Report on VideoNote for the
Task Force on VideoNote, E-learning and Online Courseware Systems
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Synopsis

In Fall 2008, Vice Provost Michelle Moody-Adams created the Task Force On VideoNote, E-Learning, and Online Courseware Systems[1]. Its first charge was to decide whether a pilot study on the use of VideoNote[2] in Cornell's classrooms should be conducted. In December 2008, the Task Force recommended that such a pilot study should be performed in Spring 2009, with about 10 courses taking part. The interim provost agreed to this study, with funds to support it coming from the provost's office so that all students in participating courses could access VideoNote free of charge.

The pilot project was expected to provide information on the following concerns:

(1) What effects does the availability of VideoNote materials have on course attendance?
(2) How often do students use the services, and for how long with each use?
(3) Is there any evidence that students who used the materials developed a better mastery of the material than those who did not?
(4) Do student evaluations indicate that VideoNote materials are helpful to them in their efforts to master course content?
(5) How do faculty members whose lectures were made available through VideoNote assess the value of the project?

Ten courses were chosen to participate in the study (final enrollment in parentheses):

BIOG 1110 (309 students)	CS 1110 (170)	PHYS 1203 (246)
CS 2110 (168)	HD 2160 (159)	BIOEE 2780 (251)
MATH 2940 (one section, 105)	ENGRD 2030 (123)	
NS 3310 (117)	ORIE 3310 (161)	

In attempting to answer the questions posed by the Task Force, the following data were used.

- Mid-semester and end-of-semester surveys of the students
- Student grades, GPAs, gender, and ethnicity
- Attendance data in two courses (one collected manually, the other using i-clickers)
- Logs of time spent on viewing videos on the VideoNote website
- An experiment run by VideoNote in one course in Fall 2008
- Survey of students by VideoNote
- Comments requested of the instructors of the ten courses

A major conclusion of this study is that VideoNote is a significant new pedagogical tool. It increases flexibility for students, it can improve both learning and grades, and it can help instructors. Its disadvantages, such as increased skipping of lectures, can be minimized using certain practices in the classroom.

Whether Cornell can continue to support it or whether students will be willing to pay for the service is another question. Some sort of continuation is advised, for Cornell actually leads the field with this innovation, and it would be disheartening to see it die because of lack of support.

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[1] Members of the Task Force were Michelle Moody-Adams, *Chair,* Glenn Altschuler, David Gries*,* Carole Bisogni*,* Charlie Walcott*,* and Saul Teukolsky. This study was directed by David Gries. Kathy Dimiduk and Mike Hammer developed and implemented the Cornell surveys. Mike Hammer and Ryan Morris were instrumental in providing data in formats that could be used. Kathy Dimiduk and Jeffrey Dimiduk did the statistical analysis. Kathy Dimiduk was responsible for the major part of the writing of this report.

[2] The Web 2.0 VideoNote product provides online access to videotaped lectures. Two important features are (1) the use of a table of contents, produced while a lecture is being taped, to allow immediate access to any part of the online video and (2) quick creation of the video once a lecture is completed —in a matter of hours. The company VideoNote was created by two entrepreneurs with Cornell affiliations: Paul George (PhD 2009) and Ryan Morris (MEng 2008). Its URL is www.videonote.net.

Moreover, at this time, where departments are investigating cutting back on teaching resources, VideoNote might be used in innovative ways to help in that process but still have effective teaching. Keeping VideoNote in action over the next year will help everyone to look into such innovative ways. Discontinuing VideoNote will reduce the chance of such innovation. At the end of this synopsis, we list some ways in which VideoNote might be useful.

Perhaps through a combination of central university resources, college resources, department resources, and grants VideoNote can be continued in the near future.

We now answer the questions posed by the Task Force.

(1) What effects does the availability of VideoNote materials have on course attendance?

In two courses, attendance in lectures was recorded in some fashion, and we use this to study this question. In course NS 3310, with 117 students, the number of students in each lecture before the spring break was counted. Attendance remained close to 100% except for the few days before spring break. VideoNote usage peaked just before each quiz or prelim, but there was not a corresponding drop in attendance.

Course ENGRD 2030 provided attendance data in the 20 lectures in which i-clickers were used. Using data from VideoNote on usage for individual students, we determined that at most 16 of the 123 students in the class (at most 13%) had low attendance in the class that appeared to have been made up by watching VideoNote instead. Two of these were A students, and the rest were B-to-C students. A number of other students missed one or two lectures that might have been made up using VideoNote.

Responses to student surveys indicated that VideoNote did indeed result in reduced attendance, especially in early morning classes. For example, in one 8:40AM class, 29% of the students reported skipping and watching VideoNote instead at least 10 times. However, students reported that skipping could be kept under control by taking attendance (as in ENGRD 2030). Quite a few students commented on this combination as being valuable to them and preventing skipping.

In the one non-technical course in this study, the instructor took attendance each lecture until the first prelim; she noted a marked drop in attendance after that.

Overall most of the skipping was only a few times and often necessary —e.g. because of illness, to attend an interview, because of an athletic trip— so VideoNote was seen as providing needed flexibility.

Some of the chronic skippers reported using VideoNote instead of class attendance to increase what they learned from lectures either (1) to time-shift the lecture to when they were more alert and better able to learn, (2) because their learning style made use of VideoNote more effective, or (3) VideoNote allowed them to supplement lectures.

Overall, we conclude that VideoNote does enable skipping, but less than we expected, and skipping can be controlled by the use of attendance taking and interactive class sessions. Further, the presence of VideoNote enabled better learning.

(2) How often do students use the services, and for how long with each use?

The percentage of students in each class that used VideoNote ranged from 31–90%, with the average over all classes being 57%. The lowest (31% and 32%) were in freshmen courses PHYS 1203 and BIOG 1110, most of them were in the range 50–68%, and the highest (85%, 86%, 90%) were in higher-level courses (NS 3310, CS 2110, ORIE 5310/3310). We believe that the higher the course level, the more serious students are and the more use they make of VideoNote. ORIE 5310/3310 and CS2110 did not have textbooks, which likely also contributed to higher VideoNote use in those course.

Students spent a total of 7790 hours using VideoNote. One student used VideoNote for 87 hours, 96 students for 20 or more, 285 students for 10 or more, and 478 students for 5 or more hours. In total, 30% of the 1771 students in the 10-class experiment used VideoNote for 5 or more hours. Additionally, 151 students in the other two sections of Math 2940 watched a total of 1161 hours.

Thus, students voted with their time that VideoNote is a valuable resource.

In the 3000-level courses, students averaged about 14 hours on VideoNote; in the 2000-level courses, the average ranged from 2 to 8 hours; in the 1000-level courses, the average ranged from .5 hours to almost 4 hours. There appears to be a pattern: the higher the course level, the more likely that students will make serious use of VideoNote. We suspect that another important parameter is the attention paid to the presence of VideoNote by the instructor and whether the class has a textbook.

It is also clear that usage of VideoNote rose markedly just before prelims and quizzes.

(3) Is there any evidence that students who used the materials developed a better mastery of the material than those who did not?

To help answer this question, sophisticated statistical analysis was done using the students' cumulative GPAs as well as their VideoNote usage and grades in the pilot courses, indicating whether students over-performed or under-performed in a course relative to their GPA. The data suggests that use of VideoNote helped the middle-to-strong students (B to A) perform better. For example, B+ students who watched VideoNote for 20 hours or more achieved an average grade increase of almost .3 over the B+ students who did not watch VideoNote. At 10 hours or more hours of viewing, the corresponding increase was 0.2.

But VideoNote provided little help to the weak students (C to B-) and hurt very weak students (D to C-). One can guess at why the very weak students were hurt —e.g. they may have skipped many classes and then tried to cram using VideoNote— but it is only a guess.

Two classes, NS3310 and HD 2160, showed statistically significant improvements in student performance. Over all classes, high users (over 20 hours or about 1.5 hr per week) also showed statistically significant improvement.

There was no statistical difference between men and women. However, there was a statistically significant difference for URMs who used VideoNote more than 13 hours (about 1 hr per week); they performed better than non-users and their increase in performance was better than that for the overall population at similar use levels. We see roughly the same over-under performance with grade pattern for URMs as discussed above for the whole population, but the numbers of URMs at each grade level was too small to provide statistically significant data by grade.

(4) Do student evaluations indicate that VideoNote materials are helpful to them in their efforts to master course content?

Overall, 96% of the respondents to our survey who used VideoNote said it was somewhat or very helpful in understanding the course material. Even in BIOG 1110, which had the lowest positive response to this question, the percentage was 87%. Overall more than half the students said VideoNote was very helpful, with the highest percentage being nearly three quarters in NS 3310.

Overall, 86% of the respondents who used VideoNote thought that VideoNote helped their grade either some or very much. Interestingly, students perceived VideoNote as even stronger for understanding than for helping grades.

(5) How do faculty members whose lectures were recorded by VideoNote assess the value of the project?

Six of the faculty, representing 7 of the ten courses in this study, responded to a request for feedback. Their verbatim comments are given in the full report. The remarks are all very positive, and the faculty would like to see the use of VideoNote continue. Here are some of the comments (paraphrased):

- I will be very disappointed if this service were discontinued. I strongly vote that VideoNote be continued. I hope that VideoNote thrives and than many Cornell courses are put on the web.
- VideoNote helped me improve my teaching —I could monitor my speed, delivery style, and content and do better next time. I obtained copies of all my lectures and will review them.
- Great for students who get into a course late or miss a lecture because of an interview, illness, an athletic trip.
- I was able to video a lecture early and have it shown by VideoNote people in a lecture that I had to miss.
- Your videos are higher quality than others' (e.g. MIT, Yale), and the table-of-contents feature is unique.
- VideoNote may provide ways to innovate in teaching. For example, save the recordings for a later iteration of the class in which viewing the lectures is a homework assignment and class contact hours can be used more for discussion, examples, applications, etc.

Ways to use VideoNote

Below, we present some ways that VideoNote could best be used.

- As suggested by the students themselves, use VideoNote in large physics, chemistry, and other technical courses.
- In multi-section classes that cover the same content: videotape *one* of the sections, for all sections to see.
- In small-section classes like MATH 1910, which may be changed into a large lecture class because of budget considerations, providing VideoNote with one excellent instructor doing the lecturing may serve to lessen the effect. The data for

Math 2940 indicates that students will make good use of VideoNote even if the VideoNote lectures are from a different section and instructor.

- For alternate year or small section courses, videotape the class one year and then offer it the next year on video with the professor running a discussion section to accompany the videos, thus saving on faculty time.

- URM students had a statistically significant increase in their grades above that of the overall population, so VideoNote might help improve the learning environment and increase retention of URMs, if its use was widespread enough.
- Coordinate with athletics to video-tape specific lectures missed for team travel.
- Videotape courses in which Disability Services needs to make accommodations that VideoNote could address.
- Allowing students in later courses to refer back to VideoNote lectures of critical prerequisites could provide effective review, due to the good indexing of VideoNote. This might help students who missed a concept because of AP credit and would like a review.

- As part of a major grant proposal to help prepare transfer students to succeed at Cornell, collaborate with several 2-year "feeder" schools to strengthen their program for students who plan to transfer by letting their students "take" the more rigorous Cornell version of critical courses on which their work at Cornell (or other transfer school) would depend.

- Use VideoNote for faculty development, since seeing oneself teach can lead to insights in how to improve, sometimes on one's own and sometimes with the assistance of a teaching mentor.

- CIT runs a service, which Cornell units can use to record lectures, presentations, or conferences and have them placed on the web. The use of VideoNote for this service may reduce costs and provide a quicker and higher quality service.

Table of Contents

Introduction

The Task Force on VideoNote, E-learning, and Online Courseware Systems, chaired by Vice Provost Michelle Moody Adams, agreed to perform an experiment during the Spring 2009 semester. Ten classes used the VideoNote service, with funds for this experiment paid for by the Provost. Thus, the service was free of charge to students. The Task Force asked the study to address the following questions.

(1) What effects did the availability of VideoNote materials have on course attendance?
(2) How often did students use the services, and for how long with each use?
(3) Is there any evidence that students who used the materials developed a better mastery of the material than those who did not?
(4) Do student evaluations indicate that VideoNote materials are helpful to them in their efforts to master course content?
(5) How do faculty members whose lectures were made available through VideoNote assess the value of the project?

A detailed study was undertaken by the Engineering Teaching Excellence Institute (TEI) to address these questions. The results of that study are given in this report.

To answer these study questions, data was collected in a number of ways, including (1) data collected by the VideoNote website, (2) two surveys of the students during the semester, (3) clicker data for one course, and (4) data on students' grade, GPA, gender, and ethnicity. In more detail, the following data was collected. Items 1, 2, 4, and 5 were tagged by student's netIds so these data could be linked by student:

1. Mid-semester and end-of-semester surveys of the students
2. Clicker attendance data in one course, ENGRD2030
3. Number of students attending each lecture in NS3310 for the first half of the semester
4. Data on student's grade, GPA, gender, and ethnicity
5. Logs of total time spent using VideoNote
6. An experiment VideoNote ran in Fall 2008
7. A survey by VideoNote of students
8. Faculty responses written at the request of VideoNote

The study questions were adapted and studied with the data sets as explained below.

o   How many students used VideoNote, and how much did they use it?
   a. Total number of students who watched
   b. Percent of students who watched
   c. Average hours/student
      The data logs and enrollment data were used to answer this question by class and overall
         i. Using 0.1 hours as cutoff to count as user
         ii. Using 2.5 hours (equivalent to about 1 week of class time) as a cutoff to count as a user

o   Did students use VideoNote to skip class?
   a. Self report from survey
   b. Data from clicker use in ENGRD2030
   c. Percent of class attending each day for first half of semester and VideoNote log for NS3310

o   Did VideoNote improve student learning?
   a. Comparison of class grades for VideoNote users and non-users
   b. Comparison of expected grade (based on GPA and class average grade) for users and non-users
   c. VideoNote experiment run by VideoNote fall 08
   d. Self report from survey

o   Did student use vary by any of the following? (Same data as in question 1).
   a. Gender
   b. Ethnicity
   c. Grade in course

o   Did students who used VideoNote value it?
   a. Self report from survey run by engineering college

o Did any particular populations of students report high value for VideoNote?
   a. Athletes
   b. Students with disabilities
   c. Students on interviews
   d. Other

o How did faculty members whose lectures were made available through VideoNote assess the value of the project?
   a. Faculty responses to VideoNote request for feedback

Data collection

A final grade list from each of the 10 classes was used as the student list for this study. The grade list had information on grade in the class, GPA, gender, ethnicity, and netId. The netId was used to match students from the survey, the VideoNote time log, the grade list, and for the one class where we had it, clicker attendance data. Since we had complete final class lists and VideoNote time logs, all results, except from the survey, are for the entire class populations unless otherwise noted.

The study involved 1771 students. A "student" is a student in one class; the same student in two of the classes shows up twice in the 1771 students. Only the survey data was a sample, and we could compare the survey sample directly to the entire class. A few students on the grade list didn't have final grades so they were omitted from any results tied to grades. This occurred in only a few classes and for less than 3% of the students.

Two surveys addressed student opinions of VideoNote. The first survey was written by the Engineering TEI, approved by the IRB, and run once just after spring break and once at the end of the semester. Students were sent several email reminders to fill out the survey each time. The data from the first run of the survey was included in the preliminary report. The data from the second run is included in this final report. The survey questions for this survey are included as Appendix A. Where the questions directly addressed a question in this study, the survey question and a summary table for responses are included in the appropriate part of the report. For questions that weren't directly relevant to the research questions for this report, the summary tables for responses are included in Appendix B. Statements regarding student comments are drawn from both runs of the survey. References to survey questions refer to this survey, except for specific references to a separate survey by VideoNote described in the next paragraph.

VideoNote also ran a survey using Survey Monkey. It collected data from the first 100 students to reply and then closed the survey. Thus the sample was not large and not all students had an opportunity to participate. This data is included because different questions were asked than on the Engineering TEI's survey. VideoNote's survey was from a biased sample since only VideoNote users were invited to participate. Several of the answers choices were also confusing or redundant or used emotionally loaded wording. The questions in this survey are included as Appendix C.

Attendance data was obtained for two classes. In ENGRD2030, Professor Ruina's use of i-clickers allowed names and netIds to be matched to responses. He did not include attendance in students' grades. In NS3310, Professor McCormick asked a TA to count the number of students at each lecture and compute a percentage attendance. This was done until spring break.

VideoNote keeps a log of student connect time and viewing time. Viewing time was used in this experiment. Ryan Morris, of VideoNote, provided the information on viewing time matched with netIds. This was then merged into the data file that had netIds, grades, and GPAs.

VideoNote ran an experiment in fall 2008 in ECE2210 to study how VideoNote affects student performance. The 77-student class was randomly divided into 2 groups. Group A used VideoNote for a unit on Op Amps. Group B used VideoNote for a unit on Transfer Equations. Otherwise VideoNote was not provided for the rest of the course content. VideoNote was not available to Group A for Transfer Equations or Group B for Op Amps. The final exam had 7 questions, 2 pertaining to Op Amps and 2 pertaining to Transfer Equations. Scores for each student on each problem were recorded.

Results

How many students used VideoNote and how much did they use it?

Table 1 gives VideoNote usage data for each of the 10 classes and aggregate data. Classes are ordered from highest to lowest course numbers. Students who watched for less than 0.1 hr were not considered users. The basic data in Table 1 provides answers to research question 2. Figs. 1, 2, and 3 show this data graphically.

Table 1. Basic VideoNote usage data by class and aggregate

Class	Instructor	#Students/ Finalgrade	#VideoNote users	%VideoNote users > 0.1 hr	Average hours per user for semester	Total hours watched in each class
ORIE5310/ 3310	Trotter	124/123	112	90%	15.5	1741
NS 3310	McCormick	117/117	100	85%	17.3	1726
MATH 2940 Section 001	Ruina	105/105	62	60%	6.4	398
MATH 2940 Sections 002, 003	Other sections viewing Ruina's VideoNotes	303	151	50%	7.7	1161
BIOEE 2780	Zamudio	253/251	136	54%	7.9	1074
HD 2160	Schelhas-Miller	160/158	86	54%	7.6	657
CS/ENGRD 2110	Bailey	171/168	145	86%	9.4	1363
ENGRD 2030	Ruina	123/123	70	57%	3.2	226
PHYS 1203	Padamsee	246/246	78	31%	2.3	182
CS 1110	Gries	171/171	116	68%	6.0	697
BIOG 1110	Balko/Wayne	309/309	100	32%	3.8	379
Overall (only Ruina's Math 2940)	Total	1779/1770	1005	57%	7.8	7790*
Overall with all Math 2940 sections	Total	2073	1156	56%	7.7	8951*

* 65 students used VideoNote in more than one course. Since the data gives total viewing time per student without separating it into courses, these students will have all their viewing time listed in each course. This cannot be corrected in the data for each course. However, in the total time, their 652 hours are subtracted so these students' time is not double counted in the total.

VideoNote taped Professor Ruina's section of Math 2940, section 001. Students in sections 002 and 003 of Math 2940 had a different professor who wasn't taped. Students from these other two sections had access to the VideoNotes of Professor Ruina's section. Sections 002 and 003 are included in their own line in the table above. They used VideoNote at a somewhat lower rate (50% instead of 60%) but for a larger average number of hours per user (7.7 versus 6.4 for the taped section). Sections 002 and 003 contributed 13% of the hours in the entire experiment, a total of 1161 hours, even though they were watching a different professor than their own. Thus the other sections made significant use of the taping of one section of MATH 2940. For consistency between classes, in the rest of the report Math 2940 refers to section 001 only unless otherwise specified.

Fig. 1 shows the numbers of users and non-users in each class. To make sure all students who tried VideoNote were included, the minimum time to call a student a user was 0.1 hr for this graph. Fig. 2 shows the percent of students in each class who were VideoNote users (same cutoff of 0.1 hr). The users varied from a low of 32% of the class in BIOG 1110 to a high of 90% in ORIE 5310/3310. Fig. 3 shows the average hours of use per user. This is total hours across the semester.

Figure 1. Number of students using VideoNote > 0.1 hr by class

Enrollment and VideoNote Use by Class

Students used VideoNotes >0.1 hrs   Students didn't use VideoNote

Bar labels (yellow): 2, 9, 17, 43, 115, 72, 23, 53, 168, 54, 209

| 5310 | 3310 | 3310 | 2940 | 2780 | 2160 | 2110 | 2030 | 1203 | 1110 | 1110 |
| ORIE | ORIE | NS | MATH | BIOEE | HD | CS/ ENGRD | ENGRD | PHYS | CS | BIOG |
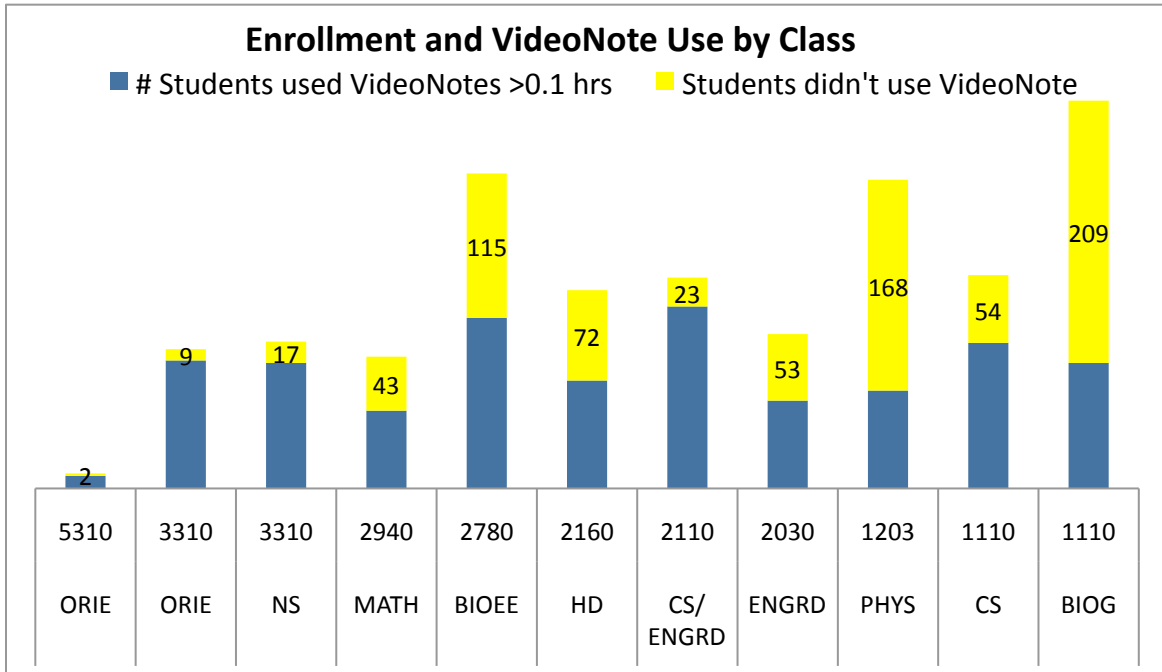
Figure 2. VideoNote users as a percent of each class. 0.1 hr is used as the cutoff for defining a user.

Percent of Class Used VideoNotes

| 5310 | 3310 | 3310 | 2940 | 2780 | 2160 | 2110 | 2030 | 1203 | 1110 | 1110 | Total |
| ORIE | ORIE | NS | MATH | BIOEE | HD | CS/ ENGRD | ENGRD | PHYS | CS | BIOG | Total |
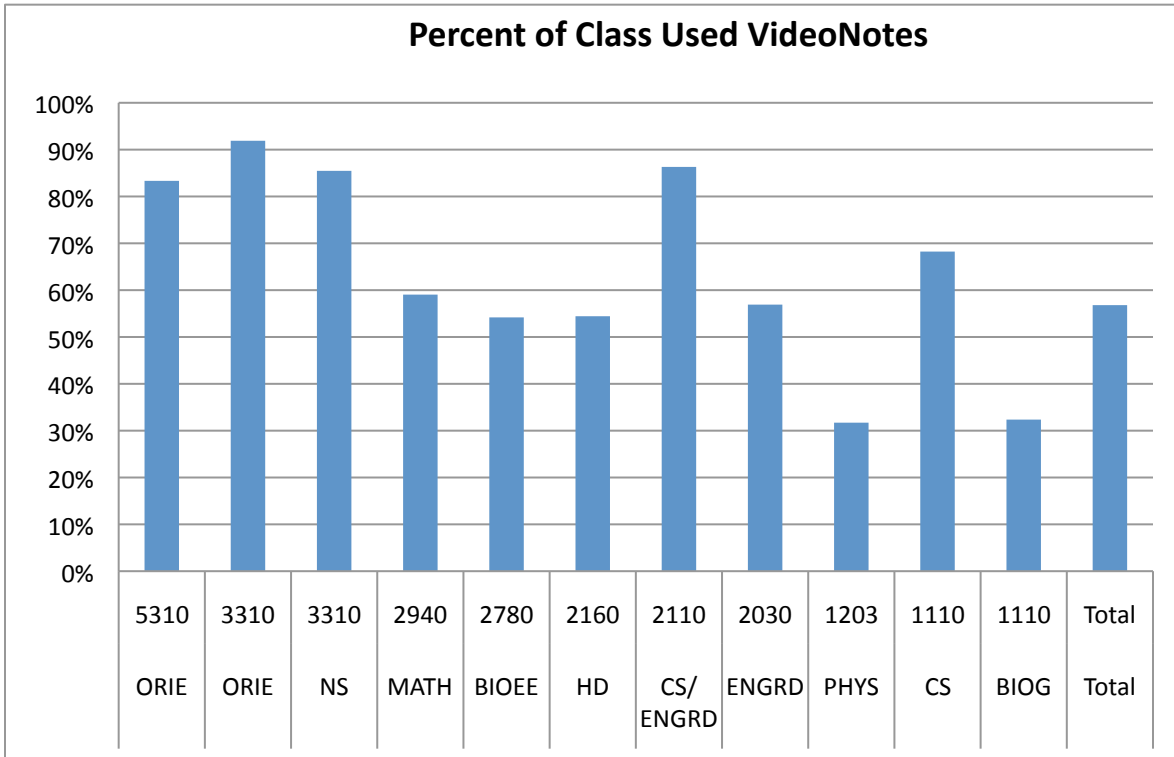
Figure 3. Average hours of VideoNote per user (> 0.1 hr cutoff) by class, ordered by class number.
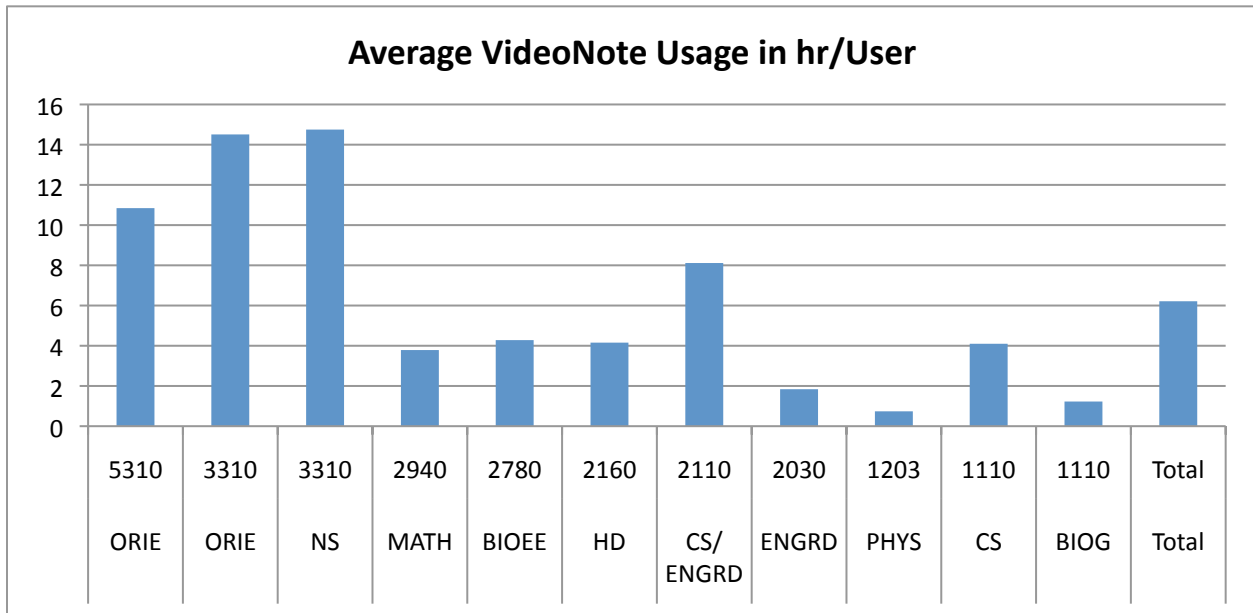
Note in Figs. 2 and 3 that the 1000 level classes generally used VideoNote less than the 2000 level classes, which generally used it less than the 3000 level classes. This is not absolute and the number of classes is small, but there does seem to be a pattern in the time students used VideoNote and the percent of students who use VideoNote.

Figure 4. Total hours of VideoNote use by class, videotaped classes in blue, Math 2940-002, 003 added in red.
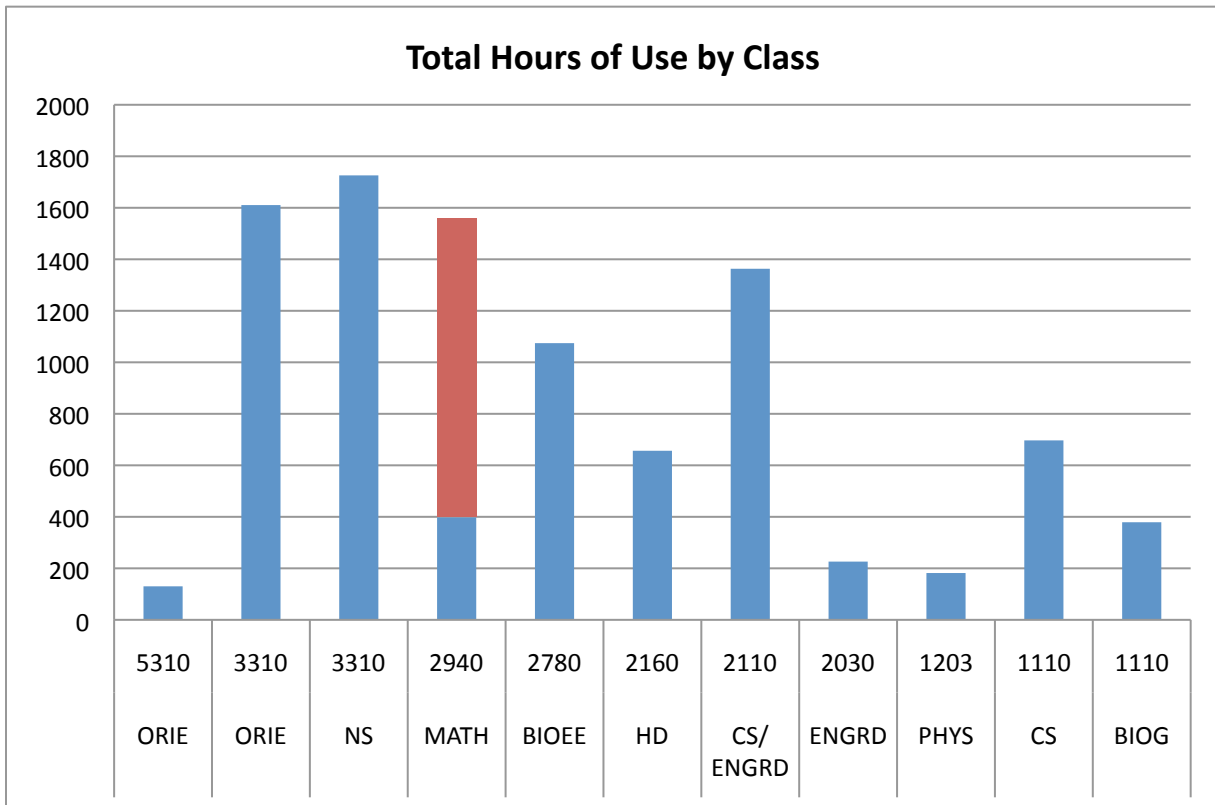
Figs. 5 and 6 repeat the data in Figs. 2 and 3 but with a cutoff of 2.5 hours so only users who watched the equivalent of 3 or more lectures (or parts that added up to that much time) are counted.

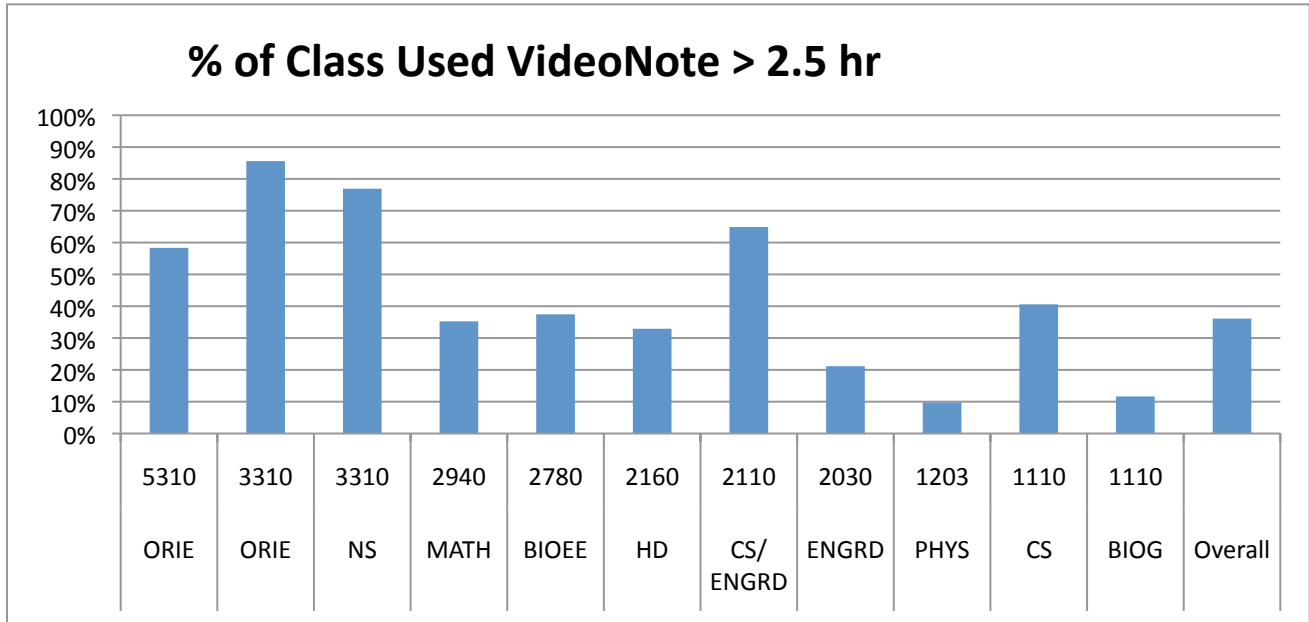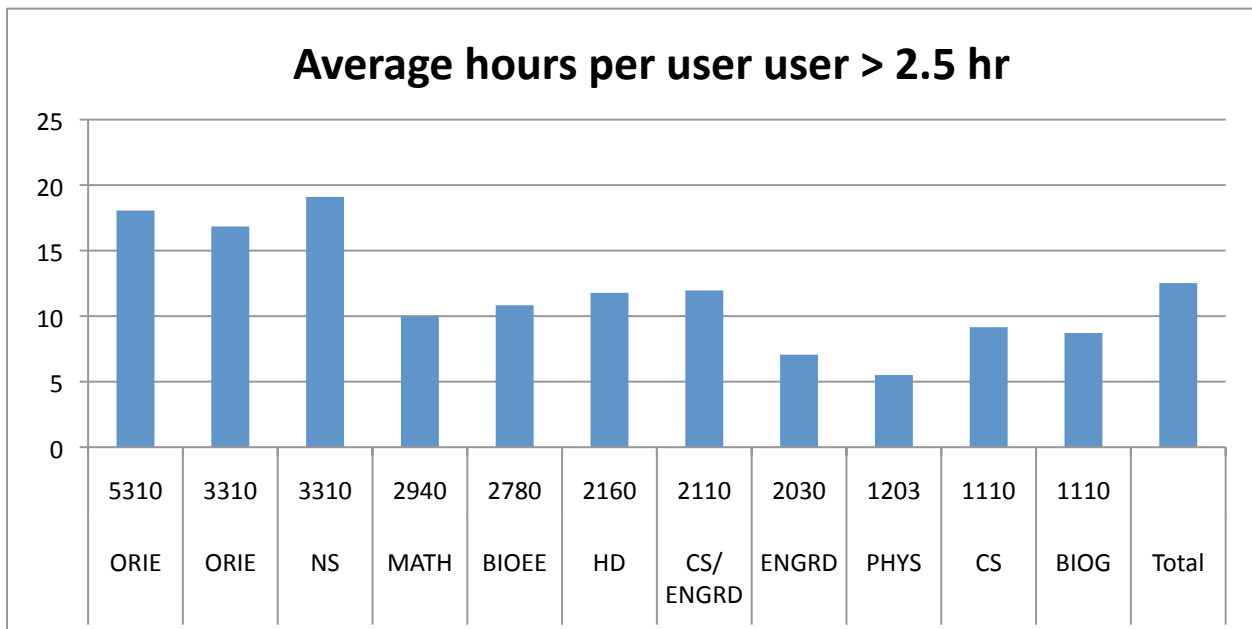**Figure 5. Percent of students who used VideoNote by class, using 2.5 hrs as cutoff to be a user**

Figure 6. Average hours of VideoNote per user (> 2.5 hr cutoff) by class, ordered by class number

The first survey question, which asked whether students used VideoNote, was used to sort student replies into users and non-users for the purpose of analyzing survey answers. See Table 2 for a summary of this data.

Table 2. Summary of survey data showing responses by class for users and non-users

Question	ORIEE	NS	MATH	BIOEE	HD	CS/ENGRD	ENGRD	PHYS	CS	BIOG	Total
	5310/3310	3310	2940	2780	2160	2110	2030	1203	1110	1110	
Total responses	43	38	22	46	43	61	31	19	52	31	355
enrollment	124	117	105	253	160	171	123	246	171	309	1470
% response	35%	32%	21%	18%	27%	36%	25%	8%	30%	10%	24%
#users in survey	41	34	17	38	27	55	20	14	44	19	309
%users in survey	95%	89%	77%	83%	63%	90%	65%	74%	85%	61%	80%
%users in class for comparison	90%	85%	60%	54%	54%	86%	57%	31%	68%	32%	57%
#nonusers	2	4	5	8	16	6	11	5	8	12	77
%nonusers in survey	5%	11%	23%	17%	37%	10%	35%	26%	15%	39%	20%

In interpreting survey data in the rest of this report, it is important to note that for every class the percent of VideoNote users in the survey was higher than in the class (even defining a user as viewing > 0.1 hr). Not surprisingly, users responded to the survey more than non-users. Because of the small number of non-users in some classes, the statistics can be strongly skewed for non-users by a single individual. One should be cautious when interpreting the non-user survey data in the classes with very few non-user respondents.

The aggregate non-user data has a population of 77 students and is a reasonable population from which to draw conclusions. Since the survey data is reported separately for users and non-users, one is looking at the percents of these populations rather than percents of the total class.

The usage data collected by VideoNote was supplemented by a survey question asking how often students used VideoNote. The VideoNote data just gives total hours, this survey question gives some idea how the time was allotted.

3. How often did you use VideoNote?
- o *Once or twice*
- o *Several times, especially around exams*
- o *Several times, but not tied to exams*
- o *More or less weekly; it was a fairly regular part of my study*
- o *Quite often, more than once a week*

Table 3. Frequency of VideoNote use

	ORIE	NS	MATH	BIOEE	HD	CS/ENGRD	ENGRD	PHYS	CS	BIOG	Total
course	5310/3310	3310	2940	2780	2160	2110	2030	1203	1110	1110	
once, twice	12%	3%	35%	18%	37%	5%	20%	21%	16%	37%	17%
several, esp exams	54%	59%	18%	61%	44%	58%	30%	50%	42%	53%	50%
several not exams	10%	9%	35%	8%	11%	5%	30%	7%	26%	5%	13%
~ weekly	12%	18%	6%	11%	4%	15%	15%	21%	7%	5%	11%
> weekly	12%	12%	6%	3%	4%	16%	5%	0%	9%	0%	8%

Overall, the dominant use is studying for exams; with 50% of the students reporting this use. Overall, 19% of the students used VideoNote regularly, defined as once a week or more often. 17% used VideoNote only once or twice. In Math 2940 and ENGRD 2030, both taught by Professor Ruina, use was less tied to exams.

Did VideoNote improve student learning?

Student learning was indirectly assessed with survey questions on student learning. An experiment run by VideoNote in fall 2008 directly assessed student learning in one class, ECE2100. For the 10 classes studied in the spring, data for direct assessment of student learning outcomes was not available; instead grades were used as a general measure of student learning. Final grades were available and gave a direct, single point measure of student learning, but outcomes and student performance on specific outcomes were not available.

Controlled experiment fall 2008

In fall 2008, Ryan Morris of VideoNote ran an experiment using the 77 students in ECE2100. He divided the class into two random groups and gave each group VideoNote for a different specific unit. The final exam had two questions on each of these topics and 3 questions for which none of the students had VideoNote. The course instructor recorded grades for each student on each of the exam questions. Group A had VideoNote access for the material that went with questions 3 and 4 and Group B had VideoNote access for the material that went with questions 5 and 6. Each of these questions was worth 15 points. The table below shows a summary of the data. The analysis given below is done by Kathryn Dimiduk, director of the Teaching Excellence Institute, and designed by Jeffrey Dimiduk, senior in ORIE. The original analysis by VideoNote had an error and is not included here.

Table 4. Controlled experiment data and analysis

	Q3	Q4	Q5	Q6	Exam Total	Q3+Q4-Q5-Q6
Ave Group A	10.895	8.579	10.289	12.211	74.211	-3.026
Std Dev. Group A	3.245	3.446	5.040	4.160	17.264	6.570
Ave Group B	10.667	8.308	11.936	13.923	78.603	-6.885
Std Group B	3.744	3.555	4.190	2.400	15.417	6.386
Group A – Group B	0.228	0.271	-1.646	-1.713	-4.392	3.858
Std error A-B	0.808	0.808	1.072	0.787	3.782	1.50
t statistic						**2.578**

The standard deviations for individual questions in each group were computed from the actual student scores. The combination Q3+Q4-Q5-Q6 was chosen to combine the effect on all 4 questions. The standard error was computed by finding the standard deviation of the A and B groups and then combining them as

square root ($StdevA^2/(38-1) + stdevB^2/(39-1)$) = standard error for A- B

The results on the 4 questions are likely highly correlated since a student's ability and effort will affect all the test questions, rather than independent, so one can't look at each question as an independent test. This combination with the negative for questions 5 and 6 takes into account that if there is a VideoNote effect, it should be opposite on questions 3 and 4 compared to questions 5 and 6. If there is a VideoNote effect, group B should have a more negative value than group A (both are negative because group A had VideoNote for the harder questions). Taking the difference in the means for the A and B groups allows one to do a 2 sample t statistic to test the hypothesis:

H_o: mean of group A (Q3+Q4-Q5-Q6) – mean of group B (Q3+Q4-Q5-Q6) = 0
H_A: mean of group A (Q3+Q4-Q5-Q6) – mean of group B (Q3+Q4-Q5-Q6) > 0

The t statistic is 2.578, which corresponds to a p value of 1%. This means that effects this large would show up in 1% of experiments with no actual effect; in other words, this difference would be seen 1% of no effect experiments and not in 99% of no effect experiments. **One can conclude that on final exam questions, students who had access to VideoNote for a question outperformed who did not have access to VideoNote.** This result is valid at a 1% significance level.

Results from grade information from 10 classes, spring 2009

In spring 2090, 10 classes were studied. The detailed experiment described above was not performed in each class. Rather course grades, overall GPA, and time viewing VideoNote were obtained for each student. Grades were compared for VideoNote users versus non-users. Preliminary analysis of the data showed that any effects would be buried under the variation in student's overall strengths as a student and in how hard the grading was in a particular class. Therefore each student's performance was normalized to give an over/under performance. This normalization was based on the student's cumulative GPA and the difference between the average grade in the class and the average GPA in the class. The details of the normalization process are described next.

Normalization:

In order to be able to compare across a wide range of students it was desired to get students across all the classes and grades to be equivalent. First, it is unreasonable to assume that all students are equally likely to get a given grade in a class; students that have consistently performed well in their classes are likely to continue to do so. To correct for this effect, the analysis started from the assumption that each student would earn a grade in the given class equal to their current GPA. A normalized value was then created for each student: a difference between their class grade and GPA. Note that data was only available for cumulative GPA including the spring semester, which would create a slight bias toward students performing at their GPA, but the effect will be small.

However, this still made the assumption that the students would perform the same regardless of which class they were in, which would hold only if all professors strictly adhered to exactly the same grade curve. So, with the over/under performance values from above, an average over/under performance for each class was calculated and used to adjust the students' performance by this factor.

We now had a statistic for student performance, for each student, that across all of them averaged 0. Thus if any population differed substantially from zero on average, it was likely that these students were being affected by something, most likely VideoNote.

Results:

Once the student's performances were normalized, average over/under performance values were found for groups of students by class and by amount of VideoNote viewing time. Two classes, NS3310 and HD 2160, showed statistically significant improvements in student performance. High users, over 20 hours or about 1.5 hr per week, over all classes also showed statistically significant improvement. See the table below for details. The level of significance of the result (p value) is smaller for more reliable/significant results. 5% is a common significance level for a strong result; these results are all better or more reliable than that.

Table 5. Results from analysis of 10 classes spring 2009 VideoNote use

Population	Number of students	Over/under performance	Level of Significance (p value) Compared to class baseline
NS 3310 top 20% of users (>25.1 hrs of use)	24	0.31	0.7%
NS 3310 top 10% of users (>32.8 hrs of use)	12	0.38	1.4%
NS 3310 used < 1 hr (baseline)	25	-0.02	----
HD 2160 users > 2.5 hr	52	0.12	0.9%
HD 2160 top 20% over users (> 6 hrs of use)	32	0.09	3%
HD 2160 used < 1 hr (baseline)	90	-0.11	----
Entire population Users > 25 hours	57	0.16	1.2%
Entire population Users > 20 hours	96	0.11	2.2%
Entire population < 1 hr use Baseline	970	0	----

At lower use values, there was not as strong an effect, as will be shown later in the section on performance as a function of grade earned. Middle and strong students over-performed and weaker students under-performed, so the aggregate data showed a strong effect only at high usage, > 20 hours. More details on this will be shown later.

Survey results on student learning

The survey asked two questions on whether students thought VideoNote helped their understanding of the class material and their grade. The results are given below.

Q8. Did using VideoNote help you understand the course material better?
- *Not really*
- *Yes, some*
- *Yes, very much*

Table 6. Does VideoNote help understanding

	ORIEE	NS	MATH	BIOEE	HD	CS/ ENGRD	ENGRD	PHYS	CS	BIOG	Total
course	5310/ 3310	3310	2940	2780	2160	2110	2030	1203	1110	1110	
no	7%	0%	0%	5%	15%	2%	0%	0%	2%	13%	4%
some	37%	26%	47%	45%	44%	35%	53%	69%	59%	31%	43%
very much	56%	74%	53%	50%	41%	63%	47%	31%	39%	56%	53%

Overall, 96% of the students who answered the survey and used VideoNote said it was somewhat or very helpful in understanding the course material. Even in BIOG 1110, the course that had the lowest positive response to this question, 87% of the users said VideoNote was somewhat or very helpful in understanding the course material. Overall more than half the students said VideoNote was very helpful. The highest percentage was nearly three quarters in NS3310.

Q9. Do you think that using VideoNote helped improve your grade?
- *Not really*
- *Yes, some*
- *Yes, very much*

Table 7. Does VideoNote help grades

	ORIEE	NS	MATH	BIOEE	HD	CS/ ENGRD	ENGRD	PHYS	CS	BIOG	Total
course	5310/ 3310	3310	2940	2780	2160	2110	2030	1203	1110	1110	
no	3%	27%	13%	8%	7%	20%	7%	18%	26%	14%	14%
some	35%	40%	58%	58%	40%	55%	79%	55%	21%	46%	46%
very much	62%	33%	29%	35%	53%	25%	14%	27%	53%	40%	40%

The students who answered the survey and used VideoNote were still strongly positive on VideoNote helping their grade but this response was not as close to unanimous as it was for helping their understanding. Overall, 86% thought using VideoNote helped their grade either some or very much. In NS3310, there was the highest response for improving understanding and the lowest response for improving grades: 100% for improving understanding and 73% for improving their grade. Overall, 40% said VideoNote helped the grade very much while 53% said it helped understanding very much. It is interesting to note that students perceived VideoNote as even stronger for understanding than for helping grades.

Did student use and learning vary by grade in the class, by gender, or by ethnicity?

Results by grade groups

Breaking down the population of each class by grades earned (A's of any type, B's of any type, C's of any type) shows a difference in VideoNote usage between these populations. Fig. 7 shows VideoNote usage by student grade. This graph also includes attendance information; within each grade students are ordered by attendance. Note that the A+ students used VideoNote only a little bit –even ones who missed many classes. This is very different from the C+ students who almost all used VideoNote regardless of attendance. The A- and B+ students had some heavy users and a few lighter users but not as much as the C+ students. See the graph below.

Figure 7: Class attendance and VideoNote usage by student in ENGRD2030
Students sorted by final grade and ordered by class attendance within each grade grouping.
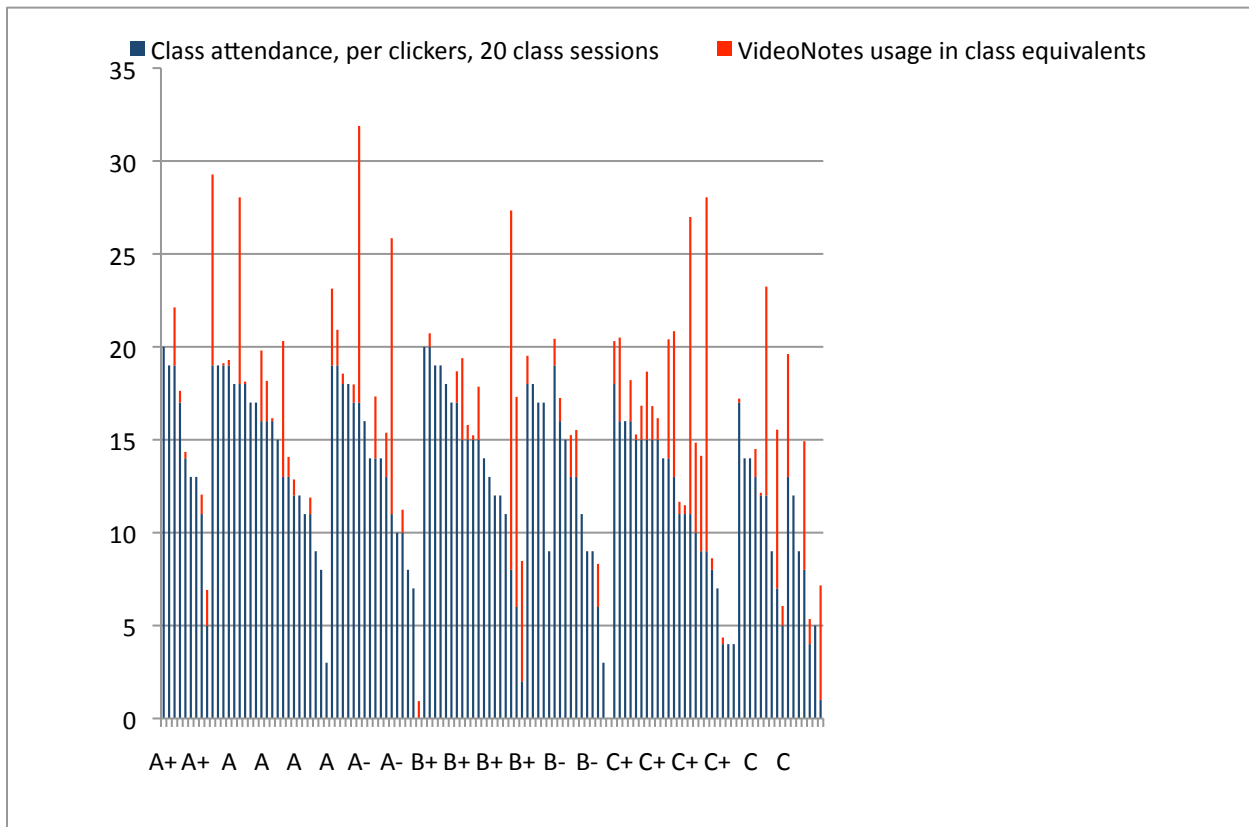
Data for all the classes are tabulated below where users were defined as use > 2.5 hours. Figures are given below the table that show trends by grade group and by hours of use.

Table 8. VideoNote use by class and grade

VideoNote Users >2.5 hr		A	B	C	DFW	INC	Total
Course	users						
ORIE5310/3310	ave hours	15.5	16.7	18.3	24.7	0	14
	#students	29	47	23	3	0	102
NS3310	ave hours	19.3	21.1	16.1	12.3	14.4	17.9
	#students	33	38	12	6	1	90
Math 294	ave hours	11	9.3	11.5	8.1	0	7.5
	#students	9	19	6	3	0	37
Math 294-002, 003	Ave hours	16.7	11.1	14.1	10.2	15.2	12.7
	#students	15	39	17	12	2	85
BIOEE 2780	ave hours	9.96	12.1	8.3	9.7	0	8.5
	#students	30	48	15	3	0	96
HD2160	ave hours	10	12.1	8.3	9.7	0	8.5
	#students	30	48	15	3	0	96
CS/ENGRD2110	ave hours	12.7	13.2	11	7.2	7.9	10.2
	#students	28	42	2	3	1	76
ENGRD 203	ave hours	6.6	8.6	7	0	5.1	8.7
	#students	9	4	12	0	1	26
Phys1203	ave hours	6	3.9	0	5.7	0	6.9
	#students	12	5	0	2	0	19
CS110	ave hours	10.2	7.7	9.4	14.6	4.2	10
	#students	26	20	17	3	1	67
BIOG1110	ave hours	8.8	9.1	6.8	0	0	6.4
	#students	11	20	5	0	0	36
Overall	ave hours	12.1	13.3	11.5	11.8	7.9	10.8
	#students	217	291	107	26	4	645

Fig. 8 shows how much students over or under-performed for various values of VideoNote viewing. Each line represents the students who earned that particular grade. The vertical axis is the amount of over-performance (positive) or under-performance (negative) where 1 is a full letter grade.

Figure 8. Over/under performance by grade group and hours of VideoNote use
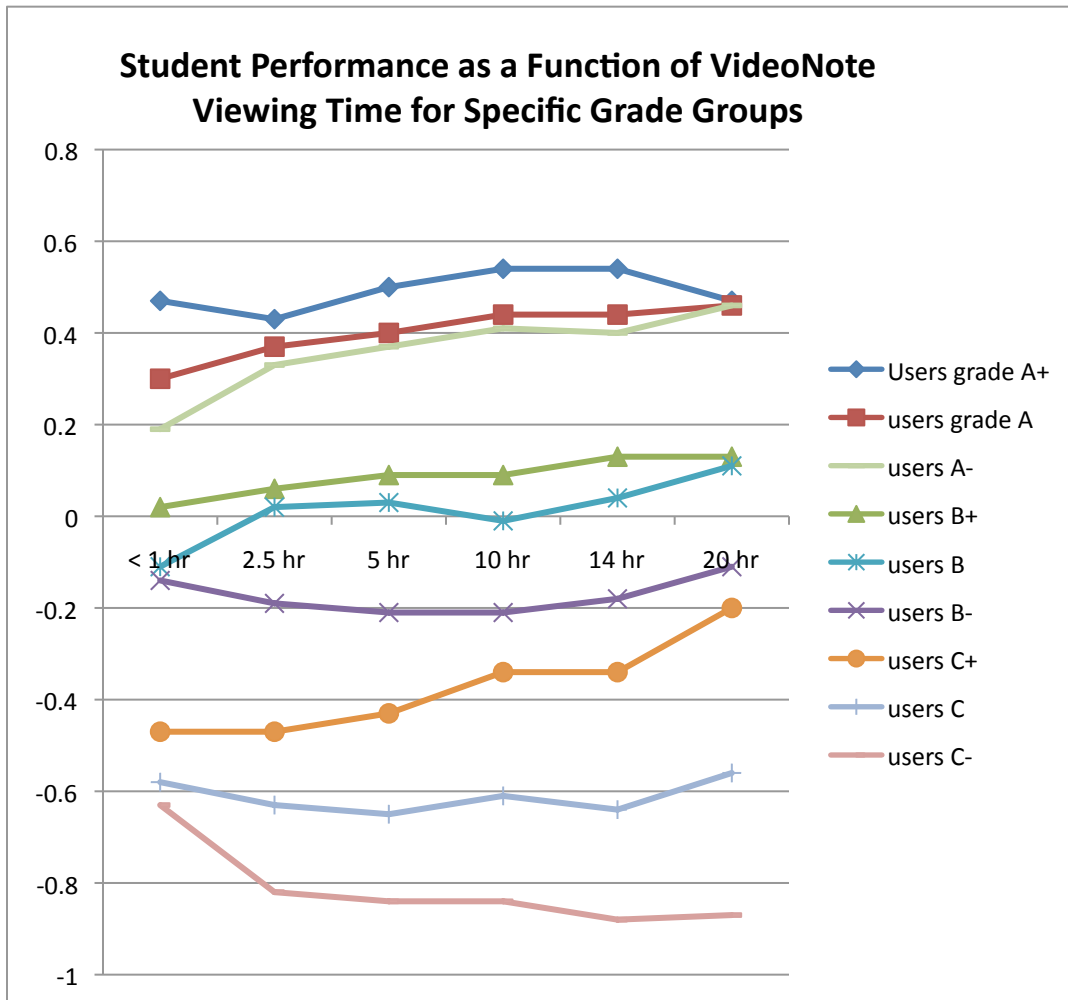
For students who scored C+ or better, there is a general trend that: increased use of VideoNote increased over- performance (except the trend doesn't quite hold for low users in the B- group). VideoNote use didn't affect the C student's under-performance very much. For C- students increased VideoNote use led to increased under-performance.

Figs. 8 and 9 do not include the extra two sections of Math 2940, which were able to view VideoNote from Math 2940 section 1.

Fig. 9 shows the same information as Fig. 8 but organized differently; the horizontal axis represents grade groups and the lines represent students who used VideoNote above the specified amount.

Figure 9. Over/under performance of students by VideoNote use and grade group.
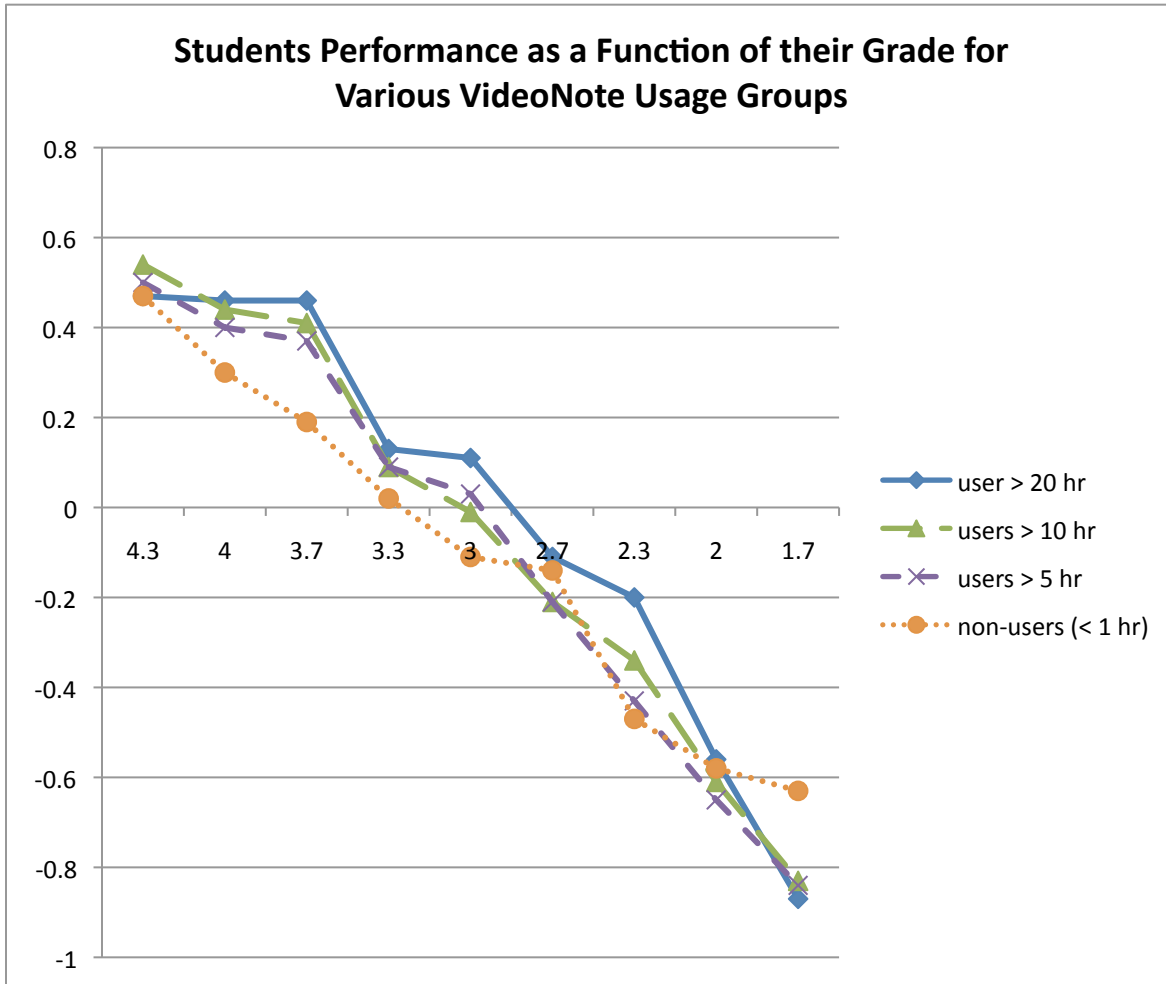
The dotted line is a baseline over/under performance by students who used VideoNote less than 1 hour. For a given student, an A is more likely to be an over-performance and a C is more likely to be an underperformance. The largest difference from baseline is for the A- students; this held at all three levels tested. Students over-performed relative to the baseline for each usage level for grades B, B+, A- and A. A student who is going to earn an A+ cannot earn a higher grade due to watching VideoNote so there is no difference from the baseline for the A+ students. B- students showed little effect from any of the levels of use. C+ students over-performed compared to baseline with high use but not lower use. C students showed little effect, and below C, VideoNote users under-performed relative to baseline at all three use levels tested.

In summary, for middle and strong students, VideoNote helped these students perform better than they typically did. For weak students, VideoNote didn't help much. For very weak students, VideoNote users performed worse.

The over/under performance was also calculated for the students in the two Math 2940 sections (sections 002 and 003) who had access to VideoNote taped in section 001. 85 out of 303 of these students used VideoNote for 2.5 or more hours. These students were analyzed separately from the overall population since it was not known if the effect of watching a different lecture would be the same as watching one's own professor. Statistically there wasn't a big enough population in each grade group to make a significant comparison between users and non-users, especially at higher use levels. Fig. 10 plots the over/under performance for users > 2.5 hours and non-users < 1 hour, but the populations by grade group are too small to draw conclusions. The largest positive effect again seems to be for the A-grade group. But there is no clear pattern of VideoNote use correlating with improved grades. While this could be an effect of taping a different professor than one's own, it is at least as likely that the populations were too small to be able to observe an effect. In Fig. 9, a grade improvement is observed for 5 or more hours of viewing across a range of good grades, but the line for 2.5 hours was not included because it didn't clearly follow the pattern of the higher use lines. In Fig. 10, only the 2.5 hours line had enough population to plot and even that has only a few students at some points. Thus Fig. 10 couldn't include lines for users above 5, 10, and 20 hours

where the effect was much stronger. This is an effect of only 303 students in these 2 sections as opposed to the 1770 in the larger study, not that there weren't student having these higher usages – just not enough of them to plot the lines.

Figure 10. Over/under performance for the students in the other two sections of Math 2940
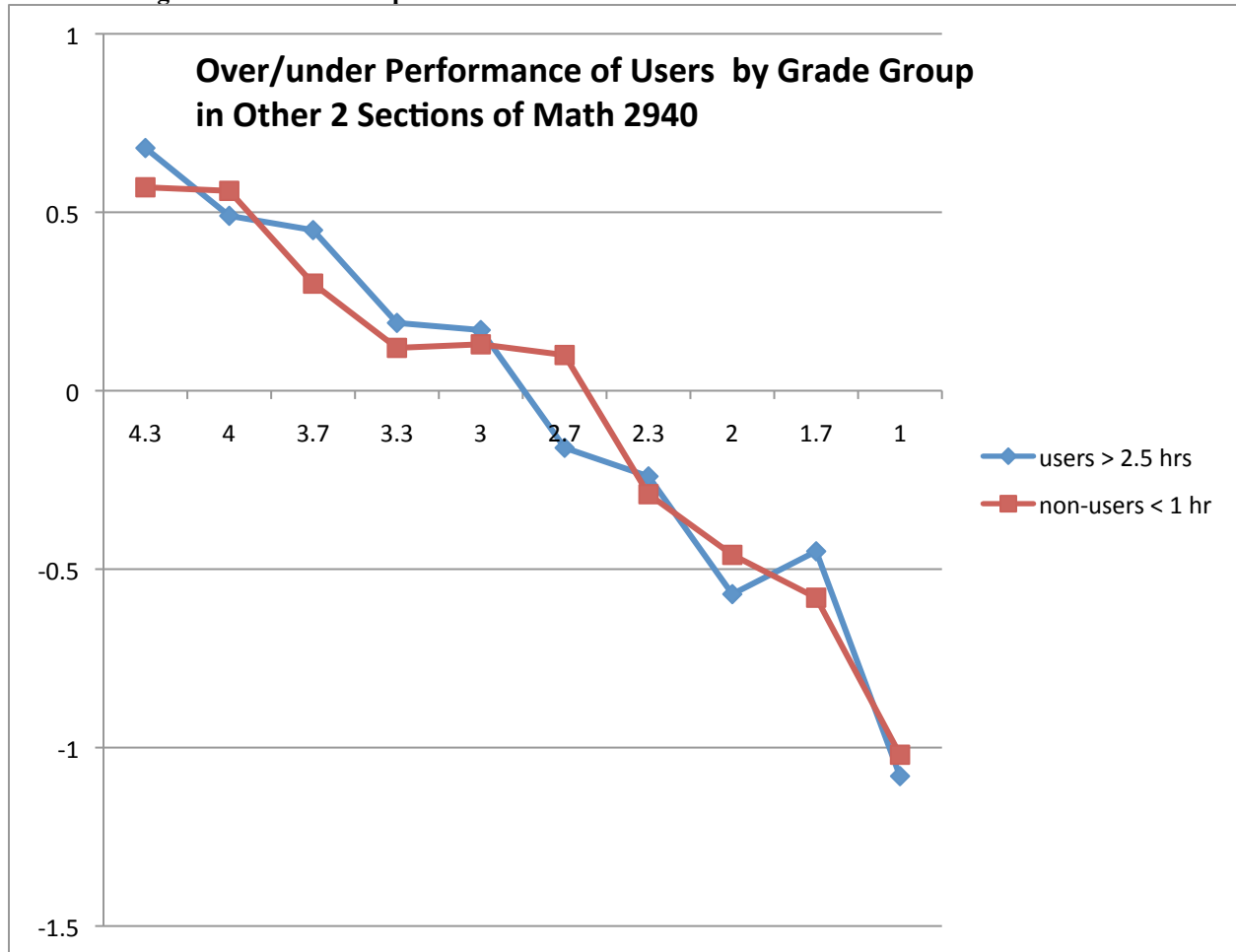
Results by gender

Overall, there was not a statistically significant difference in how much women used VideoNote compared to how much men used VideoNote. A difference was not found in achievement for men and women using VideoNote.

Results by ethnicity

The grade data on students in the 10 classes was also tagged by ethnicity. Using the same methods described in the section on student learning, the results for under-represented minority (URM) students were compared with the results for the overall population. Because the population of URM students is small, care had to be taken to have a sufficient population size. Therefore, for this graph, a cut-off of 5 hours was used to define VideoNote users. A viewing time of < 1 hour was used to define non-users. That gave a clear distinction between the populations and a sufficient size in each group.

Statistics were calculated for URM users and non-users. The VideoNote users had a significant improvement compared to the non-users; this improvement was significantly better than for the overall population.

Fig. 11, below, shows the results for URM students versus the overall population by grade groups. The vertical axis represents over/under performance compared to the expected value based on the student's GPA and the classes' difficulty. A 1 represents a full letter grade difference. The horizontal axis is the student's grade in the class. There were no A+ URM students and only one A out of the entire group of users, so the A student is shown by an x that isn't connected to the line.

The points for the individual grade groups of URM users represent small populations. The trend can be seen in this data but exact details by exact grade are not statistically valid; the overall result of URM's improving more than the overall population combines all the grade groups and does have a sufficient number of student's to be statistically valid. This can be seen in the graph from the fact that the two baselines (dotted lines) are similar but the URM VideoNote user performance is considerably higher for the VideoNote users than for the overall population for grades B⁻ or better. At C, the groups are all similar and both populations underperform if the grades are below C with the URMs being slightly worse, though not enough students earned C- or below for the comparison with the overall population to be statistically significant for students at C- or below.

Figure 11. Graph comparing the over/under performance of URM students with the overall student population. Vertical scale is compressed compared to Fig. 7 to include the larger over-performance of the URM students.
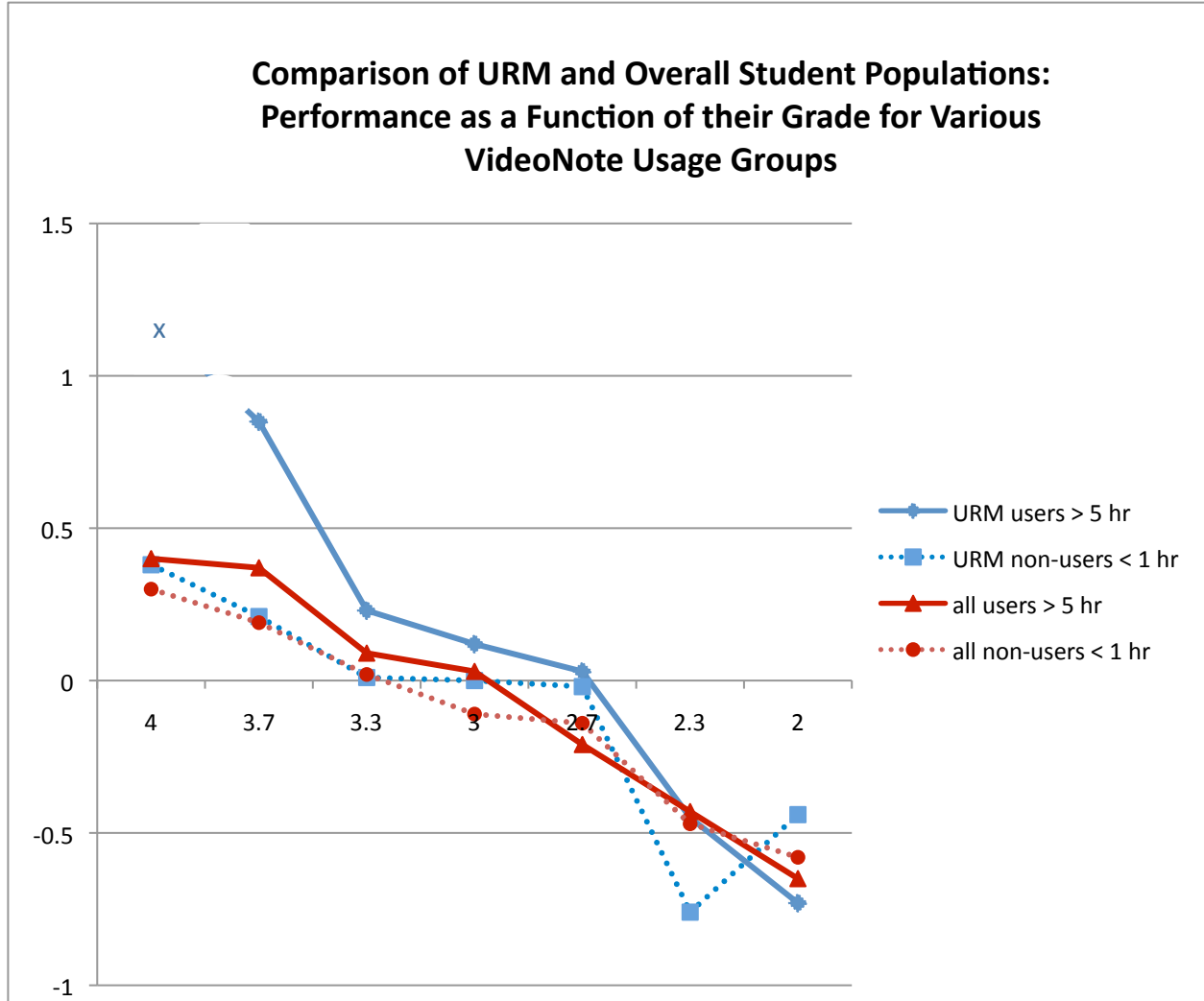
Since the number of URM students in each class was small, the statistics were run only for URM students aggregated across all the classes. The URM students started showing a measurable increase in grades with use above 10 hours. The effect increased with higher use. The table below shows the over/under performance for URM students at different grade levels and the p value (level of significance of the result – smaller p values mean the result is more significant with 5% being a common significance level for a strong result).

Table 9. Over/under performance for URM students for various VideoNote usage times

| VideoNote users with view times as indicated	Number of students	Over/under performance Compared to baseline of URM < 1 hr viewing	Level of significance (p value)
URM > 25 hr	8	0.42	2.4%
URM > 20 hr	8	0.42	2.4%
URM > 15 hr	15	0.26	3.4%
URM > 13 hr (top 10% of users)	19	0.29	1.1%
URM > 10 hr	22	0.19	4.8%
10 hr > URM > 5 hr	27	-0.21	negative
Baseline: all students < 1 hr	99	0.04	---
All students > 13 hours	204	0.01	42% (random noise)
URM >13 compared to all>13			1.5%

The URM students who watched VideoNote more than 13 hours over performed by 0.29 letter grades (equivalent to a + or -on a letter grade). This is just under an average of 1 hour per week. These were the top 10% of users by view time and the result is significant at the 1% level. The population helped is small, 19 students, but the results are significant. At a view time of >20 hrs the over-performance is 0.42 with a p value of 2.4% for a population of 8 students. Students with viewing times of 5 hr to 10 hr under-performed as indicated by the negative value, -0.21. Further investigation would be needed to understand why VideoNote was so helpful to the higher users and led to a decrease in performance for the moderate users. The over/under performance of URM users > 13 hours is compared with all users > 13 hours; for the URM users the over/under performance was a statistically significant 0.29 while for all users it was 0.01, almost no change.

Did VideoNote enable skipping class?

This question was addressed with 3 pieces of data. First, Professor Ruina used clickers as well as VideoNote in ENGRD 2030, which provided an attendance record for the 20 class sessions when clickers were used. Fig. 7, repeated below, shows for each student the number of classes attended and the number of class equivalents of VideoNote viewing (total time divided by 50 minutes). To make this graph, students were sorted by final grade in the class and then ordered within each grade grouping by attendance as measured by clickers. Each grade had students ranging from nearly perfect attendance to low attendance.

Several A and A- students that had very good attendance also had high VideoNote usage; clearly these students were not skipping class and using VideoNote to make it up. There are also high users at the lower grades who did not have good attendance; they probably did skip and then make up the class but at least they made up the class. Many students watched a few hours total of VideoNote, and they are spread across all grade levels. Of particular interest is that the C+ students had the highest rate of VideoNote usage. Thus it is not just the best students who are using VideoNote.

**Figure 7 repeated: Class attendance and VideoNote usage by student in ENGRD2030
Students sorted by final grade and ordered by class attendance within each grade grouping.**
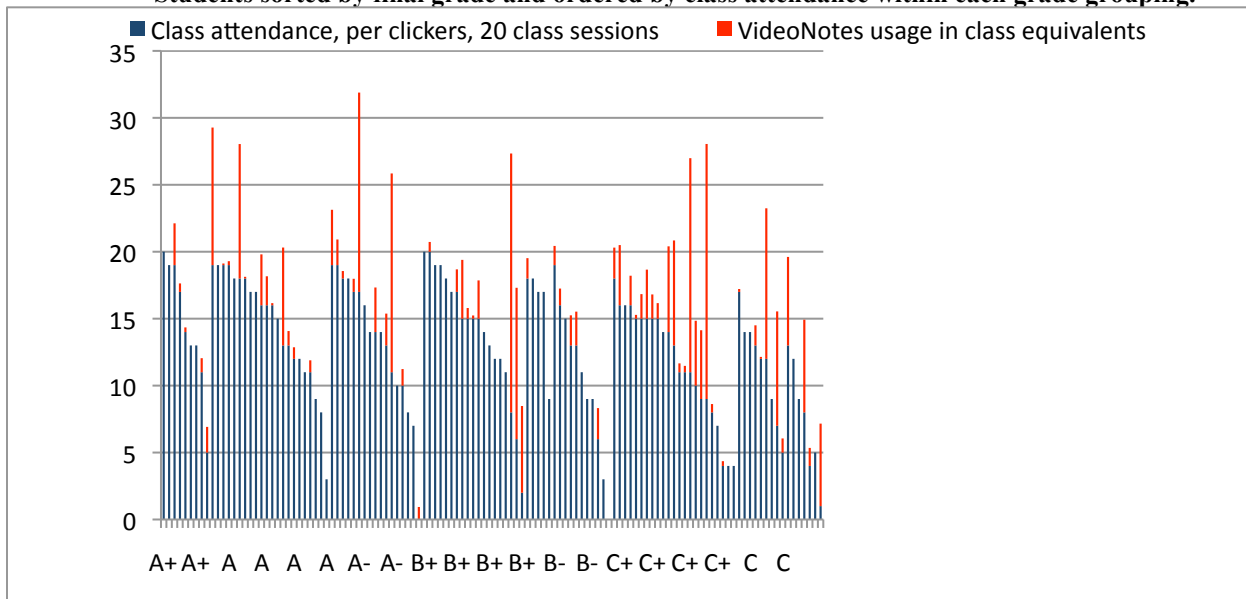
The second piece of data on skipping came from attendance data in NS3310. The percent of students in class was computed for each class before spring break. Individual attendance was not recorded. Fig. 12, below, shows this attendance data overlaid with VideoNote usage by day. For this figure, VideoNote usage was scaled to fit on the graph so relative heights of usage are important but not the actual values. (Graph courtesy of VideoNote). Each of the peaks in VideoNote usage occurs just before a quiz or prelim in class. The attendance was relatively flat, with small increases on the actual quiz and test days and the lectures before those days. The attendance did not significantly fall off following the first quiz; students did not start skipping in droves once they had tried VideoNote. From the graph it appears that VideoNote was used to study for exams but not significantly to skip class.

Figure 12: Graph of student attendance and VideoNote usage by date in NS3310 (provided by VideoNote)
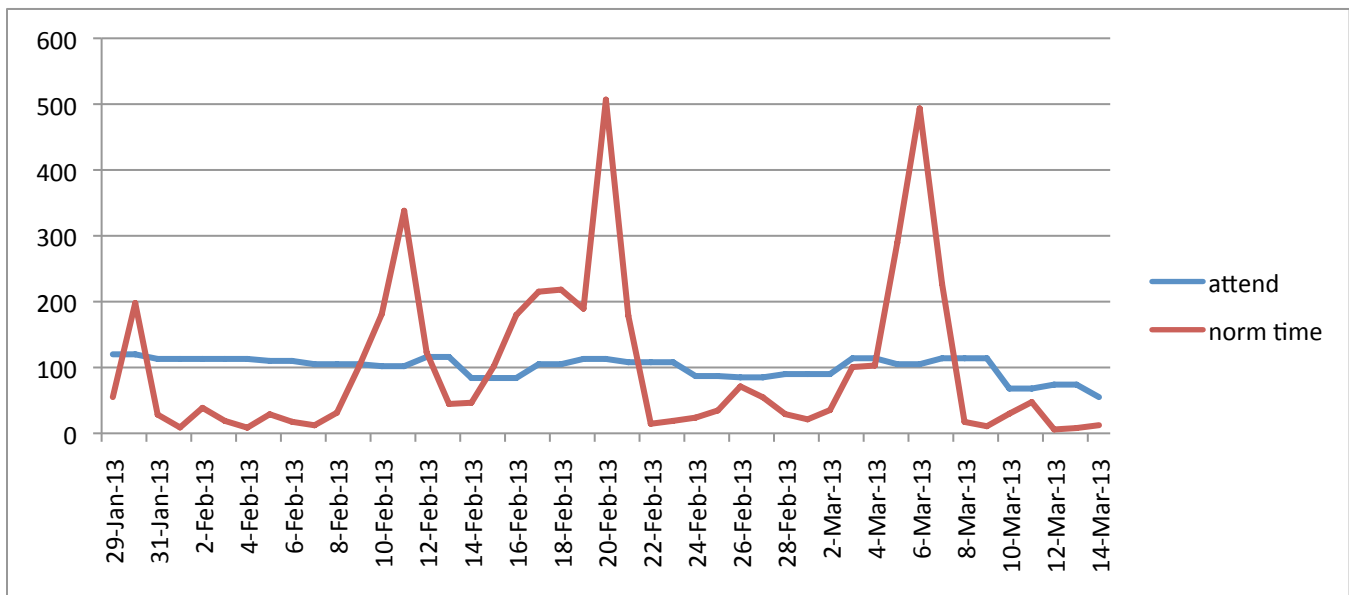
The third piece of data came from the student survey. The issue of skipping class was a sufficiently important issue that it was addressed in 3 different questions. Because a survey is a self-report and students might not feel comfortable just saying

they had skipped class, the question was asked directly and also embedded in how did they use VideoNote. Questions 4, 5, and 12 pertained to skipping or missing class. The survey results are shown below for each class.

Q4. In what ways did you use VideoNote? Mark all that apply.
- *To go back over a difficult point*
- *When I was reviewing for an exam*
- *When I got stuck on a homework or assignment*
- *As a way to take notes and flag important or difficult material*
- *When I missed a class because I was sick or had a conflict, such as a job interview*
- *When I missed a class for other reasons*
- *Other (give reasons in text field)*

Table 10. Ways VideoNote was used

	ORIEE	NS	MATH	BIOEE	HD	CS/ ENGRD	ENGRD	PHYS	CS	BIOG	Total
course	5310/ 3310	3310	2940	2780	2160	2110	2030	1203	1110	1110	
review point	68%	82%	59%	71%	37%	75%	80%	64%	70%	53%	68%
exam review	83%	79%	41%	79%	59%	91%	65%	79%	61%	74%	74%
HW help	46%	47%	29%	34%	11%	60%	65%	79%	45%	0%	43%
notes or flag point	39%	68%	12%	37%	30%	27%	20%	36%	32%	26%	34%
missed class: sick, conflict, job interview	68%	94%	71%	66%	89%	65%	60%	64%	64%	63%	71%
missed class: other	71%	68%	47%	45%	52%	64%	45%	36%	61%	53%	57%
other	7%	6%	0%	5%	0%	5%	0%	0%	2%	0%	4%
Total	383%	444%	259%	337%	278%	387%	335%	357%	336%	268%	334%

Of the students who responded to the survey and used VideoNote, overall 71% said they had used VideoNote to make up a class missed because of being sick, a job interview or other conflict. 57% of these same students said they had used VideoNote because they had missed a class for another reason.

Q5. Did you skip class and watch it on VideoNote instead? If so, how many times?
- *No*
- *Yes, 1-2 times*
- *Yes, 3-10 times*
- *Yes, more than 10 times*

Table 11. Frequency of Skipping

	ORIEE	NS	MATH	BIOEE	HD	CS/ ENGRD	ENGRD	PHYS	CS	BIOG	Total
course	5310/ 3310	3310	2940	2780	2160	2110	2030	1203	1110	1110	
No	17%	26%	24%	53%	26%	29%	60%	21%	34%	42%	33%
Yes, 1-2 times	34%	38%	41%	39%	52%	40%	25%	50%	50%	32%	40%
Yes, 3-10 times	20%	24%	35%	8%	15%	16%	15%	7%	16%	21%	17%
Yes, more than 10 times	29%	12%	0%	0%	7%	15%	0%	21%	0%	5%	10%

There is considerable variation in how much students skipped in each class. In ENGRD 2030, where clickers were used and the professor had attendance data from the clickers, 60% of the students did not report skipping and watching VideoNote instead. In ORIE 3310, which did not take attendance and met at 8:40 in the morning, 29% of the students reported skipping

and watching VideoNote 10 or more times and another 20% reported skipping 3-10 times. More than one student commented on using using VideoNote to time-shift the class to a time when it was easier to stay awake or concentrate.

The other classes fall between these extremes and overall 33% of the survey respondents who watched VideoNote said they never skipped. This is consistent with the answer on question 4. 73% of the students skipped and watched VideoNote instead twice or less. Thus a large majority of students report not using VideoNote as an excuse to skip and often the skip was necessary and normally the lecture couldn't be made up by watching a video of the class.

The issue of skipping showed up again in an agree/disagree type question. This question was set up to have both the "feel good" and the "continue clicking the same column" response opposite of the previous question so students had to consciously report disagreeing.

Q12. The availability of VideoNote enabled me to skip classes.
- *strongly disagree*
- *disagree*
- *neutral*
- *agree*
- *strongly agree*

Table 12. VideoNote enables skipping

	ORIEE	NS	MATH	BIOEE	HD	CS/ ENGRD	ENGRD	PHYS	CS	BIOG	Total
course	5310/ 3310	3310	2940	2780	2160	2110	2030	1203	1110	1110	
strongly agree	27%	15%	0%	5%	30%	11%	5%	0%	5%	16%	12%
agree	29%	41%	44%	11%	15%	27%	20%	15%	34%	16%	26%
neutral	15%	21%	38%	24%	30%	20%	20%	23%	30%	42%	24%
disagree	20%	15%	13%	34%	15%	31%	35%	46%	20%	16%	24%
strongly disagree	10%	9%	6%	26%	11%	11%	20%	15%	11%	11%	13%

This reversed phrasing still yielded similar results, though there was more indication of skipping (or not reading the question carefully) on this question. Overall, 38% either agreed or strongly agreed that VideoNote enabled them to skip class. Overall, only 37% disagreed or strongly disagreed and 24% were neutral so presumably weren't significant skippers. As on the Question 5, there is considerable variation between classes. BIOEE2780 had the least agreement with the assertion that VideoNote enabled skipping at only 16% for agree or strongly agree. ORIEE 3310 and NS3310 had the highest agreement at 56% in each class.

Combining all this information, it appears that VideoNote did enable some skipping, especially in early morning classes, but that students reported that skipping could be kept under control by taking attendance as in ENGRD 2030. Quite a few students commented on this combination as being valuable to them and preventing skipping. Students in classes that did not use clickers also suggested using this combination. Overall most students reported only light skipping and for "necessary" causes, so one of VideoNote's strengths is the ability to make up the class.

Some of the chronic skippers reported deliberating using VideoNote instead of class attendance to increase what they learned from lectures either by time shifting the lecture to when the student was more alert and better able to learn or because of a learning disability or learning style issue the student found it easier to learn from the video or to use the video to supplement the lectures. Overall it appears that while VideoNote did enable some skipping, it did more to enable better learning.

Did students value VideoNote?

One way to determine how much students valued VideoNote is by how much of time they spent on VideoNote: 7790 hours in total. The highest reported usage was 87 hours for one student. 96 students used VideoNote for 20 or more hours. 285 students used VideoNote for 10 or more hours. 478 students used VideoNote for 5 or more hours. The amounts to nearly 30% of the 1771 students in the 10-class experiment use VideoNote for 5 or more hours. Thus, students are voting with their time that VideoNote is a valuable resource. Adding in the other two sections of Math 2940 who could also watch the Vide-

oNote of section 001, increases the overall viewing time to 8951 hours and brings the number of students watching more than 5 hours to 541 students.

The survey also asked several questions related to how students valued VideoNote. The questions pertaining to learning and grades were included earlier in the section on "Did VideoNote Improve Student Learning?" Those answers indicated students highly valued VideoNote for both learning and grades. The rest of the survey questions related to how student's valued VideoNote are included below.

Q13. Subsidizing VideoNote so I can use it in a course is a good use of University resources.
   o *strongly disagree*
   o *disagree*
   o *neutral*
   o *agree*
   o *strongly agree*

Table 13. Users responses on university subsidy of VideoNote

users only	ORIEE	NS	MATH	BIOEE	HD	CS/ ENGRD	ENGRD	PHYS	CS	BIOG	Total
course	5310/ 3310	3310	2940	2780	2160	2110	2030	1203	1110	1110	
strongly agree	61%	82%	50%	57%	52%	71%	45%	50%	48%	42%	59%
agree	24%	15%	38%	27%	41%	24%	30%	36%	34%	42%	29%
neutral	10%	3%	6%	11%	4%	4%	20%	7%	11%	5%	8%
disagree	2%	0%	6%	3%	4%	0%	5%	0%	5%	5%	3%
strongly disagree	2%	0%	0%	3%	0%	2%	0%	7%	2%	5%	2%

Table 14. Non-User responses on university subsidy of VideoNote

non-users	Total
course	
strongly agree	9%
agree	25%
neutral	27%
disagree	17%
strongly disagree	21%

Because many of the classes only had a small number of non-users respond to the survey, statistics are given only as an aggregate for all non-users rather than by class. Of the survey respondents, 5% of VideoNote users and 38% of non-users disagreed or strongly disagreed that using university resources to subsidize VideoNote was a good use of resources. 78% of users and 34% of non-users agreed or strongly agreed that this was a good use of resources. The remaining students were neutral.

Q15. I would recommend to other students that they try using VideoNote.
- *strongly disagree*
- *disagree*
- *neutral*
- *agree*
- *strongly agree*

Table 15. VideoNote recommendations by users

users only	ORIEE	NS	MATH	BIOEE	HD	CS/ ENGRD	ENGRD	PHYS	CS	BIOG	Total
course	5310/ 3310	3310	2940	2780	2160	2110	2030	1203	1110	1110	
strongly agree	61%	79%	56%	46%	54%	62%	45%	31%	50%	53%	56%
agree	32%	15%	31%	43%	35%	35%	35%	62%	36%	32%	34%
neutral	5%	6%	6%	11%	8%	4%	15%	8%	7%	16%	8%
disagree	2%	0%	6%	0%	4%	0%	5%	0%	7%	0%	2%
strongly disagree	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%

Table 16. VideoNote recommendations by non-users

non-users	Total
course	
strongly agree	7%
agree	24%
neutral	49%
disagree	13%
strongly disagree	7%

Of the survey respondents, 90% of VideoNote users and 31% of non-users would recommend VideoNote to other students. Of the users 8% were neutral and 2% disagreed. This is an extremely strong recommendation. Perhaps surprising, even non-users would recommend VideoNote to other students.

Q16. What is the most you would be willing to pay for the use of VideoNote in a one-semester course?
- *nothing*
- *$25.00*
- *$50.00*
- *$75.00*
- *$100.00*

Table 17. Amount users would pay for VideoNote

users only	ORIEE	NS	MATH	BIOEE	HD	CS/ ENGRD	ENGRD	PHYS	CS	BIOG	Total
course	5310/ 3310	3310	2940	2780	2160	2110	2030	1203	1110	1110	
$100	2%	6%	0%	0%	0%	6%	0%	0%	0%	0%	2%
$75	2%	0%	6%	0%	11%	6%	0%	0%	6%	0%	3%
$50	10%	3%	0%	5%	7%	8%	0%	0%	21%	5%	7%
$25	32%	50%	19%	21%	19%	38%	35%	29%	12%	21%	31%
nothing	54%	41%	75%	74%	63%	43%	65%	71%	61%	74%	57%

Table 18. Amount non-users would pay for VideoNote

non-users	Total
course	
$100	1%
$75	0%
$50	1%
$25	19%
nothing	79%

    This question was asked for all survey respondents, users and non-users. The responses are separated in the two tables above. Of the users, 31% would be willing to pay $25 while 57% wouldn't be willing to pay that much. 12% would be willing to pay more. Note, however, that students are being asked whether they would be willing to pay for a service that they were getting for free.

    Surprisingly, 21% of the non-users chose one of the pay options. One possible explanation would be that students interpreted the question as there should be a charge to those students who did use the VideoNote. A second possibility follows from some of the comments in which students stated they hadn't used VideoNote but that it was good to know it was there if they needed it. It is possible these students would be willing to pay if they had to miss a lecture and needed VideoNote to make it up.

Q14. It bothered me that the class was being recorded and affected my participation in class.
-   *strongly disagree*
-   *disagree*
-   *neutral*
-   *agree*
-   *strongly agree*

Table 19. Recording of lectures bothering users

users only	ORIEE	NS	MATH	BIOEE	HD	CS/ ENGRD	ENGRD	PHYS	CS	BIOG	Total
course	5310/ 3310	3310	2940	2780	2160	2110	2030	1203	1110	1110	
strongly agree	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
agree	5%	0%	0%	0%	4%	0%	0%	8%	0%	0%	1%
neutral	7%	3%	19%	5%	7%	13%	10%	8%	14%	16%	10%
disagree	15%	15%	19%	16%	7%	17%	35%	23%	18%	5%	17%
strongly disagree	73%	82%	63%	79%	81%	70%	55%	62%	68%	79%	72%

Table 20. Recording of lectures bothering non-users

non-users	Total
course	
strongly agree	1%
agree	4%
neutral	16%
disagree	26%
strongly disagree	53%

Only 1% of VideoNote users and 5% of non-users were bothered by the videotaping of their class. This is a total of 8 students between users and nonusers out of the 355 students who returned the survey, only one of whom was seriously bothered by the taping.

A separate survey was also conducted by VideoNote. This survey is discussed in Appendix C.

Overall students found VideoNote very useful as indicated by the hours they put into it and their responses on its value in increasing understanding and grades. Their willingness to pay for the service is much less than their view of its usefulness. Very few students were bothered by their class being videotaped.

Did particular populations of students report high value for VideoNote?

We read through all the comments for the mid-semester survey and the final survey, looking in particular for specific populations that the students reported would be especially helped by having VideoNote available. Students recommended having VideoNote available for the following populations:

(a) Athletes who have to miss class for out of town games.
(b) Certain disabled students who have trouble such as
    a. Seeing the board
    b. Hearing the lecture
    c. Taking notes during lecture
    d. Medical issues that cause absences
    e. Ability to maintain intense focus throughout a lecture
    f. Sleep disorders (also tied in to previous issue)
(c) Students who have large projects in another class that isn't well organized or a group that isn't well organized who appreciated being able to make up a missed class
(d) Students who want to time shift a class
    a. To take two overlapping classes (sometimes the conflict is just 1 session a week)
    b. Who think better at a different time of day
(e) Students who have to miss class for a job interview
(f) Students who miss class because they are sick. Several students reported liking knowing that they could make up a class if they became sick even though they hadn't had to do so.
(g) Students requested VideoNote in hard classes, upper level classes, and math, science and engineering classes.
(h) Students who are having difficulty in the class and need to hear the material or sections of it again.
(i) Students who need to finish an incomplete. Having VideoNote available could make the process much easier for both the student and the faculty member.

Several faculty expressed a concern VideoNote use would be mostly by the students who would get an A anyway and that other students would not take advantage of this resource. To address this concern, students were grouped by the grades they earned in the class, and VideoNote use was computed for each group. A letter grade grouping included the + and – of that grade. For each group, the number of students in the group and the average usage for those students was computed. For this study, a student was considered a user if they viewed 2.5 hours or more of VideoNote. The results are shown in Table 21.

Table 21: Average view time for users > 2.5 hrs by grade and class

VideoNote Users >2.5 hr		A	B	C	DFW	INC	Total
Course	users						
ORIE5310/3310	ave hours	15.5	16.7	18.3	24.7	0	14.0
	#students	29	47	23	3	0	102
NS3310	ave hours	19.3	21.1	16.1	12.3	14.4	17.9
	#students	33	38	12	6	1	90
Math 294	ave hours	11	9.3	11.5	8.1	0	7.5
	#students	9	19	6	3	0	37
BIOEE 2780	ave hours	9.96	12.1	8.3	9.7	0	8.5
	#students	30	48	15	3	0	96
HD2160	ave hours	10	12.1	8.3	9.7	0	8.5
	#students	30	48	15	3	0	96
CS/ENGRD2110	ave hours	12.7	13.2	11	7.2	7.9	10.2
	#students	28	42	2	3	1	76
ENGRD 203	ave hours	6.6	8.6	7	0	5.1	8.7
	#students	9	4	12	0	1	26
Phys1203	ave hours	6	3.9	0	5.7	0	6.9
	#students	12	5	0	2	0	19
CS110	ave hours	10.2	7.7	9.4	14.6	4.2	10.0
	#students	26	20	17	3	1	67
BIOG1110	ave hours	8.8	9.1	6.8	0	0	6.4
	#students	11	20	5	0	0	36
Overall	ave hours	12.1	13.3	11.5	11.8	7.9	10.8
	#students	217	291	107	26	4	645

The overall pattern was that amongst the VideoNote users, the B students had the highest average viewing time. This was also the case in 6 of the 10 classes. In ORIE, the average use per user increased as one went to lower grades. Overall it is clear that use was spread across all grades, including unsuccessful students. Incompletes are listed separately because VideoNote could be extremely valuable to students who had to make up an incomplete.

Faculty response

VideoNote solicited feedback from the faculty teaching the 10 classes where VideoNote was used. Seven faculty responded, representing eight of the ten courses. The six faculty from more technical courses all thought very favorably of VideoNote as a study aid, a way for students to make up missed classes, and a way to improve their own teaching. Faculty are also thinking of innovative ways to use VideoNote to improve their courses. For example, Professor Trotter suggested re-using some of the videos as homework, which would allow more class time to be devoted to discussion, examples and applications. He is teaching the same course in summer school and is experimenting with making use of the resource of his spring lecture videos. None of the faculty found the taping intrusive, and all would like to see the service continued. The comments from the professor for HD2160 give a more mixed report; the comments are very detailed, specifically discuss the difference between her course and a more technical course, discuss in more detail issues with skipping both with and without a valid reason and the issue of intellectual property rights. The faculty responses are given below.

*Note: These are the complete quotes from the professors who responded; they have not been screened or filtered or biased in any way. They are ordered from high course numbers to lower ones, in the same order as the tables and graphs in this report.

Ryan -- As you know, I am a strong supporter of the VideoNote effort.

I feel that this medium provides a unique opportunity for students to review lecture material, either alone or interactively with other class members. This aspect of VideoNote is useful, not only in and of itself, but also in ways which will permit innovation in teaching. For example, I could see some value in saving the recordings for a later iteration of a class in which certain VideoNote lectures would be viewed as "homework assignments" so that classes could be devoted to examples, applications, review, etc.

Leslie Trotter (ORIE 3310)

I enjoyed many/all aspects of the experience. Mostly, I was relieved that students could easy catch-up on missed work. It always happens throughout the semester. TAs can help them but it's never the same as hearing the lecture. The taping was never an intrusion in class. I got to the point I didn't even notice it was happening. Your helpers did a great job and were very courteous.

I was disappointed that no one did the last day of class. I know it was slope day but someone should have taped the last class. The final comment is a bit trivial. When I did view the video of my and other classes, I noticed that much of the lecture (except for the first lecture) was focused only on the slide and did not ever show the class or presenter even when he/she became animated about a topic. I appreciate that it's not the most exciting job (taping) but it would make for a better viewing experience if there were more "variety". Also, when viewing another class, I noticed that I could not see what was being pointed to. The person's pointer was too small to see clearly (even for the students in the classroom, I'm sure). That's easily fixed!

I would be very disappointed if this service were discontinued. I know the students really appreciated having it!!

Charles McCormick (NS 3310)

First, I want to note that my course, HD 2160, Adolescence and Emerging Adulthood, which is a social science course, was the only nontechnical course covered by VideoNote in the pilot. In other words, we were the only course that was not a math, science or engineering course. I note this, because my classes do not involve working through problems, for which repeated viewing might be helpful. Also, I note that TakeNote has covered my class for years and covered it again this semester. I make copies of TakeNote available on reserve in the library, because I believe that students who can't afford it should also have access to it. (The TakeNote people are fine with this; in fact, they deliver the copies of TakeNote to the library.) In addition, the median final grade in HD 2160 was a B+ for this semester; it has been a B+ for many years.

I do not take attendance and do not have baseline data on attendance from past semesters, but the TAs and I did take a count of how many students were present throughout the semester this spring. The course had 159 students enrolled. The average attendance until the end of February was 125 students. After the first prelim, which was on March 3, until spring break, the average attendance was 100 students. After spring break the average attendance was 80 students.

Students evaluate Human Development courses electronically, but I also ask them to fill out my own evaluation of the course, in which I ask for specific feedback on the readings, lectures, discussion sections, papers, and exams. This semester I also asked students for feedback on VideoNote, asking the following questions as one block of questions requiring one answer:

Did you take advantage of the opportunity to watch the videos of the lectures on the VideoNote website? Did you watch them when you had to miss class for illnesses, sports events, or religious holidays? Did they help you to review material, when you had already attended lecture? Did having them available result in you not attending as many lectures? How does having VideoNote available compare to having TakeNote available? Did you use VideoNote or TakeNote more frequently?

The responses I got from the 80 or so students who were still attending class after spring break indicate that many students said they missed the class 3 to 5 times because of illness, religious holidays, being out of town, or because they skipped it to get other academic work completed. These students watched VideoNote for the classes they missed and found it extremely helpful. Some students said they didn't use VideoNote at all. While most students reported that they did not use it to review concepts, some students said they watched it for clarification of lecture or to check concepts that were unclear in their lecture notes. Below are some sample quotes from students.

"I went to every class and used the VideoNote outlines of lecture to help me study."
"I really didn't use it for this class, because it wasn't necessary. I have used VideoNote for other classes and it is beneficial."

"I came to all lectures, so I never used VideoNote, but I used the TakeNote on reserve in the library to supplement my own notes."

"Yes, it helps me a lot when I review it. I copy my notes over and it helps a lot."

"I watched the lectures online while studying for exams. I also attended class, so it was very helpful to hear it a second time. I have never used TakeNote."

"For the day that I was sick, it was very helpful. But people didn't come to class. Perhaps only allow 3 and then charge, so people only use it when they really can't come."

"I watched VideoNote because I skipped class because I didn't want to go. I didn't use VideoNote to review material when I attended class. Having VidoeNote available resulted in me attending fewer lectures. I didn't get TakeNote."

"I used it to study--very helpful."

"I watched the VideoNote for days I was sick or really behind in work. They were also really helpful for filling in my notes."

"I watched it if I missed class because of a meeting, etc. I also watched it to review materials while I was studying for prelims."

"Videonote was extremely helpful for when you cannot make class--keep it!"

"I never made use of VideoNote. I came to every lecture and took my own notes, so it was pretty much unnecessary for me."

"One day when I was sick I used it. It was annoying how no one came to class. Useful for slackers."

"When I was very busy with work, I would watch VideoNote instead of coming to class. I also watched them to clarify parts that confused me."

"I only watched VideoNote when I would miss a lecture to study for an orgo prelim that evening. I almost always went to lecture. I used TakeNote to study for the exams as a supplement to my own notes."

"I did watch VideoNote occasionally. This was mostly if a felt that something covered in class I didn't understand. On occasion when I had to miss class, this was helpful, too. I used it particularly for reviewing for exams."

"I did take advantage of VideoNote and it was extremely useful when I missed class because I was sick. They were also good for reviewing material. I never used TakeNote."

"I did not use VideoNote. I found it was harder to take notes that way."

"Yes, I watched VideoNote. I watched them when I got sick and couldn't come to lecture. I write slow, so I would go to lecture and then use VideoNote to fill in the things I missed. No, I still went to lecture. I think there is something more you get from actually being in class than just watching it. But it really did help when I got sick."

Ryan, you noted *"that people were not using VideoNote very much to make up for missing entire lectures--the majority of the usage was for less than 15 minutes--so they were using it to review specific topics, not entire lectures. Only a small fraction of the time did people view an entire lecture. Also, you can see from the usage data that it wasn't steady through the semester--to replace class. It was very concentrated around the prelims and final."*

Students could have been using it to replace class by watching it around the times of the prelims and final. In a nontechnical course, there are no problem sets. You only need to know the material for the exams. I ask all the students who get a D or F on a prelim to come see me. One of those students said he did not understand why he did not do better on the prelims, because, although he did not attend class, he studied for 10 hours for each prelim. The way he studied was to watch VideoNote while following along on the TakeNote. I pointed out that this was not studying; this was the equivalent of going to class (although he never took his own notes). Also, one student told me he could go through the outline of VideoNote in 15 minutes, so my guess is that some of the 15 minute use was to replace class--they simply read the VideoNote outline rather than watching the entire lecture. One student wanted to enroll in a class that started at 2:30, even though my class ended at 2:40. She planned to watch all of my lectures on VideoNote. The only problem she could see was that she couldn't be late for the other class, so she would need make-up prelims for my class. I said no.

As you know, I requested that only students and TAs in the class have access to VideoNote. I think there are intellectual property rights issues with making it available to the world. A number of years ago, when Blackboard could be accessed without a Cornell id, I had a faculty member from California call me who had looked at my Blackboard site for Adolescence and wanted me to send her additional information from my lectures that was not on my Powerpoint. She had never taught a class on adolescence, was putting one together, and thought mine looked good. One of my friends suggested that I ask her if she would send me part of her salary.

My view is that, although students who did attend class found it helpful, particularly if they had to miss class, that it did allow half of the class to stop attending after spring break. I'm not sure that it has the same benefits for a nontechnical class where there are no explanations of problems, which students can benefit from watching repeatedly, as it has for a technical class.

Christine Schelhas-Miller (HD 2160)

It was a pleasure working with you this semester. Many students from both classes have told me how useful were your videos. Further, when I compare your videos of classes with, say, MIT's, your video quality is better, your website is better, and your linking of text with video is better. Finally, having your friendly video system running in my class I think helped make my teaching better. And I think, were you to video me again, it would get better still. Please let me know if there is any way I can help you continue this great service.

Andy Ruina (MATH 2940, ENGRD 2030)

I found videonote extremely helpful in monitoring the speed and style of my lectures and demos. I actually went through more than half of them and found places where I could have (should have) done better. And this had a positive effect (I hope) on my lectures after the direct video feedback. I am so pleased with tapes that I requested a complete copy for the whole semester from Ryan which he kindly provided. Now I can go through the rest with the same intent.

I also polled one of the sections about their use, and got a large show of hands. I would strongly vote that this option remain available.

Hasan Padamsee (PHYS 1203)

My remarks; VideoNote is a WONDERFUL resource for several reasons:
1. Students who add the course late can catch up easily.
2. Students who have to miss a lecture (e.g. for an interview, or going on an athletic trip) can see it.
3. Students can review parts of lectures easily. The table-of-contents feature is wonderful. No other service does this so well.
4. Instructors can see how well THEY do and then improve.
5. It is possible to videotape a lecture early, in case the instructor has to miss a class, and have everyone watch the video.
All of these advantages far outweigh the one con people bring up --students won't come to class.
And with the use of i-clickers and interactive learning, the attendance issue goes away too.
The only issue is cost. Who is going to pay? At a time when the university is trying to cut its budget by 5% --after already doing so once-- it is very difficult to come up with the money.

David Gries (CS 1110)

I wanted to take this chance to thank you for Video Note. Video Note gives me a chance to review my lectures from the students' perspective and evaluate both the delivery and the material in order to improve the lectures and the course for next year. Thanks for putting the lectures on DVD so I can review the lectures more conveniently.

Technically speaking, the quality of the Video Note lectures is very good in terms of sight and sound and the videographers were always polite and unobtrusive. They actually felt like a part of the teaching team.

I also know that the students are also thankful for VideoNote, They use Video Note to review the material, to check on certain parts of the lecture using the search command, and to watch the lectures they miss. This has been a fantastic service for the students and I do not think it has affected attendance at all.

I hope Video Note thrives and grows so that many of Cornell's courses are put on the web. Because of the searchable format of Video Note, Video Note is even better than the MIT and Yale video lectures that are posted on the web to teach and attract high school students to come to Cornell!

Thanks again for Video Note!

Randy Wayne (BIOG 1110)

Cost of VideoNote for this study

Cornell paid $5,000 (a negotiated discount price) for each course. Dividing the cost by the total number of hours viewed for each course gives the cost per hour of viewing. See Table 22 below. Since the cost per viewing hour depends on class size and percent utilization, those numbers are included as well. In this table, ORIE 5310 and ORIE 3310 are combined because students were in the same class, so the fee for VideoNote was paid once.

Table 22. Cost per hour of viewing VideoNote by course

Class		Instructor	Enrollment	% users	Total hr	Cost/hr
ORIE	5310/3310	Trotter	124	91%	1611	$3.10
NS	3310	McCormick	117	85%	1726	$2.90
MATH	2940	Ruina	105	59%	398	$12.56
MATH	2940 all sections		408	45%	1559	$3.21
BIOEE	2780	Zamudio	253	54%	1074	$4.66
HD	2160	Schelhas-Miller	160	54%	657	$7.61
CS/ENGRD	2110	Bailey	171	86%	1363	$3.67
ENGRD	2030	Ruina	123	57%	226	$22.12
PHYS	1203	Padamsee	246	32%	182	$27.47
CS	1110	Gries	171	68%	697	$7.19
BIOG	1110	Balko/Wayne	309	32%	379	$13.12
Total	Total	Total	1779	57%	8442	$5.92

The cost effectiveness of VideoNote varied considerably per course, from a low of $2.90 per hour of viewing to a high of $27.47. Variations came from the number of students in the course, what percent of students watched, and the number of hours they watched. At the risk of generalizing from this small sample of classes, VideoNote is more cost effective in large classes, in upper level classes, and in particularly difficult classes. Computer science courses were more cost effective than other courses at the same level. This is consistent with the survey comments where students specifically asked for VideoNote in ORIE courses, in Chemistry courses, in Physics courses and in difficult technical courses. In a course with multiple sections, taping one section and allowing all the sections access to VideoNote is an effect way to leverage the resource and is well used by the students.

Two of these courses, ORIE 3310 and CS/ENGRD didn't use textbooks. Both of these courses had high VideoNote use and lower costs per student.

Conclusions

Students strongly valued VideoNote and thought it helped their grades and learning. This is confirmed by statistically valid evidence that VideoNote use correlated with improved student grades: in the direct comparison of two populations on a final exam, for users > 20 hours, for NS3310 and to a lesser extend HD 2160, and for URM students with use above 13 hours. Quite a few student comments indicated VideoNote reduced student stress levels by providing some time flexibility. Even students who didn't use VideoNote commented that they valued having it available in case they ever had to miss a class. ORIE 3310, NS 3310 and Math 2940 students voted with their time that VideoNote was especially valuable to them. ORIE 3310 and CS2110 class did not have a textbook in spring 2008 and both of those classes had high use.

There was not a significant difference in VideoNote use or grade improvement by gender. Under-Represented-Minority (URM) students averaged a statistically significant over-performance with less viewing time than for the overall population. More importantly, URM students had a statistically significant increase in their grades that was higher than that of the overall population.

Students across all letter grades made use of VideoNote with the relative amount for each grade grouping varying somewhat by class. Generally the grades groups of C+ and above had more gain with higher VideoNote viewing. Below C+ there was a flat or negative correlation with increased viewing; one could speculate that this was due to considerable skipping and watching VideoNote instead of class but there is insufficient data to test this hypothesis. The population size below C+ was quite small so the results for those groups may not be statistically valid.

VideoNote usage varied considerably by class, both in percent of students who used VideoNote and in the average hours watched. Generally VideoNote was used more in higher level courses, more technical courses, and computer courses. Overall

57% of the students watched at least 0.1 hours of VideoNote for a combined 7790 hours and an average of 8.4 hours each. Very few students were bothered by having their class videotaped. The total hours viewed increased to 8951 when including the additional sections of Math 2940 who had access to Professor Ruina's VideoNote lectures.

Most faculty thought having VideoNote in their courses was extremely valuable. Several professors commented that they thought their teaching improved by watching the videos and several had innovative ideas on using VideoNote to improve the overall course. Professor Trotter is teaching ORIE 3310 again in summer 2009 and is experimenting with an innovative teaching approach making use of his taped lectures from the spring. Professor Schelhas-Miller reported less value for VideoNote in her non-technical course.

A faculty concern was whether VideoNote would enable skipping. The availability of VideoNote did enable some skipping; the survey reported roughly one third of students didn't skip, 40% skipped once or twice and one quarter skipped 3 or more times. There was significantly more skipping reported in the earliest morning class. Professor Schelhas-Miller reported significant skipping in her class and that her interviews with students indicated skipping was enabled by VideoNote. Students commented that taking attendance when using VideoNote alleviated the skipping issue. VideoNote would likely be useful for making up an incomplete.

Certainly if cost were not an issue VideoNote would be worthwhile. It is highly valuable to certain populations. It is quite possible that the value of VideoNote would increase if students where shown several effective ways to use it following some studies in how to most effectively incorporate it into students study habits.

We pass on to the study committee the much harder decision of comparing the value for the cost of VideoNote versus other learning aids and budget issues.

Some Recommendations

1. Keep VideoNote in specifically targeted classes: students voted with their time that VideoNote is useful.
2. Continue using VideoNote in NS 3310, HD 2160 and ORIE 3310; these courses had measurable learning gains or very heavy use of VideoNote.
3. If the experiment were continued, shift the mix of courses toward large, difficult, upper level, technical courses and large CS courses (depending on faculty willingness, of course). Try it in a chemistry course such as Chem 2090, or Organic Chemistry 3570 and 3580, and a more technical physics course such as Physics 2213. Consider using VideoNote in ENGRD 2700 and look for other large lecture ORIE courses.
4. Use VideoNote in one section of large multi-section math courses and make VideoNote available to the students in all sections. Consider whether it is best to video the best teacher or video each section for a different content unit. An example could be math courses such as 1910 and 1920.
5. Consider using VideoNote in classes where a textbook is not required. Consider whether students should contribute towards the cost if they aren't also buying a textbook.
6. Use VideoNote in CS 1110 courses and then make the relevant lectures available to the independent study 1 credit CS courses that use the same computer languages.
7. Coordinate with athletics to tape specific lectures missed for team travel
8. Coordinate with disability services —in some cases VideoNote access might be a good accommodation and the dollars would be leveraged for the whole class to benefit
9. Explore pricing options

Additional ways to consider using VideoNote

1. In other multi-section classes that cover the same content: use VideoNote in one of the sections but not all of them. Consider whether it is best to video the best teacher or video each section for a different content unit.

2. Survey comments indicated several students used VideoNote to deal with schedule conflicts already. As classes are combined to save money, VideoNote would be a way for a student to take a class that has a partial overlap with a lab or section rather than having to delay the class as well as later classes that depend on it.

3. In courses where Disability Services needs to make accommodations that VideoNote could address. Several survey answers commented on this. Resources would be leveraged as many students could use the service once it was paid for.

4. In specific lectures in specific course that athletes have to miss. Perhaps paid for by the athletic program.

5. In courses that are critical prerequisites for later courses, allowing students in the later courses to refer back to VideoNote lectures. This could be quite effective due to the good indexing of VideoNote.

6. In courses that many students use AP credit to skip and which are pre-requisites for later courses. Often AP course can be very strong overall but omit a few topics. Let students in the later course access the VideoNote for the prerequisite class that was skipped by AP credit to fill in any holes in their knowledge.

7. As part of a major grant proposal to help prepare transfer students to succeed at Cornell, collaborate with several 2-year "feeder" schools to strengthen their program for students who plan to transfer by letting their students "take" the more rigorous Cornell version of critical courses that their work at Cornell (or other transfer school) would depend on. Often there is a critical sophomore course for a major, which makes academic success difficult for transfer students.

8. Use VideoNote in a class that is only offered occasionally, especially graduate or upper level courses. Then the course could be offered again at a reduced faculty workload by having students watch the VideoNote lectures with the professor leading a discussion section on the content so students would still have the richness of the interactions but without the professor having to prepare and give the full lecture series

9. For faculty development since seeing oneself teach can lead to insights in how to improve, sometimes on one's own and sometimes with the assistance of a teaching mentor.

Speculation based on survey comments

Based on comments by students, we speculate that the availability of VideoNote reduces student stress:

 i.   In taped classes, legitimate absences can be made up more easily
 ii. When other classes have project overloads the VideoNote taped class can be viewed later
 iii. For students with different learning styles
 iv. For students who think better at other times (8 PM rather than 8 AM)

<u>Acknowledgements</u>

Appendix A. Engineering College Survey Questions
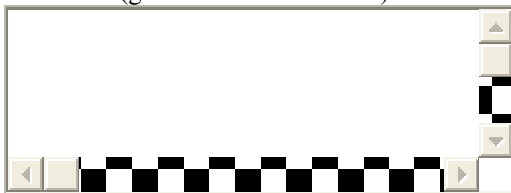
Survey on the use of VideoNote Spring 2009

These questions are intended only to help Cornell evaluate the usefulness of VideoNote and how students use it. Your answers to these questions are anonymous. Ten courses are being surveyed, and a report will be written after the semester ends based on this survey, data collected by VideoNote, i-clicker data from a few courses that are using them, and courses grades. Your instructor will see only data in aggregate form, with all identifying information removed.

1. Did you use VideoNote in this class this semester?

○ Yes --Please skip to question 3.

○ No

2. If not, why not? Please mark all that apply.

☐ Didn't need to

☐ Cost

☐ Not convenient

☐ Don't like online content

☐ Doesn't fit the way I like to study

☐ Other (give reason in text field)

Skip to question 12.

3. How often did you use VideoNote?

○ Once or twice

○ Several times, especially around exams

○ Several times, but not tied to exams

○ More or less weekly; it was a fairly regular part of my study

○ Quite often, more than once a week

4. In what ways did you use VideoNote? Mark all that apply.

☐ To go back over a difficult point

☐ When I was reviewing for an exam

☐ When I got stuck on a homework or assignment

☐ As a way to take notes and flag important or difficult material

☐ When I missed a class because I was sick or had a conflict, such as a job interview

☐ When I missed a class for other reasons

☐ Other (give reasons in text field)

5. Did you skip class and watch it on VideoNote instead? If so, how many times?
○ No
○ Yes, 1-2 times
○ Yes, 3-10 times
○ Yes, more than 10 times

6. Mark all that apply to your use of VideoNote:
☐ I watched entire lectures
☐ I used the index to jump to and watch specific parts of lectures
☐ I used the difficulty rating feature of VideoNote to help me find sections to review
☐ I contributed ratings to the difficulty rating feature
☐ I watched VideoNote with a study group

7. Where did you watch VideoNote? Mark all that apply:
☐ In the library
☐ In a computer lab
☐ On my personal computer
☐ On a friend's computer

8. Did using VideoNote help you understand the course material better?
○ Not really
○ Yes, some
○ Yes, very much

9. Do you think that using VideoNote helped improve your grade?
○ Not really
○ Yes, some
○ Yes, very much

For each statement below, indicate how strongly you agree or disagree with the statement.

10. VideoNote was very useful to me in learning the course material.

strongly disagree ○   disagree ○   neutral ○   agree ○   strongly agree ○

11. Using VideoNote changed how I studied, in a positive way.

strongly disagree ○   disagree ○   neutral ○   agree ○   strongly agree ○

12. The availability of VideoNote enabled me to skip classes.

strongly disagree ○   disagree ○   neutral ○   agree ○   strongly agree ○

13. Subsidizing VideoNote so I can use it in a course is a good use of University resources.

strongly disagree ○   disagree ○   neutral ○   agree ○   strongly agree ○

14. It bothered me that the class was being recorded for VideoNote and affected my participation in class.

strongly disagree ○   disagree ○   neutral ○   agree ○   strongly agree ○

15. I would recommend to other students that they try using VideoNote.

strongly disagree ○   disagree ○   neutral ○   agree ○   strongly agree ○

16. What is the most you would be willing to pay for the use of VideoNote in a course for one semester?

nothing ○ $25.00 ○ $50.00 ○ $75.00 ○ $100.00 ○

17. In which other courses you have taken would VideoNote have been useful (list up to 3, in order of preference)?

18. Please provide any other comments you wish to make regarding VideoNote and your course.

Thanks for your help!

Appendix B. Answers to Engineering College Survey Questions Not Included in the Report

Question 2 refers to using VideoNote from Question 1. We were looking to see if there was a structural reason that should possibly be addressed. Nothing particularly important came out of this question.

Q2. If not, why not? Please mark all that apply.
- o *Didn't need to*
- o *Cost*
- o *Not convenient*
- o *Don't like online content*
- o *Doesn't fit the way I like to study*
- o *Other (give reason in text field)*

Table B1. Why students did not use VideoNote

	ORIEE	NS	MATH	BIOEE	HD	CS/ ENGRD	ENGRD	PHYS	CS	BIOG	Total
course	5310/ 3310	3310	2940	2780	2160	2110	2030	1203	1110	1110	
no need	33%	75%	50%	50%	67%	50%	24%	100%	47%	60%	52%
cost	0%	0%	0%	0%	11%	0%	6%	0%	0%	0%	3%
no con-venient	0%	0%	0%	10%	6%	0%	6%	0%	7%	0%	4%
don't like online	0%	0%	0%	0%	0%	13%	6%	0%	0%	7%	3%
not how I study	33%	25%	33%	20%	11%	38%	35%	0%	33%	20%	25%
other	33%	0%	17%	20%	6%	0%	24%	0%	13%	13%	13%

We were curious as to how students used VideoNote, in particular the indexing and the rating features. Looking at the data for question 6 below, it is apparent that students watched whole lectures and used the index to jump to specific content but used the rating feature very little.

Q6. *Mark all that apply to your use of VideoNote:*
- o *I watched entire lectures*
- o *I used the index to jump to and watch specific parts of lectures*
- o *I used the difficulty rating feature of VideoNote to help me find sections to review*
- o *I contributed ratings to the difficulty rating feature*
- o *I watched VideoNote with a study group*

Table B2. How VideoNote was used

	ORIEE	NS	MATH	BIOEE	HD	CS/ ENGRD	ENGRD	PHYS	CS	BIOG	Total
course	5310/ 3310	3310	2940	2780	2160	2110	2030	1203	1110	1110	
whole lectures	90%	91%	82%	95%	93%	82%	55%	57%	73%	68%	82%
index to spot	76%	85%	65%	71%	67%	98%	90%	100%	75%	84%	81%
by rating for review	0%	6%	0%	3%	4%	4%	5%	0%	7%	5%	4%
contributed rating	5%	3%	18%	8%	7%	20%	10%	14%	11%	11%	11%
study group	10%	6%	0%	0%	4%	9%	0%	0%	5%	11%	5%

In fall 2008, VideoNote was offered in several courses with the model that students needed to pay for VideoNote. The Engineering College paid for several subscriptions for the library so that students could watch it there. We wanted to collect data as to how students used VideoNote when the survey was completely free to the students. 65% watched on their own computers. 30% did watch in either the library or the lab.

Q7. Where did you watch VideoNote? Mark all that apply:
- *In the library*
- *In a computer lab*
- *On my personal computer*
- *On a friend's computer*

Table B3. Where students watched VideoNote

	ORIEE	NS	MATH	BIOEE	HD	CS/ENGRD	ENGRD	PHYS	CS	BIOG	Total
course	5310/3310	3310	2940	2780	2160	2110	2030	1203	1110	1110	
library	21%	23%	13%	26%	15%	15%	8%	26%	12%	17%	18%
lab	16%	8%	13%	17%	6%	15%	15%	0%	10%	0%	12%
own computer	57%	64%	70%	55%	76%	62%	69%	74%	73%	83%	65%
friend's computer	6%	6%	4%	2%	3%	7%	8%	0%	5%	0%	5%

Q10. VideoNote was very useful to me in learning the course material.
- *strongly disagree*
- *disagree*
- *neutral*
- *agree*
- *strongly agree*

Table B4. Measure of Usefulness of VideoNote

	ORIEE	NS	MATH	BIOEE	HD	CS/ENGRD	ENGRD	PHYS	CS	BIOG	Total
course	5310/3310	3310	2940	2780	2160	2110	2030	1203	1110	1110	
strongly agree	49%	71%	38%	45%	26%	49%	30%	38%	30%	42%	43%
agree	34%	24%	44%	45%	48%	44%	55%	46%	43%	26%	40%
neutral	17%	6%	13%	8%	22%	5%	15%	15%	27%	16%	14%
disagree	0%	0%	6%	0%	4%	0%	0%	0%	0%	11%	1%
strongly disagree	0%	0%	0%	3%	0%	2%	0%	0%	0%	5%	1%

Overall 83% of survey respondents who used VideoNote agreed or strongly agreed that VideoNote was very useful in learning course material. Strongly agreed varied from a high of 71% in NS3310 to a lower of 26% in HD2160. Overall only 2% disagreed or strongly disagreed with the statement.

Question 11 asked students views in whether VideoNote changed how they studied.

Q11. Using VideoNote changed how I studied, in a positive way.
- o   *strongly disagree*
- o   *disagree*
- o   *neutral*
- o   *agree*
- o   *strongly agree*

Table B5. Impact of VideoNote on Changing How Students Studied

	ORIEE	NS	MATH	BIOEE	HD	CS/ENGRD	ENGRD	PHYS	CS	BIOG	Total
course	5310/3310	3310	2940	2780	2160	2110	2030	1203	1110	1110	
strongly agree	32%	58%	13%	11%	19%	29%	20%	23%	25%	33%	27%
agree	34%	27%	63%	50%	33%	49%	45%	46%	41%	17%	41%
neutral	24%	6%	19%	32%	30%	16%	25%	31%	25%	22%	22%
disagree	7%	9%	6%	3%	15%	0%	5%	0%	9%	22%	7%
strongly dis-agree	2%	0%	0%	5%	4%	5%	5%	0%	0%	6%	3%

Overall 68% of the students said it did change how they studied in a positive way. 20% said it changed disagreed with the statement, implying it either didn't change how they studied or the effect was negative. These replies are just for survey respondents who used VideoNote.

Appendix C: VideoNote Survey

VideoNote ran their own survey using Survey Monkey. This survey collected responses from the first 100 students who replied and then closed to further responses. It is likely that the survey invitation was sent only to VideoNote users because those would be the netIds that VideoNote would have.

The data for the 100-student survey by VideoNote follows.

1. VideoNote offers another way to get "extra help" by reviewing and searching lectures. Do you believe that this extra ability has REDUCED the amount of time you need to see your class TA (teaching assistant) for extra help? (i.e. has VideoNote replaced time you spend with TAs) (100 replies)
   (a) The opposite - I spend more time with TAs now because of VideoNote 3.0%
   (b) No, it has not affected how much time I spend with the course TAs 55.0%
   (c) Yes, it has reduced the time I spend with TAs a LITTLE 26.0%
   (d) Yes, it has reduced the time I spend with TAs a LOT 16%

2. If you answered "Yes" to the above question, how much time would you estimate you have replaced? Put it this way: For 1 hour of TA time you replaced, how much time did you have to spend with VideoNote to get the same benefit? (ex if you used VideoNote for 2 hours to replace 1 hour of speaking with a TA, then the ratio was 2:1). (46 replies)
   (a) < 0.5 (i.e. 1h of VideoNote > 2h of TA time replaced)   19.6%
   (b) 0.5-1 (i.e. 1h of VideoNote = 0.5 1h of TA time replaced) 21.7%
   (c) About the same 1:1 (for every 1h of VideoNote used, replaced ~1h of TA time) 45.7%
   (d) 1-2 (i.e. 2h of VideoNote = 1h of TA time replaced)   6.5%
   (e) 2-3 (i.e. 2-3h of VideoNote = 1h of TA time replaced)   4.3%
   (f) 3-6+ (i.e. 3-6+h of VideoNote = 1h of TA time replaced) 2.2%

3. Have you ever been to CornellCast's website? http://www.cornell.edu/video/ This website posts special guest speakers who come to Cornell. (99 replies)
   (a) No I've never been there   93.9%
   (b) Yes I've been there before at least once   6.1%
   (c) Yes I've watched some videos   0.0%
   (d) Yes I'm a regular viewer of their videos   0.0%

4. Check out the CornellCast website http://www.cornell.edu/video/ if you haven't been there. Would you find these videos better if they used the same technology as the videos with VideoNote (i.e. higher quality and with the indexing)? (97 replies)
   (a) No, the current CornellCast video technology is better 1.0%
   (b) About the same 21.6%
   (c) Yes, CornellCast's videos would be A LITTLE BETTER with VideoNote's technology 19.6%
   (d) Yes, CornellCast's videos would be MUCH BETTER with VideoNote's technology 38.1%
   (e) Yes - also, if you don't currently watch any CornellCast Videos, you *would* watch some of them if they used VideoNote's technology because they would be so much better. 19.6%

5. Do you believe VideoNote improves your experience at Cornell in a positive way? (100 replies)
   (a) No, VideoNote is bad for my experience   2%
   (b) VideoNote doesn't affect my experience   1%
   (c) Yes, VideoNote has improved my student experience a LITTLE. 13%
   (d) Yes, VideoNote has improved my student experience a LOT. 23%
   (e) Yes, Cornell is the BEST for having VideoNote, now I just want it in all my big classes!   61%