PUTTING IN-CLASS LECTURE VIDEO ON-LINE: LESSONS LEARNED

Greg C Lee, Chiung-Fang Chiu, Ling-Chian Chang
Department of Information and Computer Education
National Taiwan Normal University
Taipei, Taiwan
{leeg, chiucf, nina@ice.ntnu.edu.tw}

Abstract

The objective of this study is to investigate the effects on students' learning behavior given that the in-class lectures were edited and made available on the course website. The focus is on whether class attendance is adversely affected and on how the students would use the videos segments to enhance their learning. Experiments were conducted over three college level courses with total enrollments of 121. Data including course website usage statistics, student questionnaire and course instructor interviews were collected and analyzed. The study yielded two main results: (1) In-class attendance is not adversely affected even with the lecture video available for viewing on the course website. (2) Segmentation of the lecture videos into smaller cohesive units is useful to the students. These findings pave a way for future practices of putting lecture videos on a course website.

Keywords

Lecture Video, ICT integration, On-line education

1 Introduction

Use of videos to enhance learning has many advantages. For one, audiovisual experiences can heighten students' awareness and encourage critical thinking skills

(Bruning, 1992). Past researches indicated that repeated viewings of explanations on difficult to grasp concepts can better understanding of contents (Torri, 1994, Ross et al., 1995), better interrelate various topics or lessons that seem unrelated (Bransford et al., 1985) and better facilitate reflections (Rowley and Hart, 1996), which are important to effective learning.

Integrating video viewing with computer network offers even more practical use of the video resources. The Living Textbook project (Mills et al., 1995) delivered real-time, multimedia, information on demand for use in classroom instruction. Over 100 hours of on-line searchable video material were put at the teachers' fingertips. On the other hand, Interactive Multimedia Distribution System (IMDS) by Jafari (1996) was used in a university setting in which students were able to watch archived video materials or television broadcast on campus networked computer. Video streaming technology even affords video viewing over the Internet. Berger (1999) let students read assignments, watch related video clips, and participate in online discussions in an off-campus distance learning course. Reynolds & Mason (2002) used on-line video to continued professional development of dentists. The video media consisted of videoconferencing and webcasting across the Internet. For those applications, video contents are part of the learning material.

Although taping lecture videos can afford students repeated viewing of the lecture, the practice is mostly found in the distance education course only. In which case, the lectures are pre-taped and placed on the course website for the registered students (e.g., Haga, 2002). It is only recently that putting taped in-class lectures on the course website for class-attending students has been experimented (e.g., Pimentel et al., 2001). However, feasibility of such practice is yet to be studied. It is the goal of this pilot study to investigate the effects on students' learning behavior if the

in-class lectures were made available on the course website. The focus is on whether class attendance is adversely affected and on how the students perceive the usage of the lecture videos. Furthermore, instead of placing unedited taped lectures on the course website, we propose to segment the lecture video into logically cohesive units with index so that students can quickly locate the part of the lecture that they want to watch.

2 Research Methods

2.1 Basis and Limitations

This study was carried out in college level courses. To limit the scope of in-class lecture types, we conducted the experiment in courses in which the course instructor made use of electronic slides in their lectures. There are two reasons for this restriction:

1. Use of electronic slides for instructional purposes is common at the college level.
2. Each slide usually contains a cohesive unit of lecture which makes change of slide a good segmentation point in the taped lecture video.

2.2 System and Tool

An in-house course supporting website was developed. It houses the course syllabus, the course notes, the class handouts, the presentation slides, the lecture videos and a discussion forum. A snapshot of the website is depicted in Figure 1. The screen is divided into four frames: the video playback frame, the current slide frame, the discussion thread frame and the lecture slides frame. The lecture slides frame contains the set of slides used in one lecture period. Each slide also corresponds to a starting and ending time in the taped lecture video in which the slide

was being lectured. When clicked, that slide is enlarged in the current slide frame, the corresponding lecture segment is played in the video playback frame and the corresponding discussion thread is displayed in the discussion thread frame. Therefore, students are able to watch and listen to the lecture corresponding to a particular slide and be able to discuss about it at the same time. The website automatically keeps track of the usage statistics, including the number of times each video segment was viewed by each student.

In order to ease the burden of the course instructor and the course teaching assistant (TA), an automatic video segmentation system was also developed. The TA only has to supply the name and location of the lecture video, then the system automatically divides the video into different video segments, each corresponding to the lecture on a particular slide. Although this is mostly an automated process, the TA has the freedom to override each video segment's starting and ending times as necessary. Once video segmentation is completed, by clicking of a button, the video segments are converted into streaming formats for playback over the Internet. Furthermore, video streams and the original slides are automatically uploaded to the course website with hyperlinks properly generated. Thus, the extra effort on the TA's part is also minimal. A more detailed description of the system can be found in Lee and Tsai (2002).

2.3 Participating Classes

A total of 121 students among three distinct courses participated in this study. The three classes were:

1. Chinese Grammar: a required undergraduate course with 56 non-Computer Science (CS) students. The class meets for two consecutive hours per week.

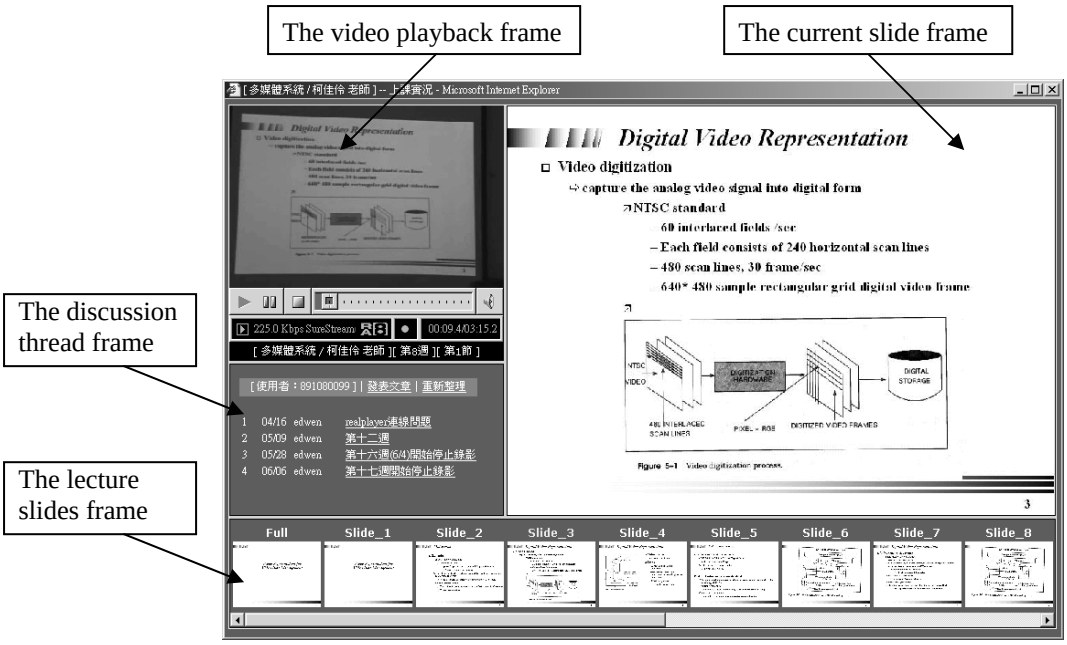

Figure 1. Snap shot of the website with 4 frames

2. Discrete Mathematics: a required undergraduate course with 52 CS majors and 4 non-CS majors. The class meets twice a week, once for two hours and once for one hour.
3. Advanced Computer Architecture: a graduate level course with 9 CS graduate students. The class meets for three consecutive hours every week.

The course instructors all lectured with PowerPoint slides projected onto a white screen through a LCD projector.

2.4 Experimental Procedure

Since this is a pilot study, we did not ask the course instructors to run the class any differently to take advantage of the course website. Thus, the course instructors go about their preparation and teaching routine as usual. It is the TAs and the students who have to change their routines. The course instructors conducted their lectures primarily with PowerPoint slides. The TAs taped the in-class lectures (50

Table 1. Video viewing statistics among all three classes.

Course	No. of Students	Total video Viewing	Avg. Video Viewing	Video Viewing	
				by lecture	by slide
Chinese Grammar	26(56)	758	29.1	332 (44%)	426 (56%)
Discrete Mathematics	23(56)	347	15.1	179 (52%)	168 (48%)
Advanced Computer Architecture	9(9)	267	29.7	82 (31%)	185 (69%)
Overall	58 (121)	1372	23.7	593 (43%)	779 (57%)

minutes per lecture) with video camcorder and used the in-house lecture video segmentation system to prepare and upload the video streams onto the course website within 2 days after the lecture. The students can then view the taped lecture video at anytime from any place where Internet is available.

2.5 Data Collection

Research data are collected from three different sources. First is the course website usage statistics. Since each student had an individual account on the course website, when and how often each video was viewed were automatically recorded. At the end of the semester, students were given a questionnaire to retell their experience in using the course website, in particular, to give comments about the usefulness of having the lecture videos on-line. The course instructors were also interviewed at the end of the semester after the grades had been posted. Interviews with the teachers were conducted primarily to validate students' comment about re-viewing the lectures on the web.

3. Results and Discussions

Table 1 depicts the video browsing statistics for each of the three classes. The nature of the course is reflected in the enrollment. The two undergraduate courses,

Chinese Grammar and Discrete Mathematics, were required courses; therefore had a much larger class size than that of the Advanced Computer Architecture graduate course, which also is an elective course (56, 56 to 9). To get a more realistic picture of the video usage, we only counted video viewings that lasted longer than 30 seconds and noted the number of students with at least two such video viewing occurrences. For the two undergraduate courses, only about half of the students actually watched the lecture videos from the course website (26 out of 56 and 23 out of 56). Therefore, the number of active participants in this study was 58 out of 121 total enrollments. The rest of the data is thus compiled over those 58 students.

In terms of video usage, students in the Chinese Grammar and the Advanced Architecture courses averaged double video viewing per student (29.1 and 29.7) over the Discrete Mathematics students (15.1). Upon interviewing the course instructors and analyzing the responses given on the students' questionnaire, the apparent less of an interest in watching the video in the Discrete Mathematics course can be attributed to the fact that the instructor also made good work of the blackboard during lecture. The instructor indicated that the nature of the course requires proving theorems and doing logical deductions in which it is best written out step-by-step on the blackboard. Since the taped lecture captured only the projected slide and although students can still hear the lecture, they were unable to see what was written on the blackboard. This deterred students from making more use of the taped videos.

Finally, by examining student's video viewing behavior, we note that video watching by slide is the preferred viewing method in the Chinese Grammar (56% to 44%) and Advance Computer Architecture (69% to 31%) courses, while in the Discrete Mathematics course, the viewing frequency is about even (52% to 48%) between viewing in entirety and viewing by slide. Further analysis shows that the

average time spent in watching video in entirety is only about 20 minutes. Furthermore, only 10% of the 593 video watching by lecture lasted over 30 minutes. The other 90% watched between 5 and 20 minutes with an average of 15 minutes. This indicates that even when students choose to watch the lecture in entirety, they were actually skipping around. In all, majority of the students tend to watch only part of the lecture as necessary.

3.1 Student Questionnaire

The student questionnaire consists of five questions aiming to understand how students perceive the usefulness of the lecture video enriched website. Summarizing statistics of students' responses are given in Table 2. On the average, students in the three courses differ only on the question about watching the lecture again to help them study difficult to understand topics. For the undergraduate courses, less than half (Question 1: 46% for Chinese Grammar and 34% for Discrete Math) of the students use the archived videos to help them study the difficult to understand topics. However, the graduate course is just the opposite (60% for Adv. Computer Architecture). There are two explanations. First, graduate students are usually more devoted to their course work and are more inclined to study everything. Secondly, there were 4 PhD students enrolled in the course and Computer Architecture happened to be one of the qualifying exam subjects to be administered at the end of the semester. Thus, they can ill-afford to leave any topic not understood. This result concurs with the average usage statistics in that the graduate students watched the lecture videos much more frequently than the students in the other two classes.

Table 2. Statistics of the questionnaire results.

Questions	Chinese Grammar		Discrete Math		Adv. Comp. Architecture	
	Yes	No	Yes	No	Yes	No
1. Did you watch the archived lecture video for difficult to understand topics?	46%	54%	34%	66%	60%	40%
2. Was segmenting the hour-long lecture into slide corresponding clips useful?	93%	7%	88%	12%	90%	10%
3. Did the on-line availability of the lecture video affect your class attendance?	2%	98%	23%	77%	10%	90%
4. Did the on-line availability of the lecture video affect your in-class concentration?	7%	93%	24%	76%	11%	89%
5. Did the on-line availability of the lecture video affect your in-class note-taking?	10%	90%	28%	72%	10%	90%

About the necessity of the option to watch video indexed by lecturing slides instead of watching the lecture in entirety, students in all three courses agreed that the option was indeed useful (Question 2: 93%, 88%, 90%). Referring back to the usage statistics in Table 1, majority of the video viewing was indeed of this nature. The most often cited reasons for this usefulness perception is that it enabled students to quickly find the part of the lecture that they are interested in. Some students wrote,

> "… I go to every class, so I only want to watch the part that I don't understand. Searching by slide is much easier than searching through the entire lecturing video..."

> "… Sometimes my note taking cannot keep up. So I only need to watch the part where my note is incomplete…"

It is interesting to note that for the Discrete Mathematics course, although the viewing tendency favors watching the entire lecture, majority of the students (88%) still thought that the option to watch in segments was useful.

In the questions on whether the availability of the lecture video on-line affected their class participation, majority of the students says no. They indicated that they attended the class as usual (Question 3: 98%, 77%, 90%), that they maintained the same level of concentration (Question 4: 93%, 76%, 89%), and that they took note as usual (Question 5: 90%, 72%, 90%). Although between 10% and 28% of the students among the three courses changed their note taking behavior (i.e. take less notes), this may not be so negative. The students could be giving more attention to the instructor's lecture and less on writing. Thus, it can be concluded that students' in-class learning behavior was not adversely affected.

The questionnaire also contained two checklist type questions, looking to understand students' mentality about the course website. Students were allowed to check all items that apply. The results are given in Tables 3 and 4. From Table 3, we see that 55% of the students used the website (presumably to view lecture videos) to aid their study. In addition, between 12% and 20% of students used the website for ordinary tasks such as downloading homework and lecture slides. However, about a quarter (27%) of the students used the website as a remedy for missed classes. Although the percentage is higher than that of Question 3 of Table 2, it is not unexpected as students do not consider "reasoned" absences as skipping classes. However, the reasons for their absences need further investigation. In Table 4, students considered what might a website, with cohesive lecture slides, lecture videos, and discussion threads, be good for in their study. Majority of the students thought it is good for better understanding of the difficult concepts discussed in class (61%).

And 44% thought that it is a good remedy for missed classes. The difference is consistent with the opinions expressed by the course instructors.

> "… Although students who missed a class can still watch the lecture on-line, I think the website is more useful for those who have attended the class and are watching the lecture for the second time. …" (Discrete Math course instructor)

> "… It is more productive to come to the class and review the not so well understood concepts using the website. … I think that is why class attendance has not been affected. …" (Chinese Grammar course instructor)

In addition, 38% of the students thought that the system would be a helpful study tool if examinations were directly related to the in-class lectures. Only between 14% and 18% of the students thought the website is good for increasing interactions between classmates and the course instructor. This is not to be unexpected as the students often see each other in many of the other classes and most of them do live together in the University dormitory.

3.2 Instructor Interviews

Interviews with the course instructors were conducted at the end of the semester after the grades had been reported. The comments were fairly consistent among all three instructors. We have grouped their comments into the following four categories.

Table 3. Reasons for having to use the course website within this semester.

Items	Percentage
To keep good faith in the experiment	4%
Post-lecture study	55%
Make up for missed classes	27%
Download homework and solutions	19%
Print the lecture slides	20%
On-line discussions with others	16%
Check for announcements	13%
Others	4%

Table 4. Responds to the question on the circumstances in which course website containing cohesive slide, lecture video and discussion threads might be most useful.

Circumstances	Percentage
Coming across difficult to understand concepts	61%
Exams are directly related to in class lectures	38%
Make up for missed classes	44%
Need to interact with the course instructor for Q and A	18%
Need to discussion class materials with classmates	14%
Others	16%

1. <u>There is no change in teaching preparation or course conduction.</u>

This is important to note since any additional burden placed on the instructor will not be welcomed. Although the course instructors were not expected to change their teaching routine, as the study went along, one of the instructor begins to develop strategies to incorporate the system as part of her teaching tool.

"… It is my intension to have students discuss over the contents of the lecture even without this system. I think this tool can facilitate and ensure off-classroom discussions. I will explore that possibility next time around. …" (Discrete Mathematics course instructor)

2. Students' learning attitude and re-viewing frequency are closely related.

   The course instructors were able to see the statistics of each student's re-viewing frequency and pattern throughout the semester. They all noted the relationship between the viewing frequency and the grades that students received. It seems that students with better grades do make more use of the system than the others.

   " … I can tell only the self-motivated students are frequent users of the system. The less-motivated students probably still need to be lured with grade incentives. …" (Chinese Grammar course instructor)

3. Class attendance is not adversely affected.

   This view is consistent with that of the students' own evaluation. The instructors did not notice a change in class attendance. However, they did notice from the statistics that those students who often missed the class did not make more use of the system. This again, concurs with students' view that the lecture videos are used primarily for post-lecture study, not as a tool for making up missed classes.

4. The flexibility to re-viewing lectures in parts is useful.

   The instructors also liked the idea of segmenting the lecture videos by slides. Although the three courses in this study are very different in nature, they all find the tools provided as useful. The Chinese Grammar course instructor said,

   "… My lecture usually contains 6 to 10 slides per hour and each slide is fairly independent of each other. So it is helpful for the students to divide up the video into smaller logical units. …"

For the Discrete Math course where the instructor utilized the blackboard in explaining contents on the slide, the instructor also thought that the availability of the video segments was useful.

> "… I do the derivations and proofs on the blackboard on purpose to allow students to follow me step by step. Although the writings were not recorded, if they (the students) have attended the class, they should have enough recollection to hear that part of the lecture and reproduce the proofs on their own, which is better for their study. …"

4. Conclusions

This pilot study involves the use of the in-house video segmentation system to automatically update course website with lecture slides and corresponding lecture video segments. The system and the lecture-video enabled course website were put to use in two distinct college level courses, one with CS majors and the other with non-CS majors. An additional graduate level CS course was also in on the experiment. After a semester of study, there are two major findings that may impact future practices.

The first major finding is that student's learning behavior was not adversely affected by having the lecture videos available on-line. Most of the students still attended the classes and maintained the same concentration levels in class. Both the students and the course instructors agreed that the lecture videos were better used for reviewing purpose rather than simply as a tool for making up missed classes. Students still value the opportunity to interact with the course instructor in person, which is not easily replaced by any computer mediated communication tool. Thus,

having the lecture videos available on-line will not unwillingly encourage students to miss classes.

The second major finding is that students tend to use the video archive to review the lecture in parts. Dividing hour-long lecture video into slide corresponding video segments turned out to be a good thing to do. Student's questionnaire and the actual usage statistics both confirmed that students liked this option of re-viewing lectures and made good use of it. Even for the course in which there was a lot of blackboard work that was not captured in the video, there were still many instances of video viewing by slide corresponding segments.

The findings of this study pave a way for future practices of putting lecture videos on a course website. Class attending students watch the class lecture on the web for the second time with a different need from those viewing the lecture for the first time as in a distance education course. As technology evolves, it becomes easier to videotape a class lecture. Post processing of lecture videos with suitable annotations, by slide or otherwise, should be done to give students maximum benefits of watching the class lectures from the course website.

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