

Using Multimedia Online Learning Tools to Supplement the Classroom Instruction

Cassandra Sue Gribbins¹ [Lulu Sun²]

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.

Keywords: multimedia, CAD, online, video

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 [1-2]. 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 [3]. 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 [4]. 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 [5]. 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 [6]. 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 [7]. Multimedia courseware has also been used in teaching mathematics to increase the student's motivation when learning topics such as loci in two dimensions [8]. Researchers developed screencasts in thermodynamics, heat transfer, and fluids, material and manufacturing courses [9-17]. Purdue University makes mention of using the screen capture and video editing software, Camtasia Studio from TechSmith Corporation, to assess students through in-video quizzes [18]. In instances where English is not the primary language, Americans with Disabilities Act (ADA) compliant captions can aid in comprehending the content of the video. Captions may also help viewers that are in noisy environments still understand what is being said in the video.

¹ Embry-Riddle Aeronautical University, P.O. Box 10924, Daytona Beach, FL, 32114, gribbinc@my.erau.edu

² Embry-Riddle Aeronautical University, Engineering Fundamentals Department, College of Engineering, Daytona Beach, FL, 32114, sunl@erau.edu

2014 ASEE Southeast Section Conference

The value of a multimedia approach to supplement classroom learning is well understood however its implementation is still limited. An educational methodology, termed Open Learning, was presented in 1996 to help guide the development of multimedia based learning. The process presented a top level approach, encouraging further research for more contextual applications [12]. In 2001, a user-centered approach based on human-computer interaction principles was emphasized as being the key approach in developing effective interactive multimedia. An understanding of the different learning styles and how they engage in multimedia should be assessed to best encompass individual preferences. Some students learn best when provided structural guidance while another set of students are more successful given index tools to develop their own approach. Again, further work citing more research is needed in order to best understand how to encapsulate a majority of learning styles. In order to promote interactivity with the media, developers can include tasks that allow the application of new knowledge in the form of online testing with instant feedback for self-assessment. Opportunities for reflection of new material can also be implemented to maintain focus [19].

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.

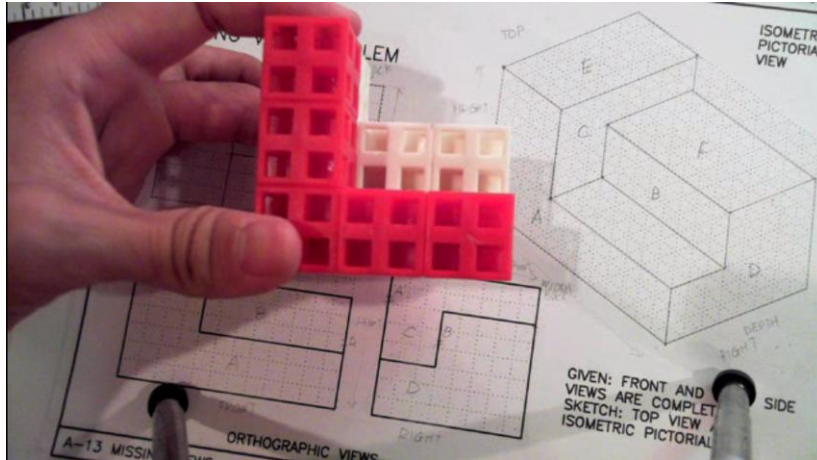
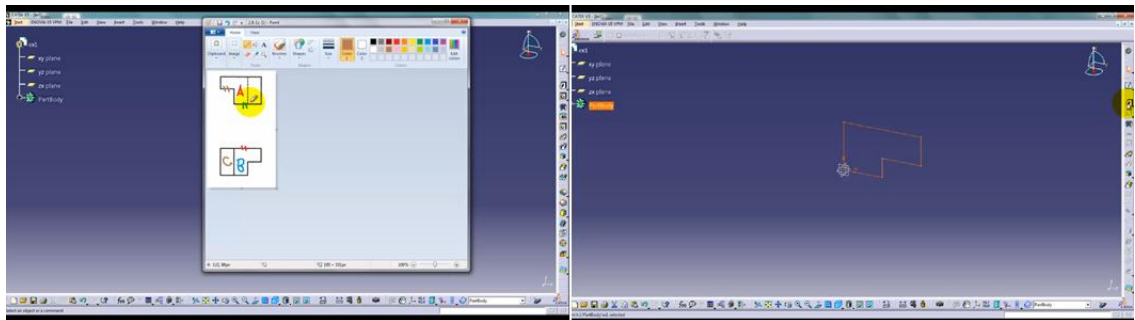


Figure 1. Hand Sketching Video

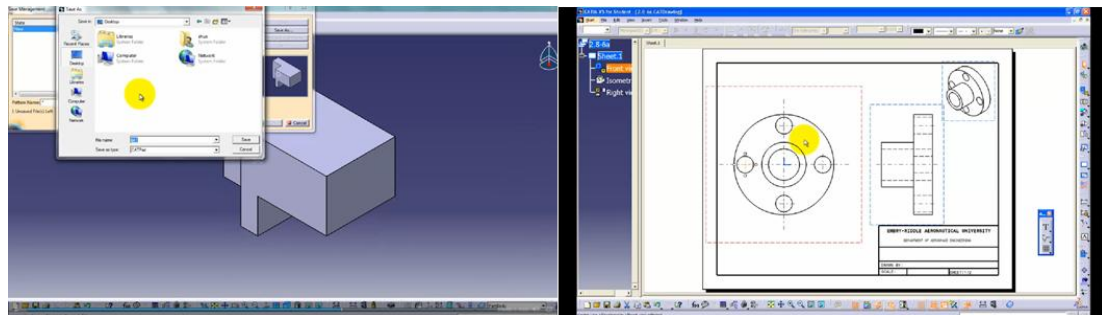
Figures 2 and 3 document CATIA, Camtasia Studio® was used to capture the CATIA screens to demonstrate how to create a 3D solid model. Figure 2 (a) shows how to use paint software to illustrate the given two orthographic views and which view should be selected to create an efficient 3D model Figure 2(b) 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 [9].



(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

Captions were implemented using Camtasia’s speech-to-text feature that interprets the audio of the video into captions with a screenshot shown in Figure 4. They were edited afterwards as technical jargon is not recognized through general speech to text software. An option to format captions into ADA compliant settings was used. The captions could either be overlain on the video or positioned under the video. Due to the CATIA toolbars covering the lower portion of the screen, the option for the captions under the video was used as illustrated in Figure 5.

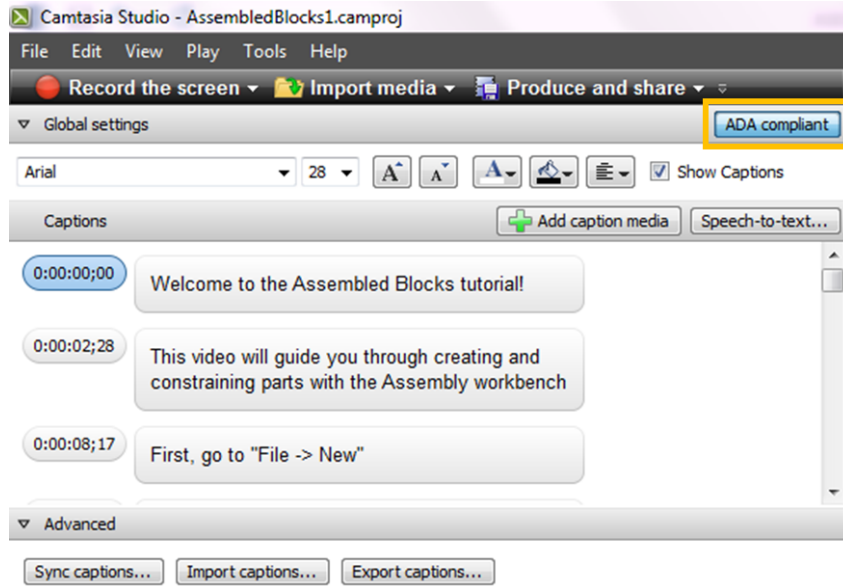


Figure 4. Camtasia caption editor highlighting ADA compliant button

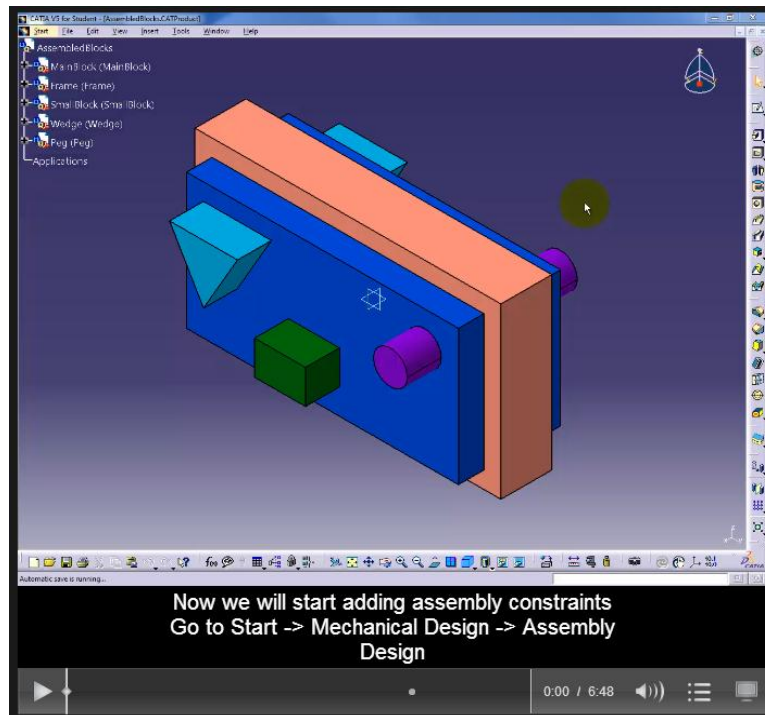


Figure 5. Produced video with captions

The quiz feature was utilized to include interactive quizzes in the videos. Figure 6 shows the four types of questions available: (a) multiple choice, (b) fill in the blank, (c) true/false, and (d) short answer. The short answer option can be used to allow the student to provide feedback on the quality of the video. Challenges encountered included adjusting the video fit within the window and having the quiz itself display.

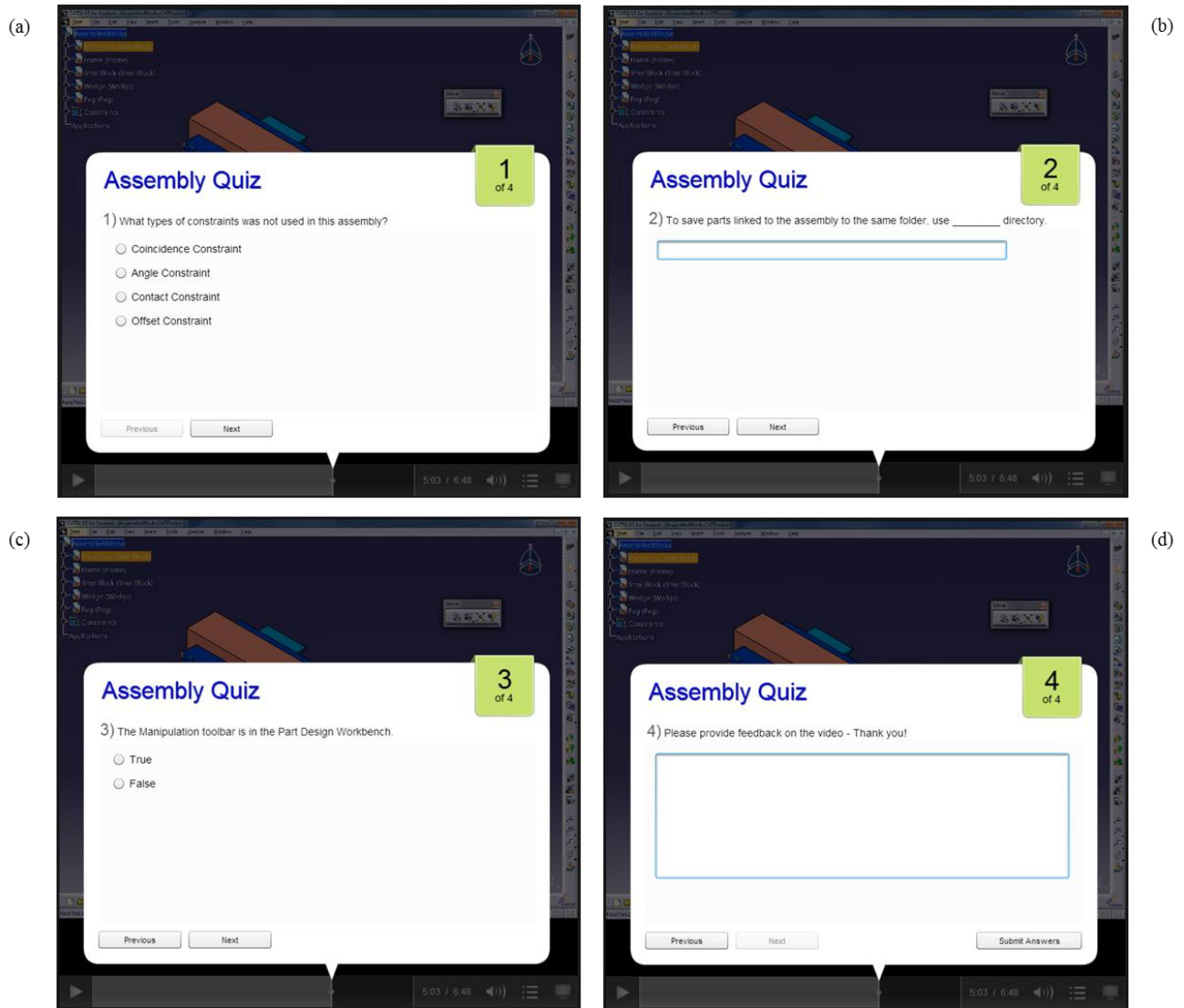


Figure 6. Types of quizzes with sample questions: (a) Multiple choice, (b) Fill in the blank, (c) True/False, (d) Short answer

In order to display the quiz format in Blackboard, a tutorial from Purdue University was used as guidance to develop the necessary custom settings for the desired format which included a SCORM output file. SCORM stands for Shareable Content Object Reference Model and is used as an industry standard for interoperability between learning content and learning management systems [21]. The SCORM output option was used to generate a zipped file that could be uploaded to Blackboard in order to retain the quiz feature as opposed to uploading just the Mp4 file, which does not allow the feature. Figure 7 shows screenshots from (a) choosing the custom production settings option on the first window of the production screen in Camtasia, (b) SCORM button option to enter settings, (c) option to select zip file production, and (d) the Blackboard upload option under the Build Content menu. An additional adjustment was to decrease the embedded video size to fit within the webpage as viewing the video in full screen disables keyboard input.

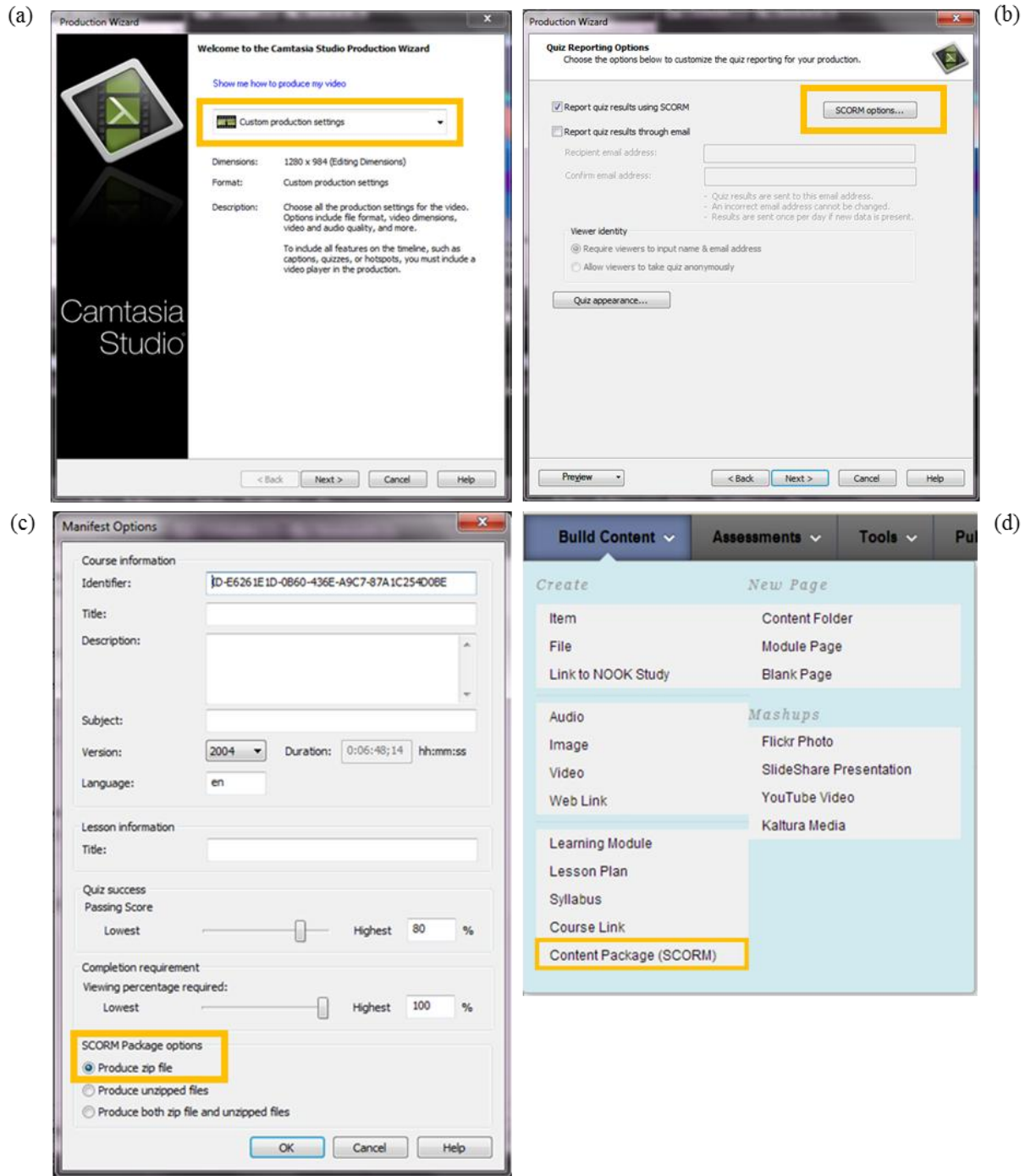


Figure 7. Production and upload specifics options: (a) Production Wizard first page highlighting custom settings option, (b) Quiz reporting options page highlighting SCORM options button, (c) SCORM options window highlighting zip file production option, (d) Blackboard screenshot highlighting Content Package selection under the Build Content tab

ASSESSMENT

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 5 (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 5 (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. A multimedia design process derived from the Virtual Labs Project at Stanford University will be researched for possible utilization in the development of the baseline video. The process consists of formally evaluating and documenting student needs and expectations of the interactive media for guidance on module design and development [22]. The process includes suggested user test questions for assessing the usability, content, and learning effectiveness of the module using a Likert rating scale of reporting whether the student strongly disagreed, disagreed, undecided, agreed, or strongly agreed. Obtaining usage data is also encouraged in order to identify number of views and time spent on each item [15].

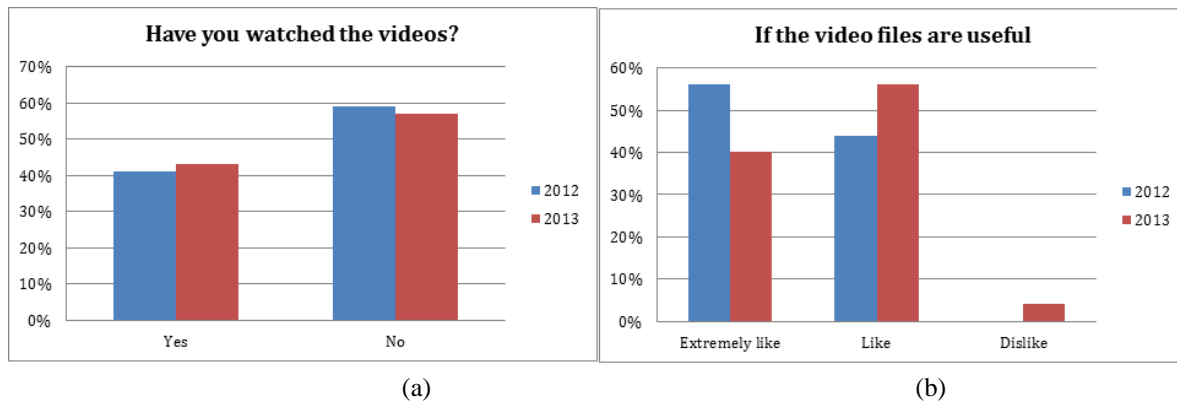


Figure 5. (a) A survey to check if students watched the videos; (b) Video files usefulness.

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 a creation of a baseline video incorporating interactive features and then updating previous video files to incorporate new content and/or updating existing course content. How the screencasts impact student performance will also be assessed.

Blackboard shows the potential of obtaining statistics on how many times the video was accessed and during what time of day including what day of the week. The addition of an interactive table of contents was attempted but technical requirements of using Camtasia’s video player, TechSmith Smart Player, provided a file format compatibility issue when uploading to Blackboard. The HTML file created by Camtasia automatically uses a proprietary Flash video player that necessitates security setting modification and further research if upload to Blackboard is to be pursued.

REFERENCES

- [1] Huston, J.C., P. J. Barrance and C. Heimcke, “Multimedia Courseware in the Instruction of Undergraduate Dynamics”, 22nd Annual Frontiers in Education Conference, Nashville, TN, 1992.
- [2] His, S. and A. M. Agogino, “The Impact and Instructional Benefit of Using Multimedia Case Studies to Teach Engineering Design”, *Journal of Educational Multimedia and Hypermedia*, vol. 3, no. 3/4, 1994, pg. 351-376.
- [3] Carver, C. A. and M. A. Biehler, "Incorporating Multimedia and Hypertext Documents in an Undergraduate Curriculum," in *Proceedings Frontiers in Education 24th Annual Conference*, San Jose, CA, 1994.
- [4] Flori, R. E. Jr., “Computer-Aided Instruction in Dynamics: Does it Improve Learning?”, *Frontiers in Education, 24th Annual Conference*, San Jose, CA, 1994.

2014 ASEE Southeast Section Conference

- [5] Chin, A., F. Robert and R. Amy, "The Multimedia Instruction Initiative: Implications for Engineering Education", *American Society for Engineering Education Annual Conference & Exposition*, Washington, DC, 1996.
- [6] Lieu, K. D., "Using Interactive Multimedia Computer Tutorials for Engineering Graphics Education", *Journal for Geometry and Graphics*, vol. 3, no. 1, 1999, pg. 85-91.
- [7] Jimenez, C., "A Media-Based Engineering Design Teaching Tool: MIT's EDICS", *American Society for Engineering Education New England Section Annual Conference*, Worcester, MA, 2006.
- [8] Zaini, Z. H. and W. F. W. Ahmad, "A Study on Students' Motivation in Learning Mathematics Using Multimedia Courseware", in *IEEE, Information Technology (ITSim), International Symposium*, Kuala Lumpur, Malaysia, 2010.
- [9] Falconer, J.L., G. Nicodemus, J. deGrazia, J.W. Medlin, "Chemical Engineering Screencasts", *Chemical Engineering Education*, 2012, 46, 58-62
- [10] Falconer, J.L., J. deGrazia, J.W. Medlin, M. Holmberg, "Using Screencasts in Chemical Engineering Courses", *Chemical Engineering Education*. 2009, 43, 302-305.
- [11] Falconer, J.L., "Use of ConcepTests and Instant Feedback in Thermodynamics", *Chemical Engineering Education*. 2004, 38(1), 64
- [12] Falconer, J.L., "ConcepTests for a Chemical Engineering Thermodynamics Course", *Chemical Engineering Education*. 2007, 41(2), 107
- [13] Millunchick, J. M. (2008). "Example of a Mini-Lecture Screencast on Dislocations", Retrieved from jmmg5.engin.umich.edu/dislocation/dislocations.html
- [14] Millunchick, J. M. (2009). "Example of a Homework Solution Screencast", Retrieved from jmmg5.engin.umich.edu/hw04/hw04.html
- [15] Pinder-Grover, T., K. Green, & J.M. Millunchick, "The efficacy of screencasts to address the diverse academic needs of students in a large lecture course", *Advances in Engineering Education*, 2011, 2 (3).
- [16] Pinder-Grover, T., J. M. Millunchick, C. Bierwert, & L. Shuller (2009a). "Leveraging screencasts to strategically clarify unclear materials science concepts", American Society for Engineering Education Annual Conference & Exposition, June 14 - 17, 2009, Austin, TX.
- [17] Pinder-Grover, T., J. M. Millunchick, C. Bierwert, & L. Shuller (2009b). "The efficacy of screencasts on diverse students in a large lecture course", American Society for Engineering Education Annual Conference & Exposition, June 14 - 17, 2009, Austin, TX.
- [18] Mong, C., "What Can Camtasia Do for You?", Purdue University Instructional Development Center Blog, 26 July 2013. Available: <https://www.purdue.edu/learning/blog/?p=6303>.
- [19] Felder, R. and L. Silverman, "Learning and Teaching Styles in Engineering Education", *Journal of Engineering Education*, vol. 78, no. 7, 1988, pg. 674-681.
- [20] Purdue University Calumet, "Camtasia Advanced Features," 3 7 2013. Available: <http://webs.purduecal.edu/oit/files/2013/09/Camtasia-Lecture-Recording-with-Quizzes-revised-9-5-13.pdf>.
- [21] Rustici Software, "SCORM Explained," Rustici Software, Available: <http://scorm.com/scorm-explained/>.
- [22] Huang, C., "Designing High-Quality Interactive Multimedia Learning Modules," *Computerized Medical Imaging and Graphics*, vol. 25, 2005, pg. 223-233.

Cassandra Sue Gribbins

Cassandra is a mechanical engineering graduate student of Embry-Riddle Aeronautical University, Daytona Beach, Florida. She obtained her undergraduate degree in aerospace engineering with minors in computer aided design and human factors in 2007, also at Embry-Riddle Aeronautical University. Her graduate study is focusing on additive manufacturing and plastics design. She has participated in STEM Outreach events and has been a counselor for the Girls Exploring Math and Science summer camp.

Lulu Sun

Lulu Sun is an associate professor in the Department of Engineering Fundamentals at Embry-Riddle Aeronautical University, where she has taught since 2006. She received her Ph.D. degree in Mechanical Engineering from University of California, Riverside, in 2006. Her research interests include engineering education and its pedagogies. She is a member of American Society of Engineering Education and a professional member of the Society of Fire Protection Engineer.