Using Supplemental Videos to Teach Energy Efficient Construction Systems: SIPs and ICF

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Abstract:

My Fall 2009 ASEE Mid-Atlantic Section paper titled ***Teaching Passive House Construction: Video vs Graphic…Which One Achieves Higher Assessment?*** confirmed, through student assessment, Gangwer's finding that 65% of students are visual learners, and that graphics with text provide a more effective means of introducing a new topic than the use of video alone, where video depicts the same material as the graphics,. In addition, I made a recommendation to use graphics with text and video together to introduce a new topic such as Passive Housing. The goal of the present paper is to test this recommendation. Does the addition of short topic specific videos to instruction already aided with visual handouts further assist student learning? This study was conducted by testing 2 lower level construction classes each consisting of 17 students. One group was the control group and the other the test group. The control group was given 2 lectures (topics: Insulated Concrete Forms (ICF) and Structural Insulated Panels (SIPs) each with diagrams of construction details but *without* supplemental video. The test group was given 2 separate but identical lectures, each with diagrams of construction details, *and* 1 short topic specific supplemental video per topic. Quizzes conducted in both groups showed that the test group scored higher on questions on these topics than the control group, and the difference in quiz scores between the 2 groups was statistically significant. These results suggest that topic specific videos are a valuable educational tool when accompanied by visual handouts.
Key words: Assessment, SIPs and ICF, video-based learning, teaching construction methods

Introduction

The goals of teaching at the university level are to instruct and inspire students, and to prepare them to function well in work settings and in other higher learning environments. A look at learning behaviors and styles can help us to better deliver information to students, and better use available teaching tools. From previous studies, we see that:

- 65% of students are visual learners, 30% are auditory learners and 5% are kinesthetic learners.[1]
- In 2009, the average American aged 18-24 years watched more than 151 hours of television a month, and an additional 5 hours of online videos a month. [2]

- According to Kaufman and Mohan, "The educational use of video on campus is accelerating rapidly in departments across all disciplines—from arts, humanities, and sciences to professional and vocational curricula." [3]
- Instruction supplemented only with a labeled diagram presented to the student on paper is ranked higher on student assessment scores than instruction supplemented only with a video showing the same content and shown for the same time duration as the labeled diagram.[4]

These study results indicate that overall, students are predominately visual learners who are accustomed to watching hours of video daily. Yet instruction augmented with video alone does not score as high among students as instruction supplemented with diagrams on paper. So the question arises: Does classroom teaching including instructor presentation of diagrams benefit further from the addition of short, topic specific videos? The goal of this paper is to seek to answer this question, by focusing on didactic instruction designed to present 2 types of energy efficient construction systems that may be used in Passive House construction – Structural Insulated Panels (SIPs) and Insulated Concrete Forms (ICFs). In this study student learning on these topics was assessed, comparing lecture-based education using diagrams alone (control group) to education including both instructional diagrams and video (test group).

Skilled teaching on construction methods has become even more imperative with the passage of The American Clean Energy and Security Act of 2009, which will require new residential construction to be 50% more energy efficient than the baseline code starting January 1, 2014, rising a further 5% every three years subsequently.[5] This Act will significantly improve energy efficiency, but will also require current students to be more conversant in energy efficient construction methods than the traditional teaching regarding construction using 2x4 wood platform frame or cavity walls.

Methodology:

This study protocol was based on 2 lower level construction methods classes, with a combined total of 34 students. These classes are part of the Bachelor of Science programs in our department (Architectural Engineering Technology and Construction Management Engineering Technology). Each group is of similar intellect, educational background, age range and cultural diversity.

As part of this study, each of the 2 groups of students (n=17) was given a separate identical lecture about 2 energy efficient construction systems Structural Insulated Panels (SIPs) and Insulated Concrete Forms (ICF). During this lecture, both groups of students were given 1 diagram (construction detail) on a paper handout for each of the 2 topics and they were informed that they would be required to draw the 2 details each with 5 specific material labels in a test at the end of class. The control group (n=17) was not shown supplemental videos on these topics during class time. The second, test group of students (n=17) received the same lecture and handouts as the test group, but was also shown 1 short topic specific video per topic during class time. The videos shown to the test group were:

Structural Insulated Panels (SIPs)
http://www.hgtvpro.com/hpro/pac_ctnt/text/0,2595,HPRO_20196_55073,00.html?c=484&videoid=66936 (duration = 2.24 minutes)

Insulated Concrete Forms (ICFs)
http://www.hgtvpro.com/hpro/pac_ctnt/text/0,2595,HPRO_20196_55073,00.html?c=484&videoid=67003 (duration = 2.10 minutes)

The primary outcome of this study is a comparison of the test results of the 2 groups, to see if video presentation of the topics in addition to diagrams on paper presented during class time increased learning comprehension and retention of these topics.

The following are the test questions (each worth 10 points):

"Draw the section of the junction of an ICF (Insulated Concrete Formed) wall and a light wood frame roof and label: (1) ICF wall (2) Gypsum board ceiling sealant, (3) Top Plate, (4) Insulation wind baffle, (5) Gasket 'sill seal'."
(10 points)

"Draw a section of a Structural Insulated Panel (SIP) roof to wall junction with painted wood siding and label: (1) the four locations of sealant, (2) 12" wood screws, (3) Building Paper/Drainage Plane, (4) Air Space, (5) Furring.
(10 points)

Each question was answered on a separate sheet of paper and graded uniformly. Each question contained 5 parts, and each correctly labeled and correctly located construction material in each student drawn detail was worth 2 points (20%) of the maximum total of 10 points (100%) per each question.

The Student's/Gosset's t-test ($\alpha = .05$) was used for both the ICF and SIPs tests.

Results:

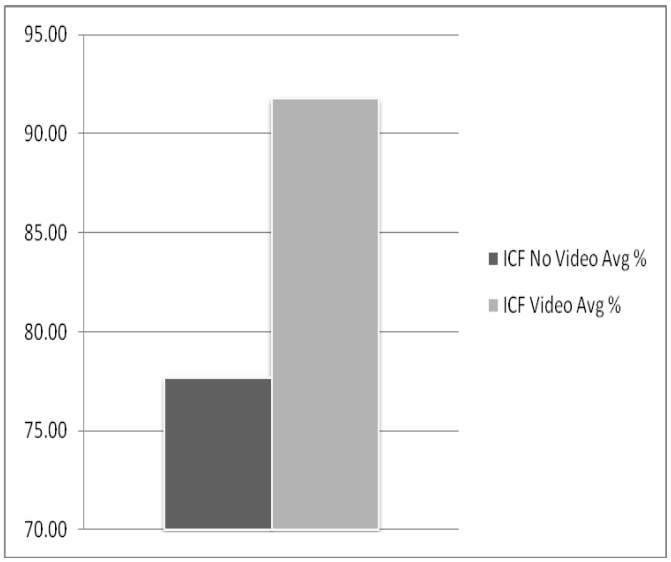
ICF Test Results:

On the ICF question, the test (video shown) group on average scored 9.18, compared with the control group (no video shown) which scored on average 7.76, a 14.1% difference, which is statistically significant ($p = 0.001$). The t statistic (3.4268) is farther from 0 than t-critical value (1.7459) for one-tailed test. The results appear to indicate that the addition of a short topic specific video on ICF to lecture-based instruction already supplemented with hand held diagrams has a measurable benefit on student learning.

ICF Test Results (continued)

Student Performance on ICF Quizzes		
	No Video	**Video**
Average	7.76	9.18
% Difference	14.12%	

Student's/Gosset's t-test for ICF (α = .05)		
	No video	*Video*
Mean	7.7647	9.1765
Variance	2.4412	1.5294
Observations	17	17
Degrees of freedom	16	
t Stat	**3.4286**	
P(T<=t) one-tail	0.0017	
t Critical one-tail	1.7459	



ICF Control and Test Results (%)

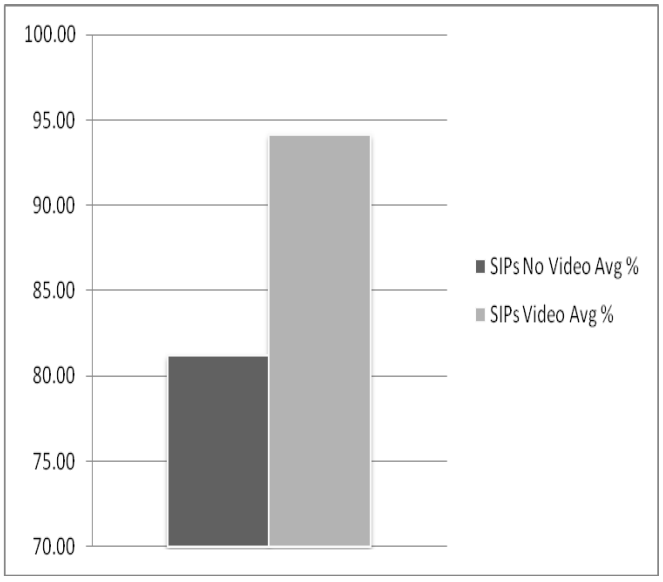
SIPs Results:

On the SIPs question, the test group (video shown) on average scored 9.41, compared with the control group (no video shown), which scored on average 8.12, a 12.9% difference, which is statistically significant (p= 0.033). The results appear to indicate that the addition of a short topic specific video on SIPs to lecture-based instruction already supplemented with hand held diagrams has a measurable benefit on student learning.

SIPs Results (continued)

Student Performance on SIPs Quizzes		
	No Video	Video
Average	8.12	9.41
Difference	12.94%	

Student's/Gosset's t-test for SIPs (α = .05)		
	No video	*Video*
Mean	8.1176	9.4118
Variance	3.6103	2.3824
Observations	17	17
Degrees of freedom	16	
t Stat	**1.9687**	
P(T<=t) one-tail	0.0333	
t Critical one-tail	1.7459	



SIPs Control and Test Results (%)

Discussion

Test results from this study show that lectures with details/diagrams and further supplemented with videos achieved a statistically higher assessment than lectures conducted without inclusion of supplemental videos.

It is worth mentioning that in a 1994 study comparing student performance between traditional classroom instruction without supplemental video and a class that used video to present the course concepts, Jordan and Sanchez found in one of their tests (n=39) that students in the sections that were shown videos scored on average 9.3% points higher than the students in the section that was not shown videos during lectures. [6]

Jordan and Sanchez's test results and the results of this study suggest that instruction augmented with topic specific videos result in increased student learning compared to teaching delivered without the use of instructional videos. However it must be noted that the sample sizes of all of these tests are small and that, although the test and control samples for this paper are assumed to be comparable in important parameters, based on admission requirements into the program, a separate test was not performed to confirm equivalency between the two groups.

The results of this study are useful in supporting the addition of videos to traditional, lecture-based teaching on construction topics. Other than bringing students to a site under construction for every construction method discussed in class, which is not feasible, instructors rely on supplemental visuals. Visual aids include: drawing construction materials and details on the classroom blackboard, images on PowerPoint slides, images from textbooks, class projects such as creating a digital visual dictionary, and videos. Gangwer notes that, "With the influx of

technology, visual learning and media literacy are perhaps more critical that they have been at any other time in history, it is essential for teachers to explore the world of technology, where their students reside, in order to teach the way the students are learning."[7]

However simply adding a video to classroom instruction is not enough. Being able to properly supplement instruction with video technologies is essential. As Rittman wrote, "Most teachers have not had adequate training in how to use various technologies in their classrooms. And the training they receive focuses on the mechanics of operating new machines with less attention given to how technology can be helpful in the instruction of specific subjects."[8]

The major obstacle to the proper use of video in education is not only the lack of awareness of teachers to the pedagogical possibilities of this mode of supplemental learning but the lack of a reference model of proper practice. Per Young, "From a learning and teaching perspective, the challenge for educators is to understand how video and audio can act as powerful, innovative and creative elements to enlighten teaching and learning." [9] In 1995, the Society for the Advancement of Education suggested that teachers need to help their students to play a more active role when instruction is augmented with video. According to the Society's report, "We have to overcome the viewer's expectation that television is a passive cognitive activity"[10] The following is a list of suggestions on using video actively in the classroom in order to combat the "couch potato" passivity commonly associated with watching television for recreational purposes:

1. Use "trigger" video clips to introduce a topic and create instant interest. [11] These videos are short in length and topic specific.
2. Match videos to learning objectives. [12]
3. View the entire video before you show it to the class.[13]
4. Incorporate active viewing by discussing the topic of the video and what the students should be looking for prior to watching the video. [14]
5. Provide a list of guiding questions prior to watching the video or stop the video to pose a question at the appropriate spots. [15]
6. Keep the message simple. Cennamo writes, "People will invest more mental effort and learn more from simple videos. Complexity in words, syntax, zooms, movement, or graphics, causes students to pay more attention to making sense of the medium and less attention to the message." [16]
7. Ensure that there is a close correlation between what is being said and seen throughout the video.[17]
8. Gross recommend, "Avoid complicated charts and graphs. They often require individuals to take time to process the information, causing them to miss whatever comes next on the videotape."[18]
9. Pair a video with a reading assignment.[19]
10. Break up or rearrange parts of the viewing, as required by the individual lesson plan.[20]
11. Conduct a follow-up activity to assess comprehension of the video. [21]
12. With regard to videos of experiments: Per Lyons et al in a study of student response to videoed experiments, "The videos where the student was able to see the experimenter received the most favorable reviews. Students really liked it when the video cut back

and forth between the entire experimental set-up to the details of handling/testing the sample. Many other student comments dealt with the production of the video, as opposed to the topical content. Monotone voices, cheesy music, and jerky editing should be avoided. Relative to content, it was expressed that explanations of equipment, instrumentation and software should be detailed, not generic."[22]

In summary, this study found that the inclusion of short, topic-specific video programs in lecture-based teaching on the construction methods of ICF and SIPs increases learning to a statistically significant degree, as reflected by student quiz scores. Further study on this topic is recommended in order to confirm this finding, and to find out other factors that can increase the efficacy of video-based education on construction methods in a lecture setting.

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