

Using Online Video Lectures to Enhance Engineering Courses

Yacob Astatke, Farzad Moazzami, Craig Scott, Ladeji-Osias

yacob.atastke@morgan.edu, kladeji@eng.morgan.edu

Morgan State University, Baltimore ,Maryland

Abstract:The use of technology in the classroom has greatly impacted engineering education during the last 20 years. The expansion of the internet and the use of computers, tablet pcs, smart boards, and other wired and wireless devices have proliferated throughout education. One thing that has not drastically changed with the infusion of technology is the traditional method of teaching, i.e. lecturing or “chalk-and-talk” method. Today’s students expect their instructors to create an active and engaged learning environment by delivering course content using more than one method (i.e. classroom lecture) so that they can access it from anywhere at any time. The Electrical and Computer Engineering (ECE) department of Morgan State University has implemented a new approach that requires all courses to use video recordings to provide supplementary materials for both face-to-face (F2F) and online courses .

This paper will present the results of the implementation of the Panapto Focus™ video lecture capture software in the Electric Circuits (200 level), Linear Systems (200 level) and Discrete Systems (300 level) courses. The new software package was implemented in the Electric Circuits course starting in the Spring 2010 semester, and the Linear Systems and Discrete Systems courses starting in the Fall 2011 semester. Each week, the instructor evaluates the students’ performance on homework assignments, and quizzes and records additional video updates to provide feedback and stress the importance of certain concepts to the class. The regular video updates allow the students to review the instructor’s feedback from anywhere at any time, and make the class environment more interactive and dynamic. We will present course data, survey results and other direct and indirect performance measures for the three courses to show that the new approach has increased student performance and satisfaction.

Introduction

Universities face an increasing interest in providing students with recorded class material because today’s students expect to have 24/7 access to online learning materials from anywhere at any time [1]. “Millennial” students see technology integration in higher education as a key component of their learning environment because they have grown up using technology in every facet of their lives [2] . The use of lecture capture technology has the potential to fundamentally change the way instructors and students interact in the classroom [3],[4],[5] . It also has the potential to change the classroom environment and the relationship between instructors and students by shifting the role of the instructor from the old way of “sage on a stage” mode to one that incorporates more interaction. The availability of recorded lectures can allow faculty members to free up time in the classroom that may be used for group discussions, team work, and other activities that engage students and create an active learning environment [6]. The ability to access additional online course material provided by the instructor from anywhere at any time provides

students with an opportunity to review difficult concepts, and supplement their learning experience.

In general, faculty members have the choice of using lecture capture technology to change and enhance their classroom environment in one of three ways. First, they can use it to allow their students to preview the course material before class by posting pre-recorded course materials. This will allow instructors to free-up more lecture time and spend more of their classroom “face-to-face” (F2F) engaging students with group discussions, and hands-on activities. This approach gives faculty members the opportunity to engage in active learning strategies that have the potential to improve student learning. Second, they can use the lecture recordings to allow students to review and understand difficult concepts in the course outside of the classroom as often as they want. One important key feature of lecture capture systems is their ability to create a detailed and precisely timed table of contents that allows students to skip any section and focus directly to a specific location of the lecture they are interested in. Finally, lecture capture software can be used by faculty to provide additional instructions, such as demonstrations and step-by-step instructions that are important to understand the primary course material. For example, instructors can record short and single-concept recordings that expand and clarify the main lecture topic. This approach may be applied in response to student questions, or as a way to provide information that allows more advanced students to gain additional insights into the course material. We will share the results of our investigation based on the implementation of the third approach in the EEGR 322 and EEGR 221 courses.

Choosing an appropriate lecture capture system is not easy because there are many stakeholders, such as: instructors, students, tech support staff, instructional designers, and others who need to be heard in the course of making the proper choice. Therefore, the results of a well-chosen deployment that take into account input from all constituents has great potential for students, instructors, and the institution. It is very important to note that any lecture capture system that is intended for large-scale university wide distribution requires a robust connectivity, processing, and storage infrastructure. Virtually all software-based capture systems that are currently on the market can record material directly to a classroom computer that is either permanently installed or brought in by the instructor. Finally, the software sends the raw files to a server for processing and distribution. It should be noted that it is not necessary for a computer to be connected to a network to actually record material. The recording can be done off-line and then uploaded to the main server at a later time. However, to do any type of scheduled recordings, some systems do require a connection to send a signal to actually begin the capture, even if the recorded content is stored on the local machine. The size of the files that are recorded can be as small as a few hundred megabytes or as large as a few gigabytes per hour depending on the settings of the recording software. The audio and video recording files are usually transmitted to the server in their “raw” format, where they are finally synchronized and indexed. Depending on the setting, the server can either process one recording at a time, or can work on multiple files simultaneously. The final piece of the lecture capture system is storage space where all the

recordings will be housed. Institutions will have to decide the type of storage space they need to allocate on the server based on the demand from the courses and instructors.

Table #1: Lecture Capture Software Comparison Chart [7-10]

Category	Tegrity	Echo360	Mediasite	Panopto
What is captured	Captures video, audio, screen activity.	Captures video, audio, screen activity.	Captures video, audio, screen activity. Capture from a Tablet PC, Document Camera or Electronic Whiteboard. Records Full Motion Video	Captures video, audio, screen activity. Ability to record audio/video, PowerPoint/Keynote from a Mac.
System-type	Web-based (no software or hardware required)	Appliance-based for full video capture; Podium PC requires only software, but captures only screen and audio.	Appliance-Based; one server supports 20 recorders	Software-based
OS Compatibility	Recording: Mac/PC Viewing: Mac/PC	Recording: Mac/PC Viewing: Mac/PC Also supports Linux	Recording: N/A Viewing: Mac/PC	Recording: Mac/PC only on paid version Viewing: Mac/PC
Accessibility	Tegrity does support accessibility, and closed captioning specifically. Although Tegrity does not automatically generate a closed captioned file for lecture recordings, they can be easily imported into and synchronized with Tegrity lecture recordings in standard .txt and .srt formats.	Automatically apply Section 508 compliant closed captions as needed. Integrated closed captioning and screen reader versions of the lectures support students with disabilities.	Automated Closed Captioning (with additional service) Standard Closed Captioning	Generated by a leader in automatic captioning, Automatic Sync Technologies. Requires an AST account (AST will charge for their service independently).
Room hardware required	None required. Works with existing room hardware (cameras, computers, microphones).	Recording appliance for video; otherwise works with existing hardware.	Requires Mediasite EX Server and Mediasite Recorder. Room integration w/ Crestron & AMX	None required, Works with existing room hardware (cameras, computers, microphones).
Campus Administrative Support and Staffing Required	Although installation and scheduling would require staff time, none of the institutions interviewed indicated additional staff members were needed.	Although installation and scheduling would require staff time, none of the institutions interviewed indicated additional staff members were needed.	Although installation and scheduling would require staff time, none of the institutions interviewed indicated additional staff members were needed.	Although installation and scheduling would require staff time, none of the institutions interviewed indicated additional staff members were needed.
System Integrations	LDAP, Active Directory CMS, SIS, Bb Vista	LDAP, Active Directory	LDAP, Active Directory	LDAP, Active Directory
Simultaneous recordings	Dependent upon license and/or configuration.	Dependent upon license and/or configuration.	Dependent upon license and/or configuration.	Dependent upon license and/or configuration.

A listing of the four commonly used lecture capture software packages currently on the market is shown in Table # 1. Most of the systems offer features that are very closely related with the main difference being in pricing that is based on the licensing agreement[7]-[10]. The most important factor that is not listed on the chart, but is always difficult to quantify, is “Ease of Use”. This is very important issue that has been taken into consideration by university administrations, because the choice of the cheapest or most cost-effective feature-rich system will not widely adopted if instructors find it too difficult to use. This was the case in our institution’s final decision to choose the Panopto Focus™ lecture capture system.

Online Video Course Supplement Development

The development and use of online course materials discussed in this paper started about 10 years ago with the addition of web-based course supplements for the regular courses [11] ,[12]. The web-based course supplements consisted of additional course materials such as PowerPoint slides, animations, short video, and other website links that were there to help the regular students understand the course material better. During the past four years, we started evaluating various hardware and software technologies that would make the course experience of online students as close as possible to the F2F students. Although the ultimate goal was to

evaluate software packages that allow online delivery of ECE courses, we were also interested in using the same software/hardware tools to enhance the class experience of our F2F students. We had to carefully evaluate the advantages and disadvantages of synchronous and asynchronous modes of content delivery for our online students. Since our goal was to offer the online ECE courses to students from within the United States or abroad, we decided to use a tool that can offer both synchronous and asynchronous course contents to the online student. We chose the Panopto Focus™ lecture capture software because it was readily available on our campus. It was also evaluated for ease of use and compared to other software packages by various faculty and staff members. The majority of the evaluators found its interface very user-friendly, and unlike other software packages, it was not prone to consistent crashes during recording sessions.

The Electric Circuits and Linear Systems courses are 200 level four credit courses that meet twice a week for four hours. The Electric Circuits course meets in the electronics laboratory, to allow students complete assignments and hands-on projects in groups, under the guidance of the instructor. The Linear Systems and Discrete Systems courses are taught with lectures sessions in the classrooms and simulation assignments using the Matlab™ software. The three courses are offered every semester to online or F2F students with a total enrollment of about 40 students in two sections of each course per semester. The course instructors enhanced the PowerPoint based lesson files by recording lectures for each sub-module using the Panopto Focus™ lecture capture software. Some instructors used the lecture capture software to record “live”, the daily course lectures of their regular ECE courses, while others recorded separate lectures for each PowerPoint lesson file outside of the regular classroom. The online lectures can be watched over the internet using streaming technology, or can be downloaded as podcasts. A screen capture of a digital logic lecture recording is shown in Fig. 1. The different time stamps on the left indicate that the students can access any part of the lecture recording by forwarding and rewinding the lesson. This allows the students to focus on a specific section of the lecture without the need to go through the whole recording.

The “Panopto Focus™ ” software was used to capture and record the daily course lectures of the regular ECE courses. It was initially tested on the students enrolled in the regular ECE courses as a supplementary material that could help them learn and understand the course material better. The students had access to daily course lectures through their Blackboard course management software. Most students downloaded podcast versions of the daily course lectures and watched them as often as they wanted until they understood the topics covered in each lecture. This approach increased the interactions and discussions between the students involved in the course. The online lectures also allowed the students to prepare and ask additional and more advanced questions to the instructor because it allowed them to have a better understanding of the course material since they were no more limited to the information that was only available in their own class notes. The statistics of the usage of the course lectures from the Electric Circuits course that were recorded from the Spring 2010 semester suggest that the students enrolled in the two pilot online summer courses found the Panopto Focus™ lecture recordings very valuable to their success in the courses. Figure 2 shows the view by month, and Figure 3 shows the detailed view statistics for each lesson recorded that was downloaded and viewed by the students. Note that some students are ahead of other students by checking the

unique number of users for each lesson. For example, the lecture recordings for Module 5-part2, and Module 5-part3 have only 2 unique users indicating that 2 students are ahead of the other students.

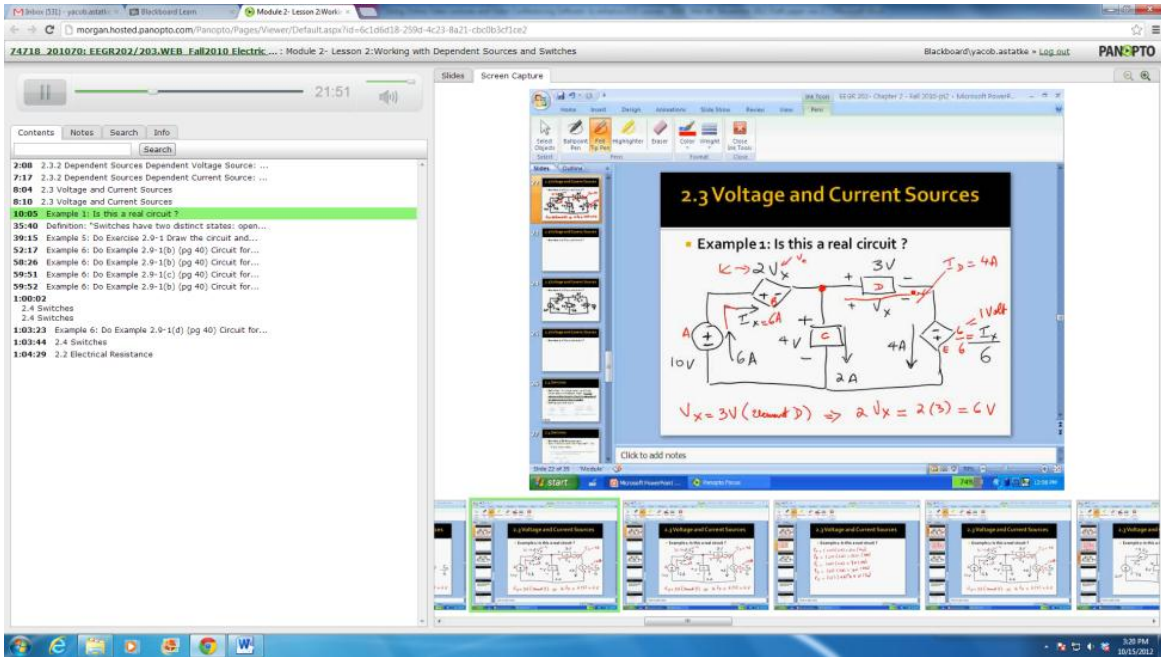


Figure 1 : Panopto Focus™ lecture recording for the Electric Circuits course

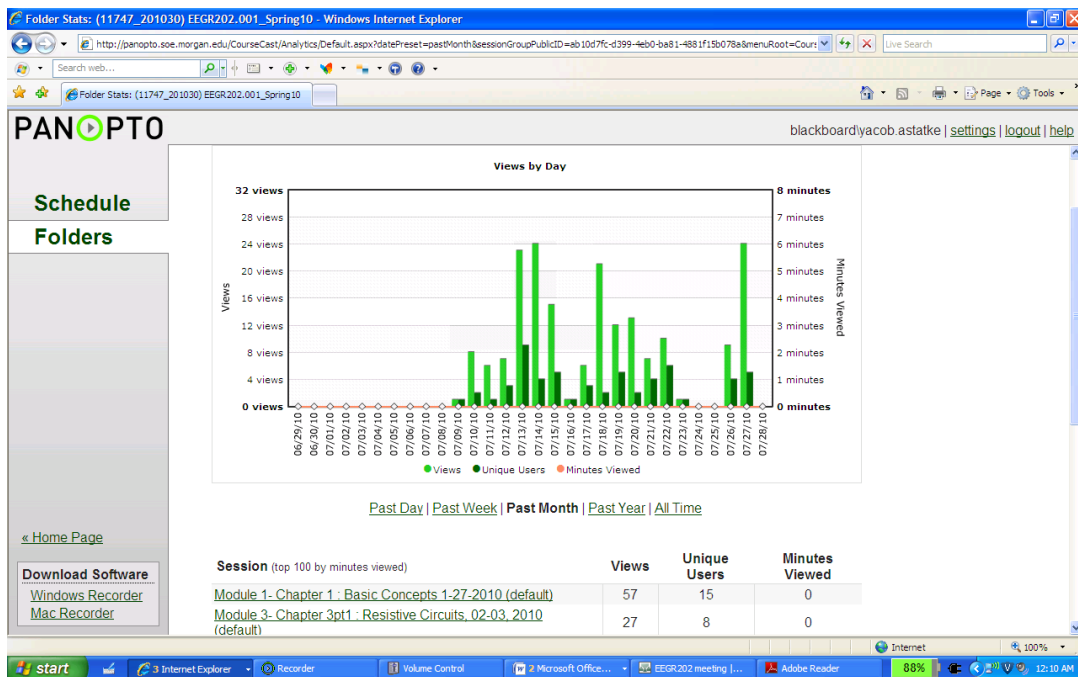


Figure #2: Monthly statistics on the use of the lecture recordings

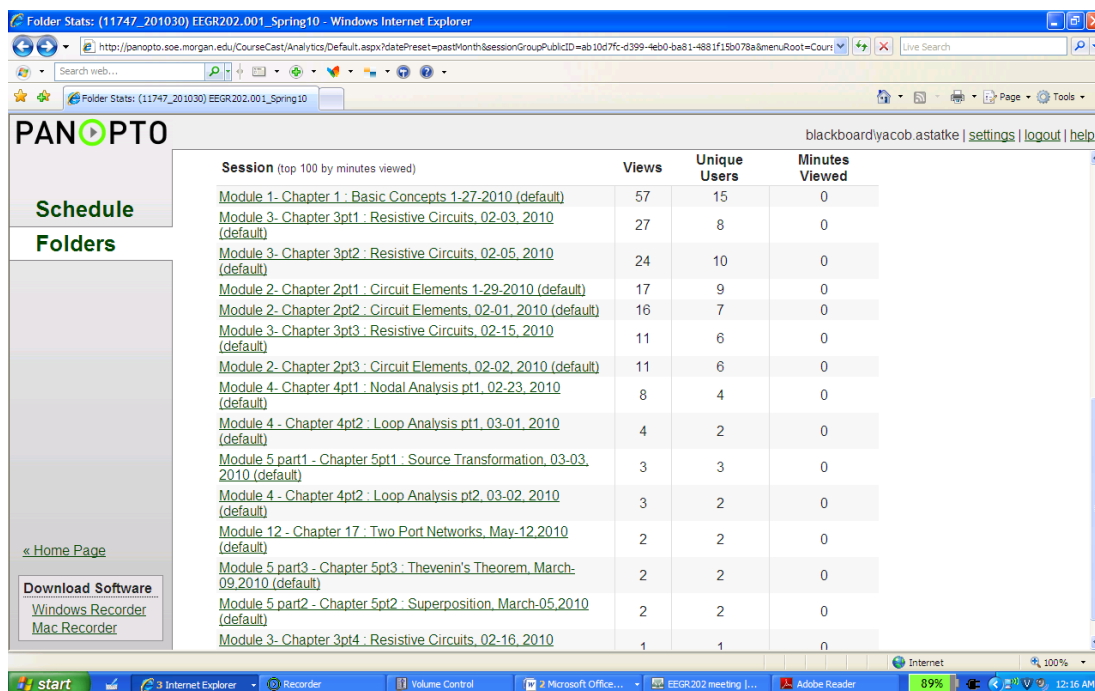


Figure #3: Detailed statistics on the use of the lecture recordings

Course Results

The impact of the online video lectures were evaluated by looking at the results of the students who used them in both online and F2F courses. It should be noted that the students enrolled in the online courses were given the same projects, homework assignments, and tests as the students enrolled in the regular courses. Although the students enrolled in the online course covered the same amount of material as the regular students, they were only given two hand written exams on campus instead of three or four exams that are given to the regular students. They were given the exams on campus because they were all local students. This will not be a requirement for future online students because we plan to form partnerships with test centers or learning centers to allow them to take their exams from other locations.

The ECE courses with online video lecture were offered during the Fall 2010 semester as hybrid courses and the Spring 2011 semester as completely online courses. The results shown in Fig 4 are based on the students who enrolled in the Electric Circuits courses. The data shows the comparison of the results for the 12 students enrolled in the online or hybrid courses during the Fall 2010 and Spring 2011 semesters, versus those enrolled in the F2F courses in the Fall 2010 semester (28 students) and the Spring 2011 semester (33 students). The results indicate that the success of students enrolled in online or hybrid courses depend strongly on the background of the student and their commitment to the course. The students who performed poorly in the online

courses did so because they either fell behind in completing the course work or missed a lot of weeks of course work due to various reasons. The students who performed well in the online courses proved that the courses were well designed and delivered because they were able to perform as well or even better than the students enrolled in the F2F courses. Similar results were obtained in the online and F2F versions of the EEGR 221 and EEGR 322 courses. They are shown in Fig. 5 for EEGR 221 and Fig. 6 for EEGR 322. The results clearly indicate that the use of the lecture video capture technology has allowed the online students to perform as well as the F2F students although they have limited face to face interaction with the instructor and the other students enrolled in the engineering courses.

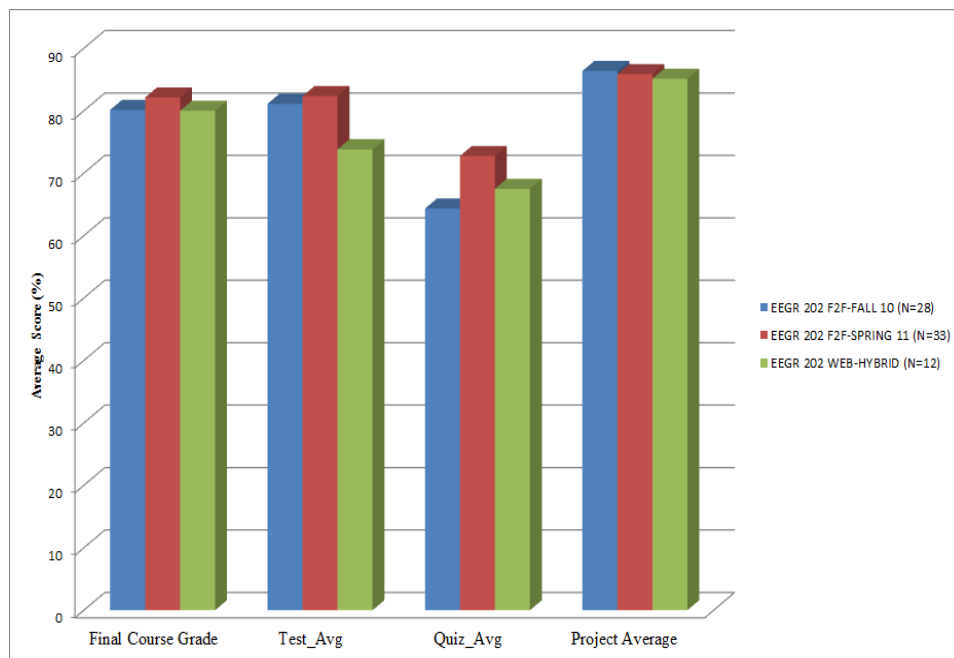


Figure 4: Grade Comparison between F2F and Online students enrolled in EEGR 202 for Fall 2010 and Spring 2011

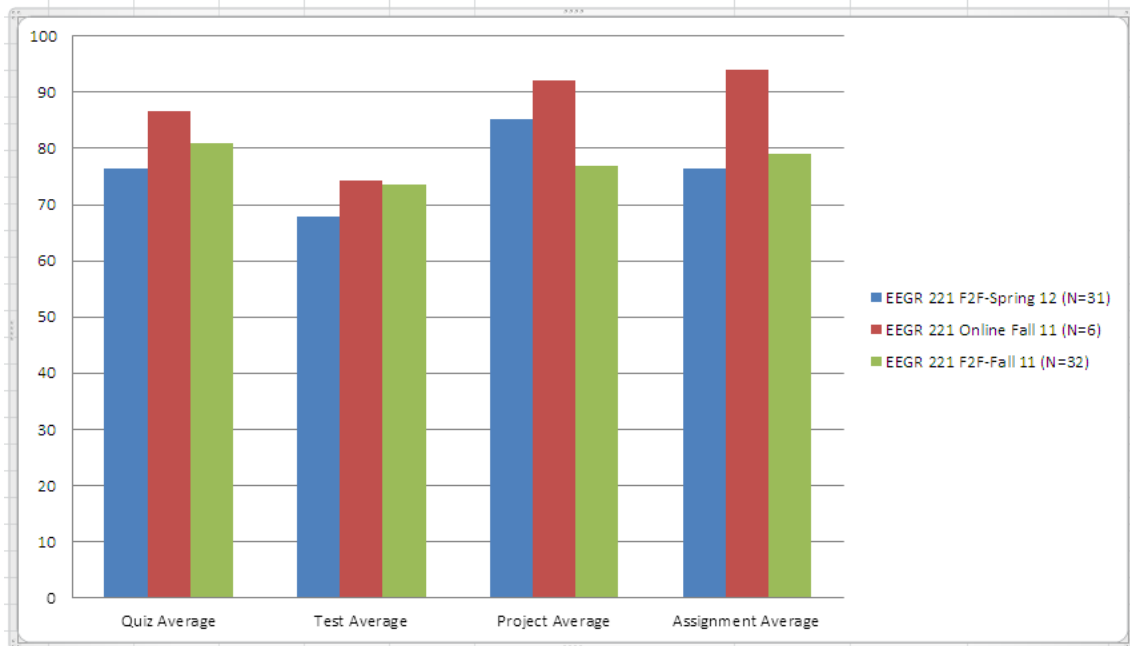


Figure 5: Grade Comparison between F2F and Online students enrolled in EEGR 221 for Fall 2011 and Spring 2012

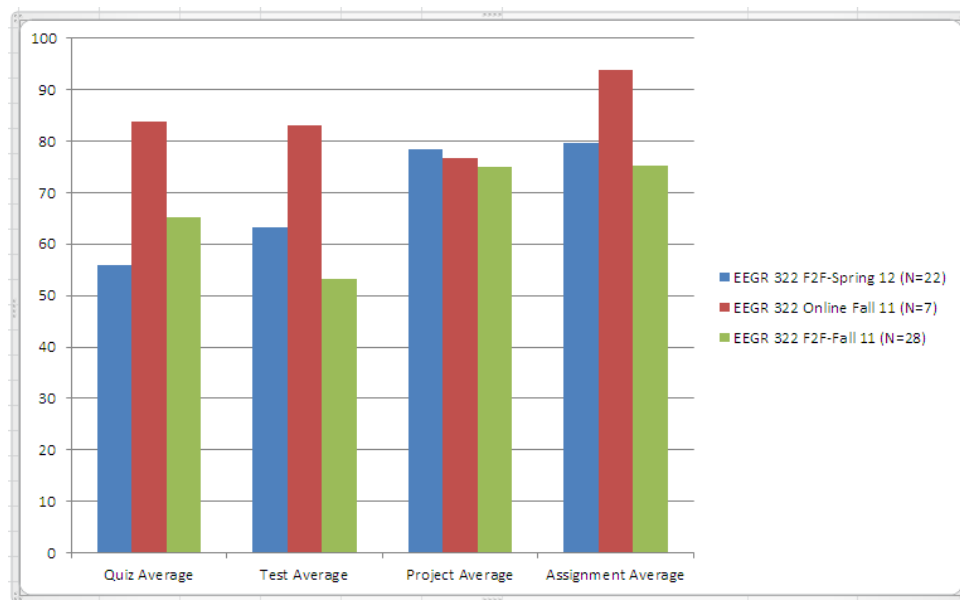


Figure 6: Grade Comparison between F2F and Online students for Fall 2011 and Spring 2012

Conclusion

Experience has shown that the introduction of any new technology in higher education brings with it a host of questions, and lecture capture is no exception. Two of the most prominent questions currently raised by proponents of lecture capture are: “Will students stop coming to class if the material is available online?”, and “Who owns the intellectual property rights to the recorded material?” Although there are no definitive answers to any of those questions, there is enough evidence [5],[6],[7] to suggest that lecture capture can have broad positive impacts on all types of students. We have shown in this paper that we have successfully implemented the lecture capture software in three engineering courses that have been offered as a face to face and online courses. The results have encouraged us to expand the implementation of the Panopto Focus lecture capture software package in additional ECE courses.

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