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Using Pre-Lesson Materials and Quizzes to Improve Student Readiness and Performance

Ms. Mary A. Fraley, Michigan Technological University

Mary Fraley is a Lecturer in the Department of Engineering Fundamentals at Michigan Technological University. Her research interests include online/blended learning methods, first-year engineering courses and program development.

Dr. A. J. Hamlin, Michigan Technological University

AJ Hamlin is a Senior Lecturer in the Department of Engineering Fundamentals at Michigan Technological University, where she teaches first-year engineering courses. Her research interests include engineering ethics, spatial visualization, and educational methods. She is an active member in the Engineering Design Graphics Division of ASEE and is currently serving as the Associate Editor of the Engineering Design Graphics Journal.

Ms. Amber Kemppainen, Michigan Technological University

Ms. Kemppainen is a Senior Lecturer in the Department of Engineering Fundamentals. Her research interests include the improvement of STEM education, ethics, and online/blended learning methods.

Dr. Gretchen L. Hein, Michigan Technological University

Gretchen Hein is a Senior Lecturer in Michigan Tech's Department of Engineering Fundamentals. Since 1998, she has been working on first-year engineering courses and program development. Additionally, she has been active in research pertaining to underrepresented groups and persistence in STEM fields.

Using Pre-Lesson Materials and Quizzes to Improve Student Performance

Abstract

Research has shown that students are preparing less for class using traditional forms (i.e.: reading textbooks) and, as a result, are not ready for class. Providing additional support materials to be reviewed before class in a format preferred by first-year engineering students may improve student readiness and performance. Therefore, in addition to traditional reading assignments, students complete pre-lesson activities such as video tutorials, online quizzes, or short "how to" exercises.

In response to a student survey given in fall 2013 on current course preparation and desired formats, materials were developed in spring 2014 for course ENG1101. The pre-lesson activities focused on videos and on-line quizzes for MATLAB. Results from the pilot suggest slightly positive improvements in readiness and performance. Therefore, pre-lesson activities have been expanded to include additional topics.

Video tutorials, online quizzes, and additional pre-lesson activities were developed for the additional topics which included technical communication, spreadsheets, problem solving, statistics, as well as the MATLAB lessons. The pre-lesson activities were incorporated in course ENG1101 in fall 2014. Students were assigned the pre-lesson videos in addition to the traditional reading assignment (textbook reading to prepare for class) with several levels of encouragement to prepare for class ranging from no encouragement to required quizzes or short assignments to be completed before class. At the end of the semester, these students completed a survey similar to the pilot survey regarding what they did to prepare for lessons and what additional support materials they would like to have.

This paper will focus on the impact of the pre-lesson activities, including short video tutorials and on-line quizzes, on student readiness and performance. The responses on the student preparedness surveys for the different groups will be compared to see if the developed materials improves student readiness. The three groups were:

- No change to the current course format
- Students could watch the videos
- Students could watch the videos and they had to complete a short, on-line quiz based on the video content.

Additionally, student learning will be assessed by comparing performance on exam scores pertaining to topics for the fall 2013 traditional reading group and the fall 2014 experimental group.

Introduction and Background

As engineering education evolves, a new way of student learning has developed called blended learning. Blended learning has been defined as "the combination of traditional face-to-face and technology-mediated instruction".[1] With this broad definition, there is a plethora of ways that

blended learning can be incorporated into courses and programs. Students perceive blended courses more positively than either traditional or on-line ones. The main reason for this is that students can manage how they allocate their time. They can choose to complete their coursework around their other commitments like sports, work and social commitments.[2] Students have stated that they value interactions with their faculty, but want those interactions to be useful to them. Additionally, engaging with other students is an important component of their education. Interactions between students and faculty naturally occur and are facilitated within the classroom. Students perceive that they receive feedback from their instructor faster in a blended learning environment.[2]

Many universities are establishing initiatives to encourage faculty to bring blended learning into their courses and programs. University of Central Florida is an institution where blended learning has been incorporated in courses since 1997. As a university, blended learning has become fully incorporated into university policy. As such, they have shown historically that students value blended learning; retention and completion rates within the courses and programs has increased.[3]

The Swanson School of Engineering at the University of Pittsburgh began promoting blended learning in 2013. As part of this program, a first-year engineering programming course was "flipped". "Flipped" classrooms are where the traditional lecture material is moved to formats that students review outside of class. The class time is spent with students completing problems and exercises. In this course, that meant students complete programming exercises during class where they have access to the instructor. Consequently, most of the students responded positively to the "flipped" environment because of the increased time to work with their instructor on various problems.[4]

At Lipscomb University, two introductory chemistry courses required students to watch videos prior to class (video lengths: 1:08 – 17 minutes). Two hundred videos were developed for the two courses or about 14 hours of lecture material was transferred from the classroom to the virtual environment. A second component of this program was for students to complete on-line homework assignments. The "extra" class time was used to answer student questions regarding the videos, homework and quiz questions, along with longer in-class problems that students solved with guidance from the instructor. Student perceptions of the flipped environment were gathered through a survey at the end of class. Many students reported that having the videos outside of class was a "burden" to them, although over 20% of the students disagreed. On the positive side, many students reported that they were more engaged in the classroom and found class to be more useful. [5]

Two faculty members at the University of Hartford wanted to see the effect of flipping a portion of a Calculus II class. The instructor taught two sections back-to-back. Therefore, he flipped one course unit for one of the sections and not the other. Like the Lipscomb University Chemistry courses[5], the instructor created one to three videos per lecture topic for students to watch prior to class. The length of the pre-lessson videos for a given lesson did not exceed 15 minutes. The flipped section students then spent most of the class time working problems and interacting with the instructor. The traditional section spent most of the class time listening to the instructor with only minimal time for questions and problem solving. As part of this portion of the class, students completed two exams. For both exams, students in the flipped environment

outperformed the students who were in the traditional classroom. Furthermore, the students in the flipped environment were surveyed to determine their perceptions of the change. Overall, the results were positive. Students liked the short videos and the inclusion of worked examples. The also reported that the videos were good to review prior to the exams. On the negative side, students wanted the opportunity to ask the instructor questions while they viewed the videos because if they did not understand some of the material, they were unable to complete the quiz at the beginning of class. [6]

At Michigan Technological University (Michigan Tech), an initiative to encourage the inclusion of blended learning in the classroom began in the 2013-2014 academic year. Faculty were encouraged to submit proposals to the Jackson Center Blended Learning Grant program for "course/program reform or expansion projects using blended and online learning".[7] Through this program, faculty can receive funds to help them incorporate blended learning or on-line resources into their courses or programs. Faculty within the First-Year Engineering Program received a small grant to develop pre-lesson instructional modules for the coverage of first-year ENG course topics on MATLAB. These pre-lessons would allow for additional course support, instruction, and/or preparation for classroom activities.[8] Pre-lesson videos have been shown to be effective for all levels of college students, but Clark, et al., reported that upper classmen tended to watch the videos before class and many first-year students watched them after the material was covered in class.[4] The activities, the data collected, and our analysis will be described and summarized in the following work.

Methodology

Michigan Tech has had a common first-year program since 1999. Students within the program have two tracks, one for those students who are calculus ready and the other for the students enrolled in pre-calculus. The calculus ready students take a two course sequence: ENG1101 followed by ENG1102. The pre-calculus students take a three semester sequence: ENG1001, ENG1100 and ENG1102.[9] The student population involved in the study were those who were enrolled in ENG1101 in the fall 2013 (comparison group) and fall 2014 (study population). Additionally, in the spring of 2014, a few pre-lesson videos were piloted to determine what worked best for students. The student feedback regarding the videos was used when developing the fall 2014 videos. The fall 2013 cohort served as a comparison because there were no blended learning components.

The pre-lessons developed through the Jackson Grant were initially for ENG1100 and ENG1101, courses where the initial coverage of MATLAB occurs. Our blended learning pre-lessons were developed and tested in a trailing section of ENG1101 during spring 2014. The composition of the trailing section is considerably different than the fall sections. The majority of students enrolled in ENG1101 in the fall are first-time-in-any-college students, while the spring section is primarily for students that are new to the university, new to the College of Engineering, transitioning from their English as a Second Language program into their academic majors, and students repeating the course. In this pilot, four videos covering topics in MATLAB were assigned to be watched prior to class. These videos ranged in duration from 5 to 13.5 minutes. Each included background information to introduce the topic, a demonstration in MATLAB, and an easy, short "Try-it" exercise. In comparison to one section of ENG1101 taught in fall 2013,

the students in the pilot group performed slightly better on exam questions related to MATLAB, although the difference is not statistically significant. Additionally, many students liked the pre-lesson videos, with 73% of the students reporting that they would like to see more course material developed in this format.[8]

Based on the feedback from the pilot group, additional pre-lesson videos were developed for implementation in fall 2014. A list of videos and their length are shown in Table 1. A total of 33 videos were developed. A strong effort was made to ensure that the video length was short, preferably 5 minutes or less. A few videos were slightly longer. As these were pre-lesson videos, the material covered a basic introduction to the topics and were meant as class preparation. Not all lessons had pre-lesson videos. Of the lessons where pre-lesson videos were assigned, most had only one video; however, two or more videos were assigned for a few MATLAB topics (e.g., for loops and arrays). Students accessed the videos through links from their Canvas course to a You Tube playlist or directly from YouTube. While some videos were watched more than others, there was an average of 604 views on each video. There were 784 students taking the course during Fall 2014. For some of the topics (e.g., MATLAB, statistics, empirical functions), these videos were watched multiple times throughout the semester: as assigned and again before the midterm and final exams.

Table 1. ENG1101 Pre-Lesson Videos Used in Fall 2014

Topic	Length (minutes)	Views
Significant Digits	3.87	1182
Unit Conversions	6.71	684
Introduction to Spreadsheets	6.45	1267
Tables and Figures in Technical Documents	2.36	981
References in Technical Documents	2.52	1326
Management Plan (Gantt Chart)	5.52	740
Creating a Histogram on Excel	4.91	1336
Quality Control Statistics Problems	7.21	474
Formatting a Graph on Excel	4.86	583
Exponential and Power Functions	5.80	810
MATLAB General Plotting	4.64	679
MATLAB Basic Navigation	5.89	608
MATLAB Polyfit (equation fitting)	6.39	718
Formatting a Graph in MATLAB	4.03	691
MATLAB Programming Basics	5.07	886
MATLAB Input/Output	7.15	851
Example: Simultaneous Equations in MATLAB	6.33	350
MATLAB Selection: if and if-else	5.88	559
MATLAB Selection: if-elseif and nested if	2.21	332
MATLAB Working with Array Variables	4.07	308
Examples: MATLAB Selection Statements	8.64	275
Creating Arrays using MATLAB for loops	2.89	596

MATLAB For Loops	4.46	849
Creating a Table in MATLAB	4.49	566
MATLAB Errors using For Loops	1.78	574
Building Vectors in A MATLAB for Loop: part 2	5.02	315
MATLAB Data Loading	5.68	470
Isometric and Oblique Sketching	3.44	195
Single Axis Rotations	4.27	182
Rotations about 2 Axes	2.66	156
Orthographic Projection	6.28	101
Orthographic Projection with Inclined and Curved Surfaces	3.53	108
Sketching Curved Surfaces	3.15	90

In this study, the impact of using pre-lesson videos in ENG1101 is examined using surveys and grades from two semesters, one which incorporated pre-lesson videos (fall 2014), and one that did not (fall 2013). Other components of this course (i.e., assigned homework, quizzes, tests, team assignments, in-class work) were comparable. A summary of the different groups used in this study is shown in Table 2.

Table 2. Summary of ENG1101 Groups used in this Blended Learning Study

Group	Comparison	Group 1	Group 2	Group 3
Semester	Fall 2013	Fall 2014	Fall 2014	Fall 2014
Number of students	534	183	308	293
Number of faculty	5	1	2	3
Number of sections	9 of 13	3 of 13	5 of 13	5 of 13
Reading	Assigned, some encouraged with clicker questions, some encouraged with pre-lesson quizzes	Assigned	Assigned	Assigned
Pre-lesson video		Assigned, not encouraged	Assigned, encouraged	Assigned, Encouraged with pre-lesson quizzes

Comparison Group. The comparison group for this study consists of nine of the thirteen sections of ENG1101, with a total of 534 students taught fall 2013 by five faculty members. This group was taught in a traditional method with assigned reading to be completed before class. In three of the sections (N=181), students were to complete pre-lesson quizzes based on the reading before class. In the remaining sections, students were periodically given clicker questions over reading to encourage students to prepare for class.

Experimental Group 1. There were three sections of ENG1101 from fall 2014 all taught by one faculty member in this group. The 183 students in this group were given the same reading

assignments and videos to watch as Group 2 and Group 3, however, students were not encouraged further to complete either of these before attending class. All material contained in the videos was covered in class.

Experimental Group 2. This group consists of five sections of ENG1101 taught fall 2014 by two faculty members. The 308 students in this group were strongly encouraged to complete the reading and watch the video(s) prior to class, however, neither pre-lesson quizzes nor clicker questions were used. Material covered in the video was typically not covered during class.

Experimental Group 3. This group consists of five ENG1101 sections (293 students) taught fall 2014 by three faculty members. Before attending class, students in Group 3 were expected to complete the reading assignment and watch the pre-lesson videos. To encourage preparation, short pre-lesson quizzes covering video content were also required. These quizzes consisted of two to five questions and were administered through Canvas, the Learning Management System (LMS) used at Michigan Tech. These quizzes are not the same as the reading quizzes given to the comparison group. The percent of students completing the pre-lesson quizzes ranged from 82% to 92%, with an average of 87.4% over all the quizzes. As with Group 2, material covered in the pre-lesson videos was not typically covered in class. Slides that covered material in the videos were included in the lesson package. The faculty in this group sometimes flipped through the slides noting topics covered in the video, and other times removed them entirely. Occasionally, material in the videos was repeated in class.

To determine how students prepared for class, students in six of the twelve sections in the control group and all sections of the experimental groups were given a survey at the end of the semester. In both years, the surveys were administered through Canvas. The comparison group surveys were anonymous; the experimental group surveys were not, so that survey responses could be paired with student performance data.

To determine if the pre-lesson videos have an impact on student performance, grades were collected for all groups, including individual homework grades, exam grades, and the final course grade (20% of which is based on team assignments). Additionally, individual student responses on the final exams were collected.

Student Survey Analysis

To determine how students prepared for class, student survey responses were analyzed from fall 2013 (comparison group) and fall 2014 (experimental groups). NOTE: Students self-reported how they prepared for class. The data reported below is an indication of their preparation, not an indication of student readiness. The survey questions and possible responses can be found in Appendix A. Table 3 shows student responses to the question: “What do you currently do to prepare for your ENG class? (select all that apply)” for the comparison group, fall 2013. The experimental groups were asked a slightly different question: “Of the items below, which did you find most helpful when preparing for your ENG class? (select all that apply, some options are not available in all sections). These results, shown in Table 4, show that students shifted their preferred preparation methods from reading and reviewing the course outline to preview lecture online and complete pre-lesson activities (quizzes, videos, and activities). More students

found the pre-lesson activities helpful in Group 3 where the pre-lesson quizzes were required as compared to Group 2 where there were no pre-lesson quizzes. Slightly fewer students did nothing to prepare when the pre-lesson videos were required. Group 1, where reading and videos were not encouraged, had the highest percentage of students who did nothing to prepare.

Table 3. Survey Responses to: What do you currently do to prepare for your ENG class? (Select all that apply)

	Comparison Group: Fall 2013 No pre-lesson videos % (N = 297)
Nothing	10.3
The assigned reading	21.7
Look at the course outline	16.6
Preview lesson materials	20.9
Complete tutorials	7.4
Complete online pre-lesson quizzes (based on reading)*	23.2

*One instructor, three sections (N=144)

Table 4. Survey Responses to: Of the items below, which did you find most helpful when preparing for your ENG class? (Select all that apply, some options not available in all sections)*

	Group 1: Fall 2014 did not encourage pre-lesson videos % (N = 138 students)	Group 2: Fall 2014 encouraged pre-lesson videos, no quiz % (N = 291 students)	Group 3: Fall 2014 required pre-lesson quizzes % (N = 269 students)
Nothing	43.5	14.8	12.3
The assigned reading	16.7	18.9	9.3
Look at course outline	26.8	27.8	22.3
Preview lecture online	15.2	31.6	35.7
Complete pre-lesson activities (quizzes, videos, activities)	22.5	54.6	66.2

*Note – Students could select more than one response so the percentages can add up to more than 100%.

Time spent preparing for class was also analyzed using the student survey responses, as shown in Table 5. It is assumed that students were able to separate time spent preparing for class from time spent on other course components (homework) as almost all survey questions pertain to lesson preparation. Comparing the fall 2013 Comparison Group to the Group 2 which encouraged pre-lesson videos, there is a slight shift of the amount of time students spend preparing for class. This most likely is due to the new pre-lesson videos which, on average, were 4.79 minutes in length. Comparing the Group 2 which encouraged pre-lesson videos but had no pre-lesson quizzes to Group 3 which required pre-lesson videos and quizzes, there was an additional shift of time spent preparing for class, but not extensively. Less than 10% of the Group 3 students who were required to take the pre-lesson quizzes spent more the 30 minutes

preparing for class. Over 72% spent less than 15 minutes preparing for class. As expected, when looking at the fall 2014 Group 1 where reading and the videos were not encouraged, less time was spent preparing for class.

Table 5.Student Responses to: On average, how much time do you use to prepare for each ENG class?

	Comparison Group: Fall 2013 (N = 293)	Group 1: Fall 2014 did not encourage pre-lesson videos % (N = 138)	Group 2: Fall 2014 encouraged pre-lesson videos, no quiz % (N = 291)	Group 3: Fall 2014 required pre-lesson quizzes % (N = 270)
Less than 5 minutes	28.0	43.5	23.4	20.4
5-10 minutes	24.6	24.6	33.0	28.5
10-15 minutes	21.2	12.3	20.6	23.3
15-30 minutes	21.5	14.5	16.8	18.1
30-60 minutes	4.8	3.6	5.2	7.4
Greater than 60 minutes	1.4	1.4	1.0	2.2

Student survey responses were analyzed to determine what percentage of students were watching the pre-lesson videos. The fall 2013 Comparison Group did not have access to the pre-lesson videos. Of the fall 2014 students, Table 6 shows a breakdown of the percentage of students who watched the video for the three Experimental Groups. As shown in Table 6, the number of students who watched all or most of the pre-lesson videos increased as the instructor encouraged the videos and if a pre-lesson quiz was required (Groups 2 and 3). Group 2 is similar to the University of Pittsburgh study because the students in this study did not have to watch the videos either.[4] Unlike the Group 2 students in this work, the Pittsburgh students instead watched the videos after the material was covered in class.[4]. By requiring a short online pre-lesson quiz before class, an additional 28% students watched all or most of the videos as compared to the students that did not require a pre-lesson quiz (Group 2) and an additional 69% of the students compared to the students whose pre-lesson videos were not encouraged (Group 3).

Table 6. Percentage of Students Who Watched Pre-Lesson Videos

	Group 1: Fall 2014 did not encourage pre-lesson videos % (N = 138)	Group 2: Fall 2014 encouraged pre-lesson videos, no quiz % (N = 291)	Group 3: Fall 2014 required pre-lesson quizzes % (N = 270)
All of the videos	1.4	11.3	30.7
Most of the videos	4.3	35.1	43.7
Some of the videos	32.6	48.1	21.9
None of the videos	61.6	5.5	3.7

The student surveys were analyzed to determine how long students watched the pre-lesson videos. Table 7 shows the breakdown for the three experimental groups. Group 2 and Group 3, who both encouraged video viewing, had similar viewing patterns where nearly 80% of the students watched most (or all) of the videos

Table 7. Duration of Pre-Lesson Videos Watched

	Group 1: Fall 2014 did not encourage pre-lesson videos % (N = 138)	Group 2: Fall 2014 encouraged pre-lesson videos, no quiz % (N = 291)	Group 3: Fall 2014 required pre-lesson quizzes % (N = 270)
Entire video	10.1	43.6	45.2
Most of the video	14.5	33.7	33.3
Some of the video	15.2	17.5	18.1
None of the video	60.1	5.2	3.3

Student Performance

A between subjects ANOVA analysis was performed to determine the effects that watching videos had on specific course metrics. It is important to note that all videos covered testable material, but there were some topics that were not covered by videos (e.g., memo writing, design project, ethics, and sustainability). Breaking this down by exam, 70% of exam 1, 100% of exam 2, and 46% of the final exam was material covered by video content. In addition, historically there has been a minimum of 90% attendance in class and there was not a noticeable change in attendance in fall 2014.

Group 1, did not encourage the videos in these sections of ENG1101. This instructor covered all the course material in class. In theory, this should result in no significant difference between student course metrics and that is what was represented in Figure 1 below and using a t-test. Although the data shows a drop in performance with those students who watched all the videos, only 2 students fall into this category. These students may have been behind in class and watched the videos to catch up. The difference in performance could also be due to how the video versus class materials were presented. In the other groups, the videos replaced course material. In these sections, the videos were in addition to the lecture material. If the videos presented the materials differently than the instructor, for some students, this could have caused topic ambiguity.

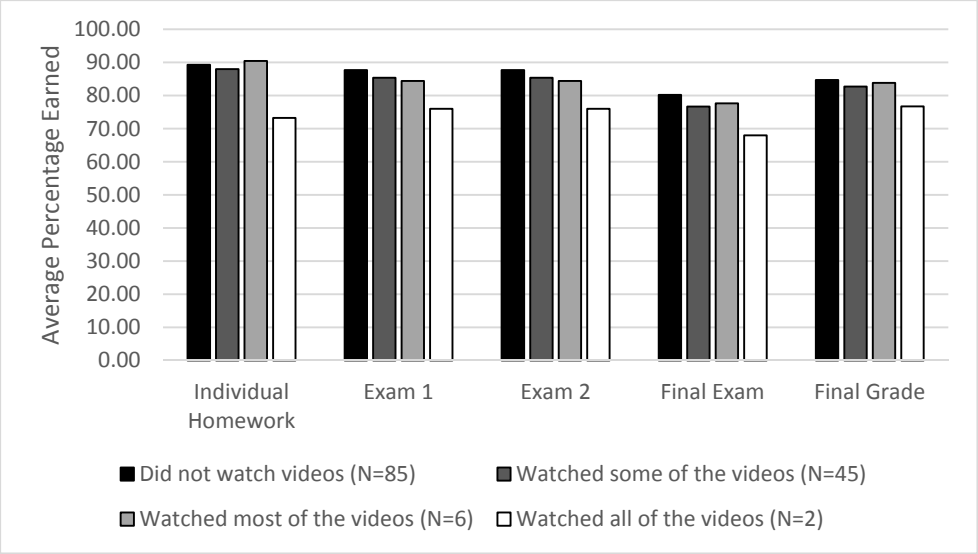

Figure 1. Comparison of video usage with select ENG1101 course metrics (Group 1, N = 138)

Figure 2 shows the course metrics for Group 2: students whose instructors encouraged the pre-lesson videos. Two instructors (5 sections with 291 students) did not reinforce participation through a quiz. Performance on the individual homework and final grade shows the highest significant improvement ($p < 0.000$). The exams, however show mixed results with students who watched all the videos as the highest performers followed by those who did not watch any videos. For this group, some of the students electing not to watch the videos could have been students who had some familiarity with the material and did not need to watch them. For this data there was a statistically significant increase in student performance in the course with increased video viewing ($p<0.05$ for the first exam, $p<0.01$ for the others).

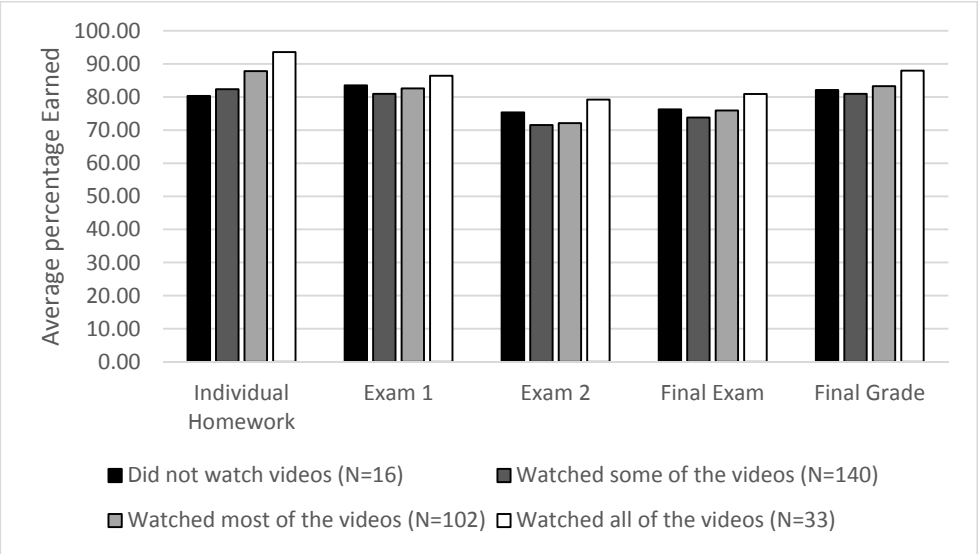

Figure 2. Comparison of video usage with select ENG1101 course metrics (Group 2, N = 291)

The results are shown below in Figure 3 for Group 3, for the three instructors (5 sections with 270 students) who required the videos and reinforced participation through a pre-lesson quiz. As shown, the performance on all metrics are progressively higher when more videos were watched. Performing a two-tailed t-test on the data revealed that all metrics, except the final exam grade, showed a statistically significant difference ($p < 0.05$) between the student video watching groups.

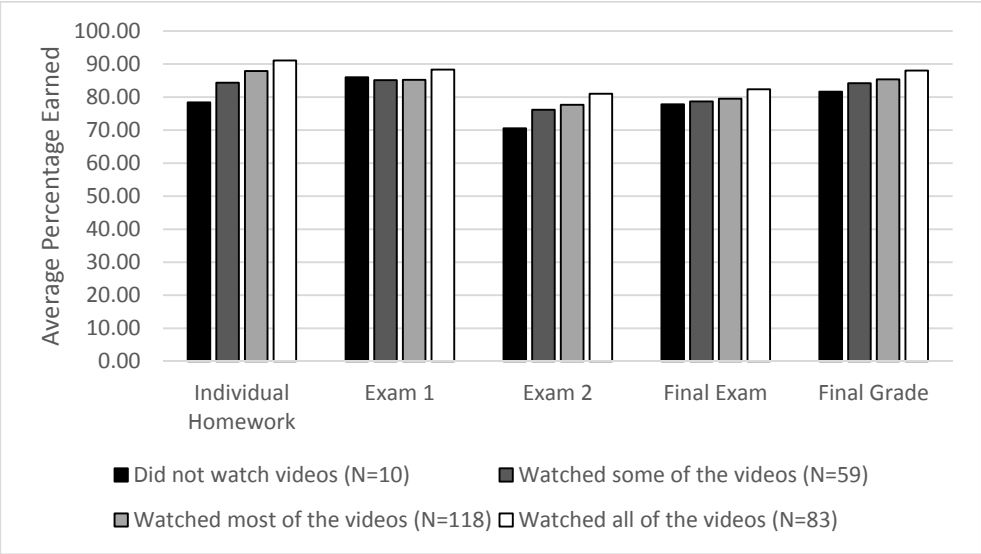

Figure 3. Comparison of video usage with select ENG1101 course metrics (Group 3, N = 270)

We compared the performance of our 2013 ENG1101 cohort with our 2014 cohort using a two-tailed t-test on the final exam. In order to obtain a more effective side-by-side comparison, we used essentially the same final exam between semesters. Table 8 shows the change in final exam performance by topic and instructor group. As shown, several topics appear to have statistically significant differences between semesters (shown bold in the table). Group 3 (required videos) showed statistically significant increases in statistics, empirical functions and graphing, and MATLAB results on the final exam. Group 2 (encouraged videos) showed statistically significant increases in unit conversions and problem solving and empirical functions and graphing. Group 1 showed only statistically significant increases in MATLAB final exam results. The pre-lesson videos appear to positively influence student exam performance.

Table 8. ENG1101 Final Exam Comparison by Topic with and without video reinforcement by Instructors

Course Metrics	Fall 2013 (N = 534)	Fall 2014 Instructor Group 1 (N = 182)		Fall 2014 Instructor Group 2 (N = 181)		Fall 2014 Instructor Group 3 (N = 291)	
	Average (Std Dev)	Average (Std Dev)	p-value	Average (Std Dev)	p-value	Average (Std Dev)	p-value
Unit Conversions and Problem Solving (4)	75.0 (22.5)	76.1 (20.2)	0.559	85.1 (20.9)	**0.000**	76.4 (34.1)	0.478
Statistics (4)	69.0 (26.3)	72.5 (23.3)	0.104	69.4 (25.2)	0.844	73.7 (30.4)	**0.018**
Empirical Functions and Graphing (5)	61.5 (23.2)	65.3 (23.1)	0.055	76.4 (23.7)	**0.000**	77.2 (25.0)	**0.000**
MATLAB (12)	70.4 (21.3)	74.3 (19.1)	**0.029**	72.5 (19.1)	0.239	76.0 (22.3)	**0.000**

Conclusions

In the fall of 2014, pre-lesson videos, which covered several topics including MATLAB, functions, statistics and others, were piloted in several sections of ENG1101. Three of the instructors assigned the videos and encouraged them with pre-lesson quizzes (Group 3). Two of the instructors assigned the videos and encouraged their usage, but did not assign pre-lesson quizzes (Group 2). One of the instructors assigned the videos, but did not actively encourage their usage (Group 1). Students in Group 3, who were assigned the pre-lesson quizzes, watched the highest percentage of pre-lesson videos, spent a slightly longer amount of time preparing for class, and reported that they preferred the pre-lesson videos/quizzes and previewing the course lesson online as study preparation methods over the assigned reading. Students in Group 2, who were encouraged to use the pre-lesson videos but did not have a required pre-lesson quiz, were 28% less likely to watch the videos, spent slightly less time preparing for class, and also preferred the pre-lesson videos and previewing the course lesson online, but at lower percentages. Both groups that were encouraged to use the pre-lesson videos watched approximately the same amount of the videos. Students in Group 1, who were assigned the pre-lesson videos but not encouraged to use them, were 69% less likely to watch the videos as compared to the students that had required pre-lesson quizzes, spent significantly less time preparing for class, and preferred using the course outline and using pre-lesson videos to prepare for class, but at much lower percentages.

Analysis of student performance shows that as students watch more of the pre-lesson videos, their performance on homework and exams improve slightly. Students in Group 3 show improvement on all metrics (homework, exams, and final grade). Students who were encouraged to use the pre-lesson videos in Group 2, showed an improvement in individual homework and final grade scores as the amount of videos watched increased. Students who were not actively encouraged to use the pre-lesson videos showed no improvement in scores with video watching. This was as expected since all of the pre-lesson video material was covered in class. Student

performance in specific topics was compared between the fall 2013 Comparison Group and the 2014 Experimental Group. Students in Group 3, had the greatest improvement in most of the topics as compared to the fall 2013 Comparison Group. Students in Group 2, who were encouraged to use pre-lesson videos, showed improvements in unit conversions/problem solving and empirical functions/graphing. Use of pre-lesson videos and the reinforcement of pre-lesson online quizzes appear to improve student performance.

Future work will include analyzing the improvement in student performance by exam topic with the amount of video viewing and preparation time for each of the experimental groups. We also want to investigate the relationship between math cohort levels, student preparation methods/preparation length of time, and performance. Qualitative analysis of open student survey responses may be investigated for common themes. We are exploring the video viewing statistics of Panopto. If the statistics available are more inclusive than YouTube's options, then we will use Panopto as the avenue for the pre-lesson videos.

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Appendix A: Fall 2014 Blended Learning Student Survey

1. Of the items below, which did you find most helpful when preparing for your ENG class? (select all that apply, some options are not available in all sections)
    A. Nothing
    B. The assigned reading
    C. Look at course outline
    D. Preview lecture online
    E. Complete pre-lesson activities (e.g., quizzes, videos, exercises
2. On average, how much time do you use to prepare for each ENG class?
    A. Less than 5 minutes
    B. 5-10 minutes
    C. 10-15 minutes
    D. 15-30 minutes
    E. 30-60 minutes
    F. Greater than 60 minutes
3. If additional support material is developed for your ENG course, what formats do you prefer? (select all that apply)
    A. Reading
    B. Instructional Videos
    C. Demonstration Videos
    D. Solutions to worked out problems
    E. Online quizzes
    F. Tutorials
4. In your opinion, are iClickers effective learning tools?
    A. I did not use iClickers in my section
    B. Strongly agree
    C. Agree
    D. Neutral
    E. Disagree
    F. Strongly Disagree
5. Did you watch the pre-lesson videos for your ENG class?
    A. All of them
    B. Most of them
    C. Some of them
    D. None of them
6. Generally, when watching the ENG videos, did you watch?
    A. The entire video
    B. Most of the video
    C. Some of the video
    D. None of the video
7. Typically, how many times did you watch each video?
    A. I did not watch the videos
    B. Once
    C. Twice

D. Three or more times

8. Do you plan to watch the ENG1101 videos to review for the final exam?
    A. Yes
    B. No
9. For your learning purposes, the “Try It” exercises at the end of the videos were typically
    A. Too simple
    B. Appropriate
    C. Too advanced
    D. Not required for my section
    E. I did not do the Try It exercises
10. What did you like about the videos?
11. What are your suggestions to improve the videos?