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Flipped Classroom Video Analytics

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Flipped Classroom Video Analytics

Abstract

Rising tuition and stringent accreditation standards increase the pressure educators feel to improve student learning using active teaching techniques. The flipped classroom allows educators to use externally viewed videos to focus on in-class time for problem-based learning. The flipped classroom is a recent pedagogical model in Engineering Technology classes Video learning analytics are an important tool to understand student engagement and usage of flipped classroom video resources. Video analytics can also help instructors understand and continuously improve the effectiveness of the video lecture class component. This research used video analytics of a Fluid Mechanics & Fluid Power Engineering Technology flipped class to determine who watches videos, where they watch, when they watch, and on what devices students watch flipped classroom videos over multiple semesters/sections.

Results show a very high percentage of students watch the video before class, most students watch in close proximity to the campus (based on IP address analysis), within one/two days before the class. Some students re-review sections of videos before tests, and use multiple mobile and desktop devices that at times shift during the semester. Video analytics allow the instructor to adjust video content knowing who watches, and where, when and how these flipped classroom videos are used by students.

Introduction

The flipped or inverted classroom has been used by engineering/engineering technology educators for a number of years [1-7]. For this study the author combined the flipped classroom approach with video analytics to gather additional insights into how students use video classroom media in an engineering class. A flipped class can have different meaning to different people, however the author use a simple definition from Lage, et.al. [8] "inverting the classroom means that events that have traditionally taken place inside the classroom now take place outside the classroom and vice versa." In the specific case of video based flipped classroom the lecture activity traditionally conducted in the classroom is now delivered in a condensed format (5 to 10 minute) video using a learning management system (LMS) or video server. This allows the students to watch the short video lecture before the class on any device. These condensed lecture videos can also be augmented with sample problems or examples completed by the instructor or teaching assistant. The traditional outside classroom activity of "homework" or problem solving is completed inside the classroom using individual problems or small group teams. These inside the classroom activities can be different forms of active learning methods such as problem based learning and peer assisted learning (cooperative learning, collaborative learning, and peer tutoring).

Students are able to use these condensed video lectures and sample problem videos at any time during the semester and as a continued resource before key class assessments. Since these videos are served through a LMS/video server the data on student usage can be used to gain additional insights. Video learning analytics provides these new insights into how students use the video media to allow instructors to improve their classes [9-11]. Therefore, the motivation for our work arose from the continued and wide use of video resources to augment flipped engineering/engineering technology classes along with building on how, when, where students use these video resources for their classes. Our specific research questions at the beginning of this study included:

- Do students watch flipped classroom videos?
- When are students viewing the video lectures in relation to the class active learning activities?
- How many times do students view any given video? (Do they return to review videos before tests?)
- Do students take advantage of the videos off campus during holidays or semester breaks?
- What devices do students typically use to watch the video on? (phones, computers,…)

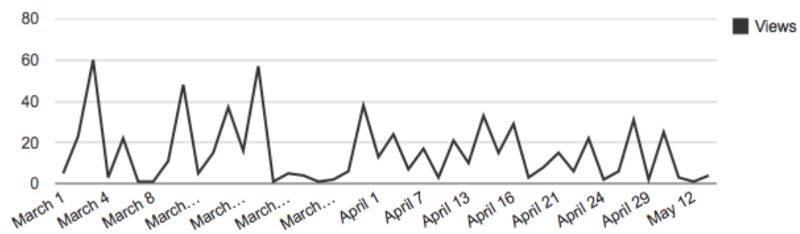
To address these research questions the author reviewed the video analytics over a three year period (6 semesters) from January 2015 to December 2017 of a 2nd/3rd year engineering technology class in Fluid Mechanics and Fluid Power.

Results

The Fluid Mechanics & Fluid Power class is a required class at Rochester Institute of Technology within the Mechanical Engineering Technology program. They typical class size is two sections of 32 students (64 total) during the fall semester and one section of 32 students in the spring semester. Over the three year study period the class enrollment varied from 30 students to 36 students in each section. This course has short video lectures for each class along with a large selection of sample problems completed. The author chose a sample of the lecture videos in weeks 1, 4, 7, 9, and 13 of the semester schedule to understand video usage over the semesters. The class is designed as a flipped class with a video before each class. The “in class” design includes a quick review the semester class schedules, and then time allotted for questions regarding the video. Students are encouraged to take notes or screen shots from the videos and after a few weeks most students have “video notes” from the flipped videos. After student questions are addressed each student is giving a short quiz (1-2 questions) from the video to solve. The students then break into small teams of 3-4 students to solve 5-8 “homework” problems on 10 large whiteboards around the classroom. These 10 large whiteboards allow the instructor to visually determine and guide students who are having difficulties with the problems.

The professors were able to track each of the lecture videos (Figure 1) from our learning management system (LMS) and video server. Figure 1 illustrates when the students viewed the videos during a sample spring semester. The decreased video usage at the end of March of this semester corresponds to a one week spring break period.

63	661	11
Media Items	Total Views	Avg. per Media Item



	Content Title	Duration	Total Views	Total Duration Viewed	Avg Rating	Number of Comments
	Pre-Lecture Gear Machines - Efficiencies	00:29:20	41	06:51:47	0	0
	Conductor Sizing & Burst Pressure	00:13:07	40	05:40:52	0	0

***Figure 1**: Course video views over time (spring semester sample March 1st to May 15th period)*

The instructor were able to track when a specific video was viewed along with the duration of the view and the client IP address to identify where students were watching the video (Figure 2). This figure shows that the majority of students in the class (36 students in this class) watched the video with 32 daily client views total or ~89% just before the class on April 2nd. Such a high percentage of views indicates that the days of worrying about student buy-in on the flipped classroom seem to be a thing of the past. As noted by Stelzer, et al, [12] students "seldom, if ever, open the textbook prior to coming to class." Stelzer et al, found that 70% of life science and engineering major students "rarely" or "never" read the textbook prior to class even though the class was designed to enforce textbook readings by using a "preflight" quiz at the beginning of the class period. These results are very similar to Vasquez, and Chiang [13] who reported that 71% of students "never" or "rarely" read the textbook prior to class despite receiving extra credit in class with clicker questions as an incentive to read the textbook for an Economics class. Of the students surveyed by Seltzer et.al, 69% of the students felt that the textbook was "useless" of "not very useful" in helping them learn the material. Overall, Seltzer et al. concluded that "today's generation of students prefer to learn from multimedia materials compared to textbooks", which is in agreement with our finding of almost 90% of students watching the course video before class. Chen, Stelzer, and Gladding in a subsequent study also found that the introduction of pre-lecture videos resulted in an improvement in student understanding in the basic physics concepts before attending the class. [14] Vasquez, and Chiang also found that pre-lecture videos improved student performance on the assessment quiz as compared to a control (textbook) group and pre-lecture videos had an even greater benefit on concept retention. [13]

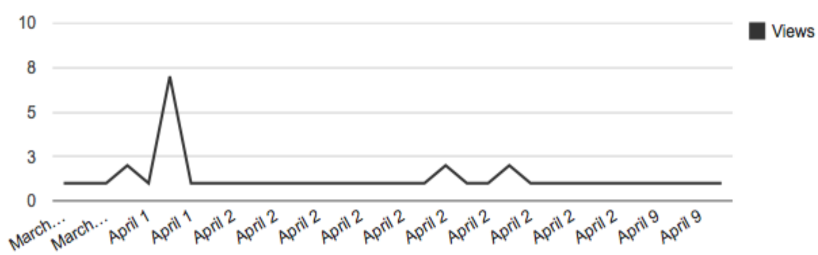
Mar 1, 2015 - May 15, 2015

Pre-Lecture Gear Machines - Efficiencies

Export: PDF CSV

Records/Page: 10

32	41	2
Daily Client View Totals	Total Views	Avg. per Total



Total Viewed	Duration Viewed	Date	Client IP
1	00:14:32	3/28/2015	129.21.69.89
1	00:21:49	3/30/2015	129.21.187.192
1	00:00:35	3/31/2015	129.21.141.62
2	00:01:29	4/1/2015	129.21.114.64
1	00:00:18	4/1/2015	129.21.180.15
7	00:08:50	4/1/2015	129.21.187.219
1	00:18:48	4/1/2015	129.21.66.79
1	00:00:43	4/2/2015	129.21.100.69
1	00:13:21	4/2/2015	129.21.117.186
1	00:16:57	4/2/2015	129.21.120.170

1 2 3 4

Figure 2*: Individual video analytics (spring semester sample March 30th to April 9th 2015 period)*

By examining the client IP addresses we were able to determine that the vast majority (80-90%) of the video usage was done local to the main campus. Rochester Institute of Technology is a large residential university with 14,000 students on the main campus. This local viewing determined by IP address included those living on-campus and off-campus within the metro area of the campus. The remote video usage was 10-15% from off-campus locations (>~50 miles from campus), as seen in Figure 3. While the percentage of remote off-campus views is small (10-15%) the geographic flexibility offered by the video lecture format seem to be of some value to students. We did observe over our study period that during semester holiday breaks the percentage of students watching videos remotely from the campus increased.

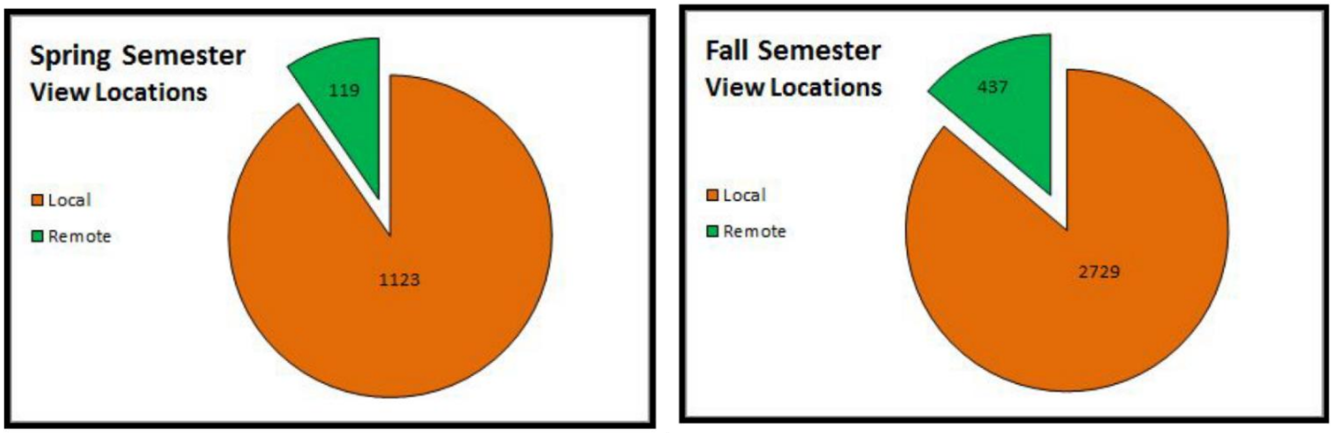


Figure 3: *Client IP analysis (spring semester and fall semester)*

The LMS and video server systems were able to record the students when watched the videos. The class meetings, represented in Figures 4 and 5 with an arrow, followed the majority of video usage. The class tests are represented by circles on the axis, with the final exam as a circle at the end of the semester. This figure shows that students are "just in time" video watchers consuming the video the evening before or morning of the class. Students also return to videos just before a test.

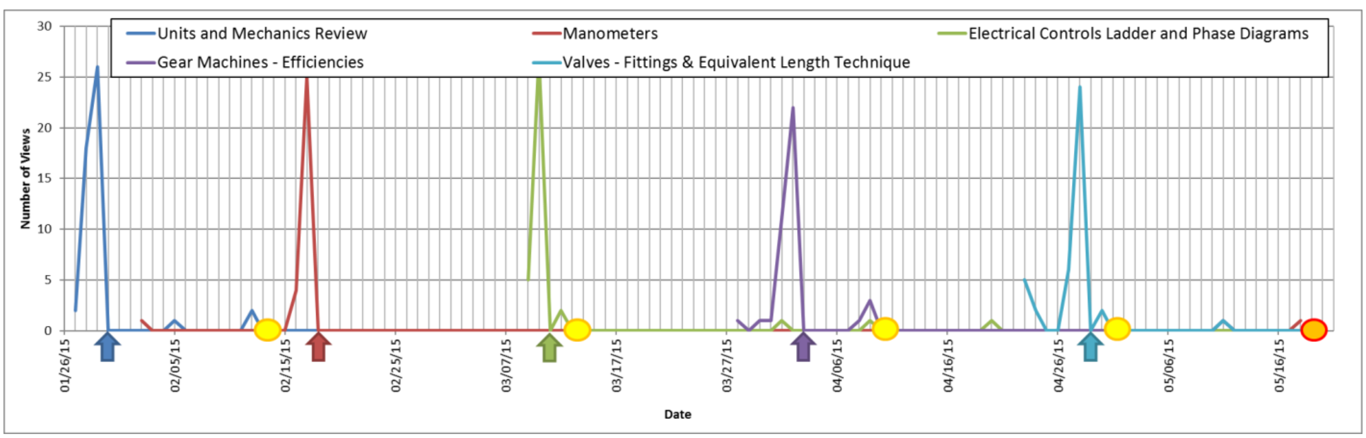


Figure 4: *Typical Spring Semester Video usage (5 lecture video sampling)*

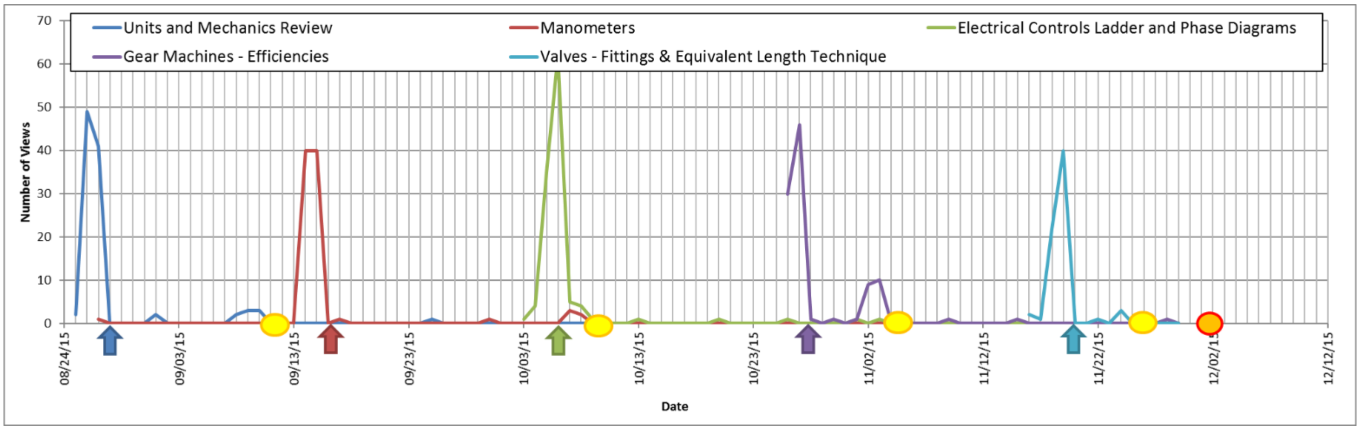


Figure 5*: Typical Fall Semester Video usage (5 lecture video sampling)*

The usage of the videos did not appear to change significantly between fall or spring semesters or over the study period years.

The video server system was also able to provide information on the operating system being used on the students' devices. This allowed us to understand whether the students were typically watching videos on Windows laptops/computers, Apple Mac devices, Android smartphones/tablets, Apple iPhones/iPads, or Chromebook laptops. Understanding the device and device screen size allowed us to move towards continuous improvement plans of the videos as smaller items would be difficult to present on small device screens. Figures 6 and 7 show that, a Windows laptops/computers were generally used to watch the videos and this did not change over a typical semester. This usage pattern was steady for the students. For other semesters we saw the use of mobile devices increase and use of larger Windows laptops/computers decrease. Students in these "changing usage" semesters started with Windows devices and switched to smaller more mobile devices over the semester (Figure 7). It was theorized that as the workload increased during the semester, the portable devices offered the students increased flexibility to consume the videos.

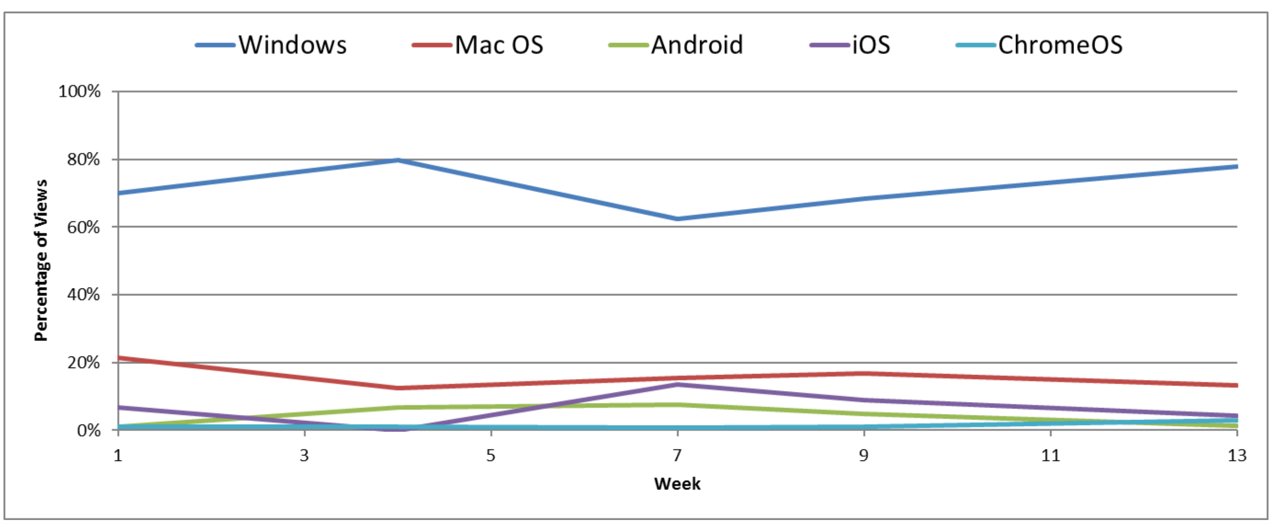


Figure 6*: Semester Device usage (steady usage)*

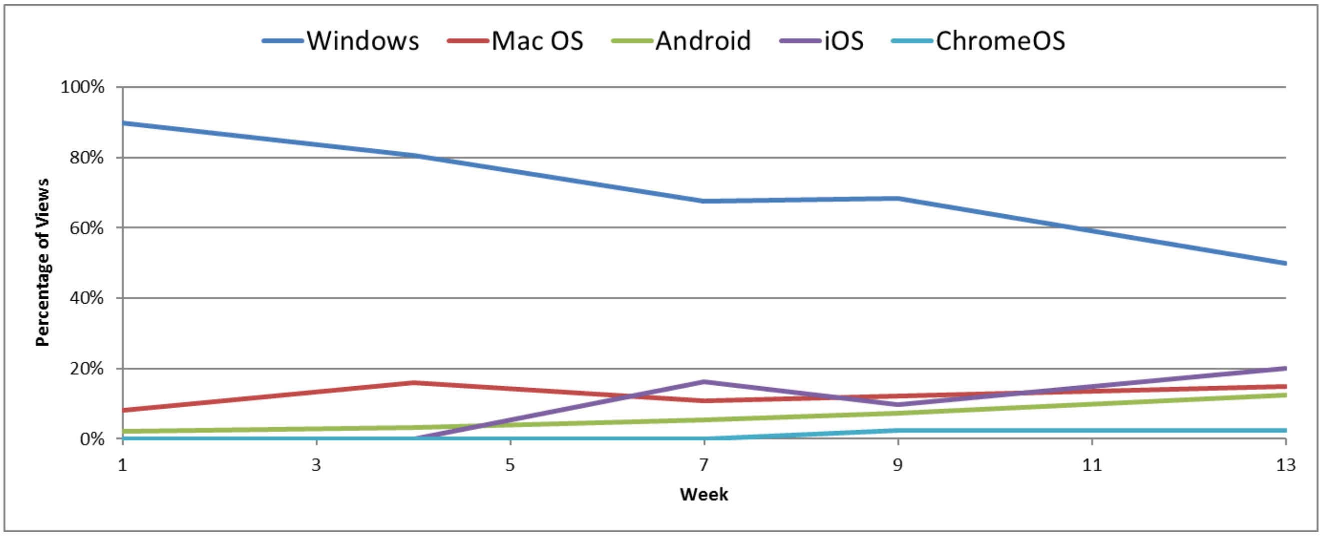


***Figure 7**: Semester Device usage (changing usage)*

Conclusion

Millions of learners are using video content in flipped classroom videos, massive open online classes or various video content platforms (Edx, Youtube, Khan Academy, Coursera, …). Each of these learners creates hundreds of video analytics contact data points that can be converted into useful information for the instructor to understand their students' learning profiles. As video content continues to increase, engineering and engineering technology educators will be able to increase our understanding of student learning needs. Overall, we found that a very high percentage of students watch the video before class in a "just in time" mode. With Rochester Institute of Technology being a large residential campus most students watch in close proximity to the campus (based on IP address analysis) with some students watching videos over semester holiday breaks remotely from campus. Some students re-review sections of videos before tests and students use multiple mobile and desktop devices that at times shift during the semester as they watch videos. Video analytics allow the instructor to adjust video content knowing where, when and how these flipped classroom videos are used by students. The advancements in automated data analysis systems will allow engineering and engineering technology instructors to capture course video analytics to build more student centered classes and materials to improve student learning.

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