.

This paper shows that multimedia online learning tools such as thoughtfully constructed videos with step-by-step audio illustrations, the creation of 3D model visualizations, and pictures provide students with unlimited contact with the instructor. They are an effective supplement to classroom instruction that helps students with understanding the course material that can be more broadly implemented outside of Graphical Communications. Surveys taken for multiple classes showed that more than 95% of students who used this online resource 'liked' it.

Video Files Creation

LifeCam Studio ® from Microsoft was used to record and better illustrate the more challenging concepts of hand sketching. Camtasia Studio® from Techsmith was used to capture CATIA model problems and to post process demonstrating the use of the 3D CAD software. The video files, approximately 10 minutes long, were saved as Mpeg4 HD files and posted on Blackboard via the Kaltura® video application.

The topics covered include engineering scales and orthographic projections to auxiliary views. In Figure 1, the audio illustration explained the layout of the given views and how to complete the missing top view and the corresponding isometric view. The cubes were used to construct the 3-D model to visualize the different views and the relationship between the orthographic views and the isometric view.

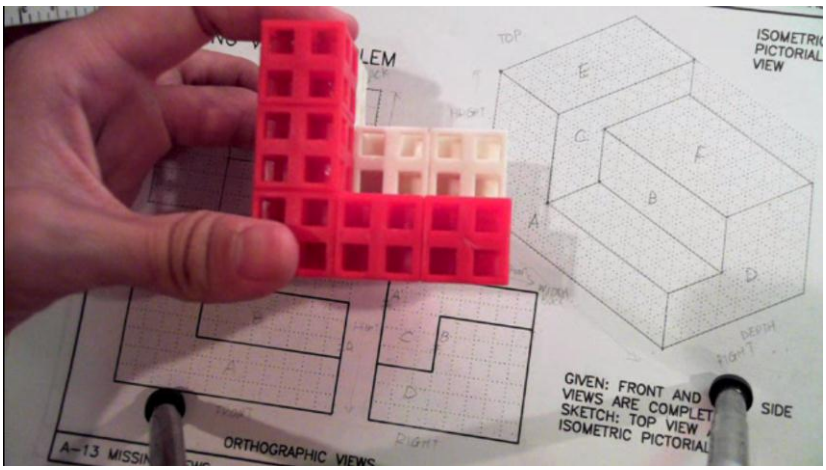
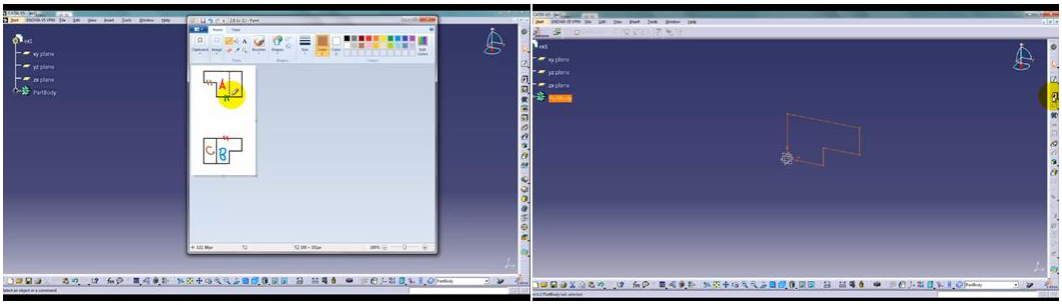


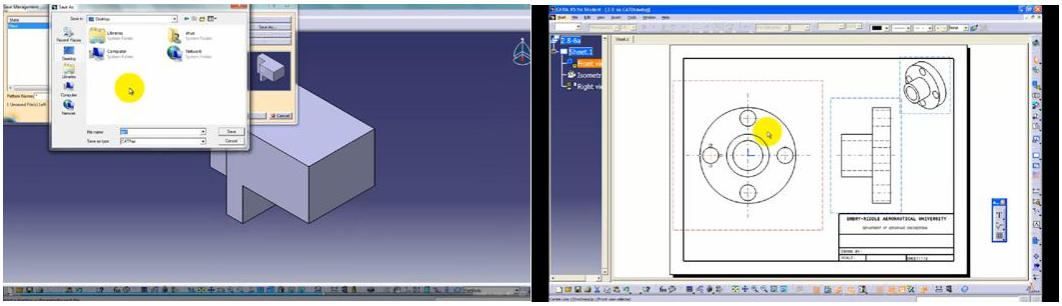
Figure 1. Hand Sketching Video

Figures 2 and 3 document CATIA, Camtasia Studio® was used to capture the CATIA screens to demonstrate how to create a 3D solid model. Figure 2 (a) shows how to use paint software to illustrate the given two orthographic views and which view should be selected to create an efficient 3D model Figure 2(b) demonstrates how to use a yellow magnifier in Camtasia to highlight the icon which would be used to create the 2D profile. Figure 3 (a) describes how to use a zoom-n-pan tab to add zoom and pan animations to video files. Figure 3 (b) was used to demonstrate how to create 2D drafting file using CATIA. It was found using animation, pictures, and audio narrations for hand sketching or CATIA 3D models facilitated another types of learners, visual learners to further improve the their comprehension (Felder and Silverman, 1988).



(a) (b)

Figure 2. (a) CATIA screen and paint screen; and (b) CATIA model.



(a) (b)

Figure 3. (a) A zoom-n-pan screenshot; and (b) CATIA drafting file

Results and Discussion

The survey was completed by 78 students in the fall 2012 semester and 55 students in the spring 2013. The survey was at the middle of both semesters and yielded positive results. Figure 4 (a) presents the results for question one asked students if they watched the video files. 41% students in the fall 2012 semester and 43% students in the spring of 2013 watched the video files. The second question asked the students for the reasons they did not watch the video files. Of those who did not watch the videos indicated they did not need to watch because they fully understood the material covered in the class. Figure 4 (b), for the students who watched the videos, all but one 'extremely liked' or 'liked' them. The one student who did not like the material, stated the material in the videos was covered too quickly.

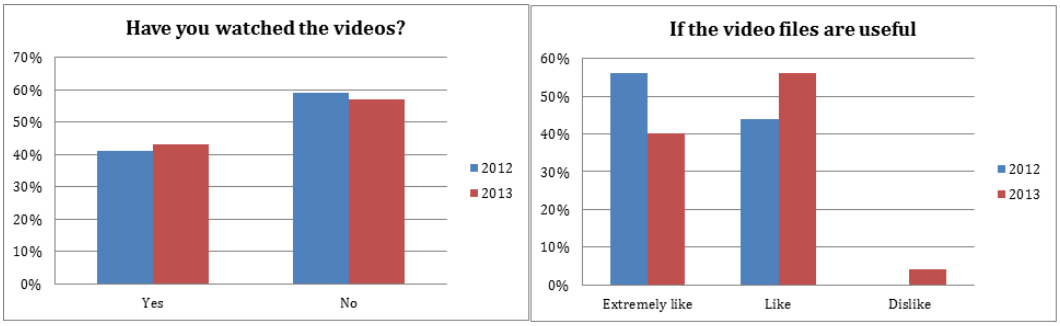


Figure 4. (a) A survey to check if students watched the videos; (b) Video files usefulness.

Conclusions and Future Work

Multimedia tools offer students another approach to study hand sketching and CAD software that can often be initially difficult to learn or understand during the limited class period. The paper demonstrates that the video files help students better understand the graphics concepts, as these can often be difficult to visualize. The design intent via audio narration, pictures, animations, and the creation of 3D models can be more clearly shown. Further improvements will include that updating video files to incorporate new content and/or update existing course content, adding captions to be ADA compliant, and tracking the number of views to get a clear understanding of what video content does well to help guide the future video creation.

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