

# An Analysis of Technology Usage for Streaming Digital Video in Support of a Preclinical Curriculum

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## Abstract.

*Usage of streaming digital video of lectures in preclinical courses was measured by analysis of the data in the log file maintained on the web server. We observed that students use the video when it is available. They do not use it to replace classroom attendance but rather for review before examinations or when a class has been missed. Usage of video has not increased significantly for any course within the 18 month duration of this project.*

## Introduction

Widespread interest in distance learning, as well as the demand for technology support of the on-campus curriculum, has lead many medical schools to institute web-based delivery of curriculum content. For curriculum content to be useful, it must be delivered in a timely manner, be comprehensive enough to draw student traffic to the web site, and be available 24 hours a day, seven days a week. The delivery of streaming digital video, in particular, requires daily commitment of resources to videotape, digitize, edit if necessary, and publish the video content. This level of curriculum support requires significant commitment of institutional resources. In this paper, we present our analysis of student usage of video as a step towards understanding patterns of usage and the importance of video as a component of the preclinical curriculum in a medical school.

## Method

**VIDEO ACQUISITION AND PRESENTATION (FIRST YEAR).** Lectures were videotaped by medical students who were also students in the course. The lecture was taped using a consumer-grade Hi-8 video camcorder. A single camera was used. The student operator moved the camera between the speaker and the lecture room screen as needed. In those cases when the room was too dark to obtain a clear picture of the speaker, the camera viewpoint was maintained on the screen.

The video was digitized via a video capture card on a Pentium III computer using the Windows 98 operating system software. The digitized video was

converted into the Real G2 streaming video format as it was captured and was stored on the computer's hard disk. During the conversion, a video compression factor was set such that the video could be used by students at home using a 56.6 Kbps modem connection. The digitized video was linked into each course web site through a web page, the Video Index page. This page provided a list of lecture titles, with the lecture date and a link to the digitized video.

The digitized video was made available to students in two formats, termed Video-on-Demand and Digital Curriculum. In the Video-on-Demand format, the streaming video plays in a video window with a few basic video controls: Play, Pause, Stop, volume control, and a slider bar to move to any point in the video stream. There is no information about the video content. In the Digital Curriculum format, the video window is placed within a web page that contains a large accompanying slide of the screen, with slide changes synchronized with the video. A brief Table of Contents of the lecture is also available on the page. Production of a lecture in the Video-on-Demand format takes about one hour and 15 minutes, in addition to the actual taping time. Production of the Digital Curriculum format takes about three additional hours for each hour of lecture time.

The first year was used for prototyping and for gathering information on production issues and student needs. We therefore restricted video coverage to the first year preclinical courses alone. Because of heavy student demand, a few second year courses were made available as well.

**VIDEO ACQUISITION AND PRESENTATION (SECOND YEAR).** Issues of production time and slide quality lead to some changes in the process of video acquisition in the second year. Video recording was transferred from a commercial grade camcorder to a professional digital video camera. This resulted in a very significant improvement of the video image with good visibility of the laser pointer on the screen and with improved color and detail rendition of histology and pathology slides. This improved quality was an essential requirement for those faculty who needed highly detailed and accurate slide images in their video lectures. Because delivery of this improved

quality to the student requires higher bandwidth than is available on a 56 kbps modem, most courses were available at both 56 Kbps and 200 Kbps. The use of a digital video camera removed the need to digitize from a video tape, shortening production time from one hour and 15 minutes to 20 minutes. The camera field of view was maintained on the screen and was not moved intermittently to the professor, further maintaining image quality.

All first and second year courses were recorded and digitized. By the end of the study, the available video covered 42 courses, including 26 preclinical courses, and over 600 hours of video.

**ANALYSIS OF USAGE BY INDIVIDUAL STUDENTS**  
Analysis of student usage was with consent of the Human Subjects Institutional Review Board. Student usage data was available only to the authors and was not revealed to course directors or relevant faculty.

**REQUESTS TO VIDEO INDEX VERSUS REQUESTS FOR VIDEO FILES.** The video index is a web page with a list of all the digitized lectures, and is stored on the same web server as all the other educational resources. The web log on this server includes a record of the login identifier of the user, allowing removal of all accesses by faculty or curriculum developers. The video file itself is stored on the streaming video server, which maintains its own log file. The default setting of this log file does not include retention of the user's identifier. Therefore, a request to the video index is used as a surrogate for a request to a video file. The following errors are possible when using the surrogate. The user may look at the video index but may not choose to view a video file. Alternatively, since the video file opens in a separate window, the user may close the video window and still be able to make another selection from the list of files in the video index.

**ANALYSIS OF WEB LOG.** Unix text processing tools were used to extract only those events from the web log file that indicated access to the Video Index page. A typical record reads as follows:

```
mitl-nt21.stanford.edu - - 9999999  
[25/Oct/1999:14:34:55-0700] GET  
/lanevid/fallvideo/videoindexmpharm201.html  
HTTP/1.1 200 6181
```

with the items having the following meaning:

“name of user machine” - - “user identifier” “date, time, offset from GMT” “command transmitted to server” “return code” “bytes returned”. The command to the server includes the course name, for example, “pharm201”. The extracted event records

include enough information to study date and time of usage, courses selected for video viewing, the identity of the viewer (though this information was used only to separate designers and faculty records from student records), and the machine from which the viewing command was issued. The record does not include information about the specific lecture viewed or the duration of video viewing. (Some of this information is available in the log file of the streaming video server but was not extracted because technical problems during the creation of this log file.)

## Results

**Usage of streaming digital video** was measured by analysis of the data in the log file maintained on the web server. The logged data was extracted from September 17, 1998, the start of the Fall Quarter in 1998, to March 1, 2000, and included all four quarters of the 1998-1999 academic year, and almost two quarters of the 1999-2000 academic year.

**TOTAL USAGE OF VIDEO.** The number of daily requests to the video index is a measure of the number of requests to view a video. Figure 1 is a plot of the number of daily requests during the 18 months of this study. With the exception of the summer (mid-June to mid-September, 1999), there is significant daily usage of video. If we compare the same quarter in different years, we see that there is an increase of daily video usage in the second year.

**COMPARISON OF VIDEO USAGE FOR FIRST AND SECOND YEAR COURSES.** In the first year of the project, we focused on capture of first year courses, recording only one major second year course, Pharmacology. Starting in September 1999, we recorded all the pre-clinical courses. Figure 2 plots total daily usage versus daily usage of Year One courses alone. In the first four quarters, there is little difference between the two graphs because very few second year courses were available. In the fifth quarter (Fall, 1999), usage of Year One courses is the same, or less, than in Fall 1998. However, there is a large increase in use of Year Two courses, many of which became available in streaming video for the first time. Winter quarter 2000 has more daily usage than any other quarter including Winter 1999. Interestingly, the increase is attributable to greater use of Year One courses rather than to incremental use of the newly available Year Two courses. This heavy use is primarily of the Biochemistry course which has a very large enrollment of undergraduate premedical students.

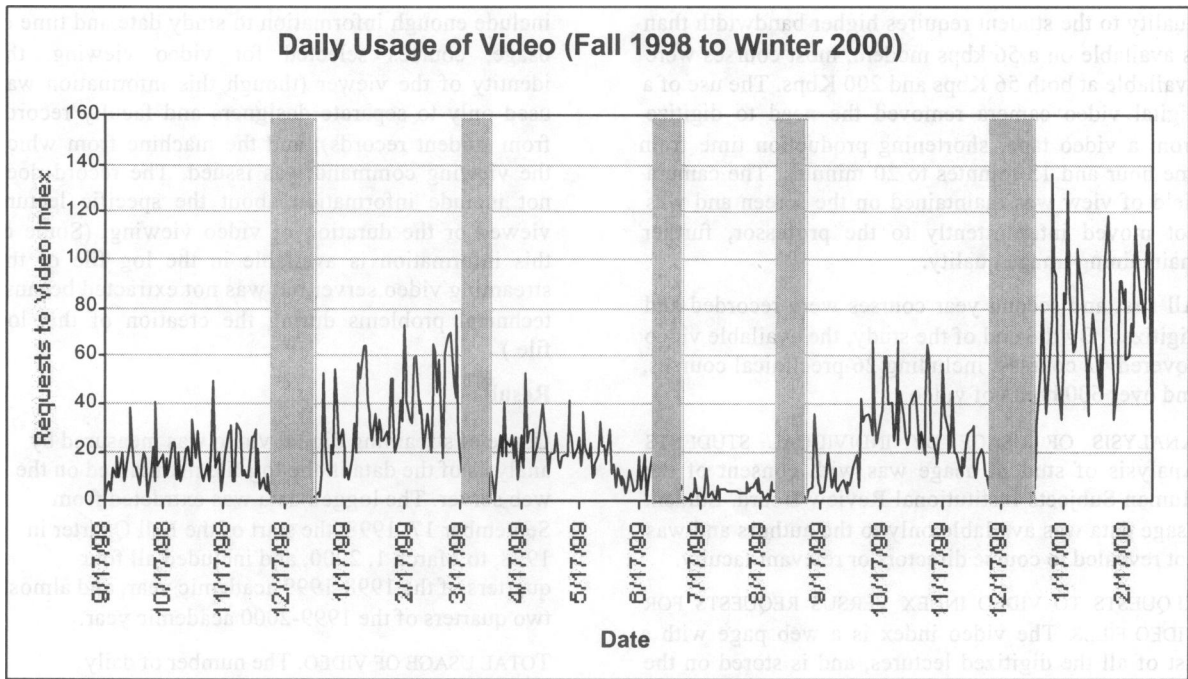


Figure 1. Evolution of video usage during the project time period. Six academic quarters are presented, with vacation periods indicated in light grey.

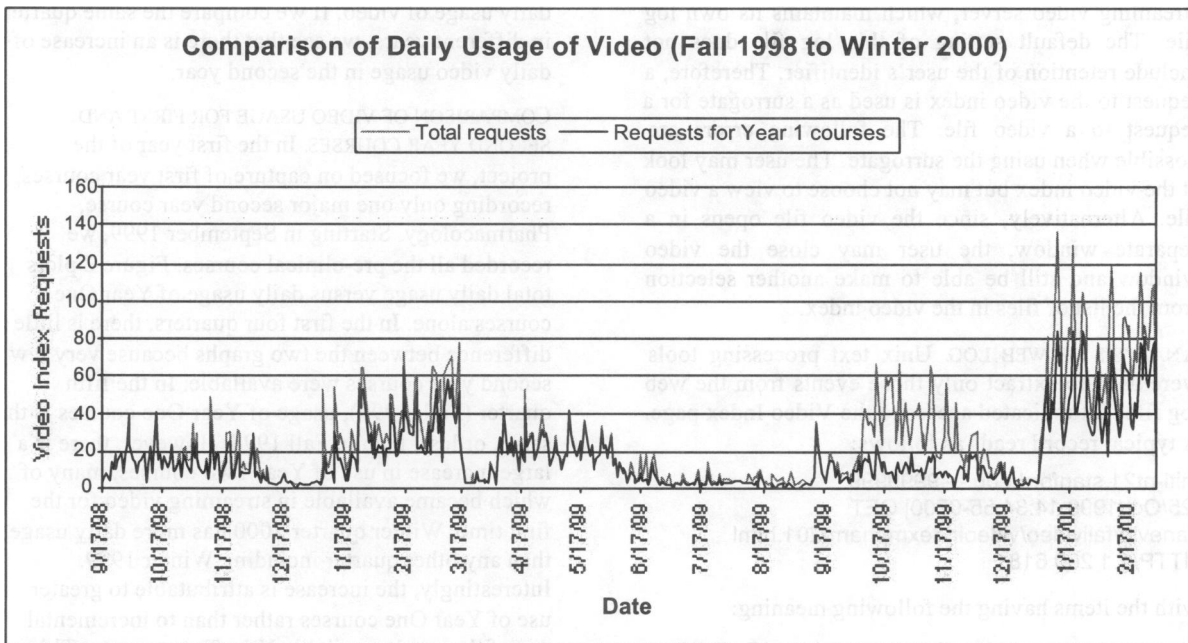


Figure 2. A comparison of video usage evolution for Year One and Year Two courses. Most Year Two courses became available after September 1999.

Course name	Number of lecture hours on video	Student enrollment	Student-lecture hours	Video index reqs 1998-1999	Video index reqs 1999-2000
<b>FALL</b>					
Histology	19	86	6880	338	191
Anatomy	70	86	5160	717	571
Path.B	32	86	3440		528
Physiol.	51	86	5160		375
Pharm. 1	33	86	4300	367	198
Infectious disease	53	86	2580		406
<b>WINTER</b>					
Doctoring	1	86	860		24
Psychiatry	36	86	1720	159	69
Neurobio	54	100	9000	532	389
Biochem	61	250	10000	1259	1646
Health research	24	86	3440	76	168
Health policy	9	86	1720	51	47
Endocrine phys	30	86	3440		373
Pathophys	18	86	1720		67
Path. C	32	86	3440		257
Pharm. 2	32	86	4300	230	191
PCM-A	2	86	86	129	45
Hematolog	16	86	860		35
Immun.	36	86	3440		112
<b>SPRING</b>					
Molecular biology	36	100	4000	293	8
Genetics	36	86	2580	231	9
CV physiol	50	86	5160	486	4
Path. A	42	86	2580	93	5
Clin psych	18	86	860	244	22

Table 1. Preclinical courses. Table rows with a gray background are Year 1 courses. Others are Year 2 courses. Most Year 2 courses were not available in streaming video in 1998-99. These data were collected before the completion of Winter, 1999-2000, and are expected to increase for this Winter quarter. The low numbers for Spring, 1999-2000, are video index requests to courses recorded in the previous year.

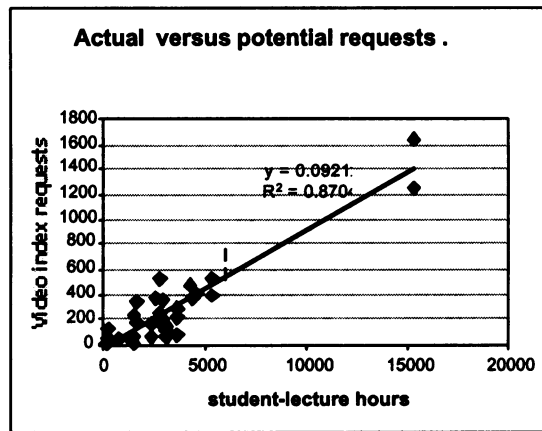


Figure 3. The actual number of requests for the video index compared against the potential usage. "Student-lecture hours" for each course is computed as the product of (the number of enrolled students) x (the number of hours of lecture available on video). The courses with the largest number of student-lecture hours is Biochemistry, for both 1998-99 and 1999-2000. The number of video requests does not measure the actual number of hours of video viewed but is a surrogate. There is approximately one video index request for every 10 student-lecture hours.

**VIDEO USAGE BY COURSE.** Lecture video was collected from 26 Year One and Year Two courses. Table 1 lists the available hours of video, the number of students enrolled in the course, and the number of video requests. Figure 3 shows the relationship between the amount of available video lecture content per course (in hours), the number of students enrolled, and the number of requests per course.

There is considerable variation in video usage of individual students and for individual courses but, on the average, there is one video index request for every 10 student-lecture hours. This video index request may result in a brief viewing of a single video or no viewing at all, or the viewing of multiple videos in a single session.

#### Discussion

We have the following major conclusions:

1. Students do use the video.
2. They do not use it to replace classroom attendance.
3. Video usage has not increased dramatically from one year to the next for any one course except Biochemistry.

The availability of lectures on streaming digital video does lead to their use by the students. There is an average of 20 to 40 video index requests per day in most quarters, going up to about 70 requests per day in Winter 2000. In both Winter 1999 and Winter 2000, there is steadily increasing demand through the quarter. In other quarters, the demand is relatively constant. We believe that the large number of undergraduates in the Biochemistry course in Winter quarter lies behind this difference, but we have not confirmed this in detail.

Interestingly, we do not see a level of usage that indicates a preference for primary learning of the material using video. If students stopped attending class and used the video as their lecture replacement, we expect to see about ten times the actual recorded usage (Table 1 and Figure 3). Anecdotally, faculty have reported some drop in attendance, and have suggested that the mere availability of the web-based video may give students confidence to skip classes. Since lectures have been available on VHS tape for many years, there has been no change in the opportunity to miss lectures. Therefore, we are not convinced that web-based video has led to any decrease in class attendance. We believe that the video is used for review, particularly at mid-term and final examination time, as is indicated by a detailed examination of the daily usage log. A few students, less than 10% of the class, use the video extensively in bursts throughout the quarter. We plan to study these students in more detail in the future.

We had expected to see an overall increase in video usage from 1998-99 to 1999-2000, but the data do not support this expectation. Examination of the requests for first year preclinical courses in Figure 2 shows similar levels of usage in corresponding quarters in 1998-99 and 1999-2000. It is possible that the process of changing our recording technology during the Fall quarter, 1999-2000, may have prevented an increase in usage in the second year. On the other hand, it is certainly possible that this level of usage represents demand, and will be stable. An increase in network speed to the home is expected to impact usage in future years.