



## **Attendance in Large Engineering Classes and Its Effect on Student Performance**

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## Abstract

In large engineering classes one of the more practical methods of delivering the material to students is through the use of a traditional lecture style class. However, in such a setting, keeping a large class engaged in the material can present quite a challenge. This challenge can be partly met through the use of technology, student response devices, and/or carefully crafted lectures. Even so, some students will remain unengaged due to other factors like physical/mental exhaustion or the many distractions a large room full of over 300 students can present. This becomes an even larger challenge in the case of a first-year introductory engineering course due to the varied backgrounds of the students; some of whom have completed high-school engineering programs and might have experienced similar subject matter previously.

This paper presents the culmination of a two-year study of an alternative for freshman engineering students to attending a large lecture in their introductory engineering course<sup>1</sup>. During the course of this study, in the fall semester, students were required to be physically present in lecture. Following this, in the spring semester, students were given the choice of either: (1) being physically present, when the lecture was given, or (2) viewing the recorded lecture. The student's in-class attendance was recorded via the *iClicker*<sup>TM</sup> classroom response system. Students who chose to not attend lecture could access the video recording via the *Blackboard*<sup>TM</sup> course management system during the same week the lecture was given. This paper consists of several parts. First a description of the freshman engineering program, as well as the methods used to track student progress is provided. Then, a comparison of student performance on exams, administered during each semester is presented. Finally, this paper includes a discussion of the effect that lecture attendance has on student learning. It is concluded that providing students with the option of either attending lecture or viewing a video recording of the lecture does not negatively affect student performance. In fact this option may even improve the performance of some students.

## Introduction

Student learning and engagement in large engineering classes is highly dependent on individual learning styles<sup>2</sup>. The traditional lecture format in which instructors transmit information to receptive students is not effective for all students. A dynamic and energetic lecturer, who utilizes the latest technology (clickers, screencasts, smartphones, tablet PCs, etc.) and crafts a thoughtful presentation, can significantly improve student learning and engagement. Even so some students will still remain unengaged, whether due to lack of sleep or the distractions inherent in a large lecture hall. In an attempt to keep the students current on the information covered in class, attendance is required in many lecture classes. For many first-year courses, this provides additional structure that aids the students in their transition from high school to college.

It is thought that if students are given the option of not attending class, then some might misuse that freedom and fall behind in their studies. The consequences of not attending lectures have been extensively studied<sup>3-6</sup>. One concern is that some students may wait until the last

minute before studying the material and in doing so will not gain the same level of long-term memory retention as repeated exposure to the material would have provided.

This study documents an alternative for freshmen engineering students to attending a large lecture. In the Watson School of Engineering and Applied Science at Binghamton University the first-year engineering program is comprised of two linked courses each semester: Exploring Engineering and Engineering Communications. Exploring Engineering I & II, each have two components: (1) a one-hour lecture section that meets twice a week, and (2) a one and one-half hour laboratory section that meets once a week. The lecture section is one for which all the students are registered while the laboratory component is split into classes of twenty-five students or fewer. In Exploring Engineering I, the fall semester iteration of this course, attendance is mandatory. However, in Exploring Engineering II students have been given the option of viewing the recorded lecture, rather than being physically present when the lecture is given. Attendance is taken in the lecture with an *iClicker*<sup>TM</sup>. Students, who choose not to attend the lecture, access the recording on *Blackboard*<sup>TM</sup>. Student access to the recording is tracked and serves as ‘attendance’ at the lecture. Lecture notes are available to both student groups on *Blackboard*<sup>TM</sup>.

Others have performed studies that touch on aspects similar to this one. Pinder-Grover<sup>7</sup> has investigated the use of Screencasts to supplement lectures, but without the option to attend lecture. Ho<sup>8</sup> has given students the option of completing web based training (WBT) or attending traditional lectures. It has been reported that the students who attended class had higher grades on assignments and the exam, but numerical results were not presented. Grabe<sup>9</sup> has given students the option of using lecture notes rather than attending the lectures and reported no significant difference in performance.

The current study compares the performance of students who attend the lectures with students who choose not to attend, but view the recorded lectures instead. Performance on midterm and final exams are compared over a two year period. Of interest here, is whether student performance varies, when accommodations of this type are made for differences in student learning styles.

#### Course Attendance

*ECHO360*<sup>TM</sup> is the lecture capture system used at Binghamton University. A link for each lecture recording is put on *Blackboard*<sup>TM</sup> shortly after a lecture is given. Students are given until midnight Sunday of the week the lecture is given to view the recording. The recording is only available and viewable during the week of the lecture, so that students are not enabled to procrastinate until just before an exam. However, the other lecture material, such as *PowerPoint*<sup>TM</sup> presentations and other printable material, is made available until the end of the course. *Blackboard*<sup>TM</sup> uses a *tracking* tool to record the number of times a folder, document, or other object is opened. A course instructor can run a report that provides statistics for the number of times a student in the course opens an object. This tracking tool can be used to record ‘attendance’ in viewing a lecture recording that has been posted in *Blackboard*<sup>TM</sup>.

In the first year of the study, ‘attendance’ for viewing the lecture recording was to be tracked. In the fall semester of the course, attendance is part of the final grade. It is believed that

freshman students need to be encouraged to attend class to aid in their transition from high school to college. It was intended to continue this policy in the spring semester, while giving students the option of either attending the lecture when it is given or viewing the recording. It was discovered several weeks into the spring semester that the *Blackboard*<sup>TM</sup> tracking tool was not consistently recording when students opened the recording for viewing. After contacting Blackboard, Inc. it was confirmed that there was a problem with the tracking tool, which would not be fixed until the next release of *Blackboard*<sup>TM</sup><sup>10</sup>. Consequently, it was decided that attendance would only be taken in class with the *iClicker*<sup>TM</sup> and student attendance would not be considered for grading purposes in the spring semester. By the second year of the study the *Blackboard*<sup>TM</sup> tracking tool had been fixed and attendance was tracked successfully. As an added incentive to keeping up with the lectures, each lecture was followed with a short on-line quiz that was made available immediately after the video was posted. Both the video and on-line quiz were available only until the end of the week that the lecture was given. All students were required to take the on-line quiz, whether they physically attended lecture or watched the video.

## Results

Student grades on midterm and final exams are shown in Fig. 1 – 4. In each of the four figures the horizontal axis represents the number of lectures students physically attended in the spring. It should be noted that attendance was not taken at every spring lecture for several reasons, such as malfunctioning equipment, cancelled classes, or special events. Physical attendance was also required for some spring lectures of all students. These lectures are not included in the data. It is important to understand that the same students who attended a given

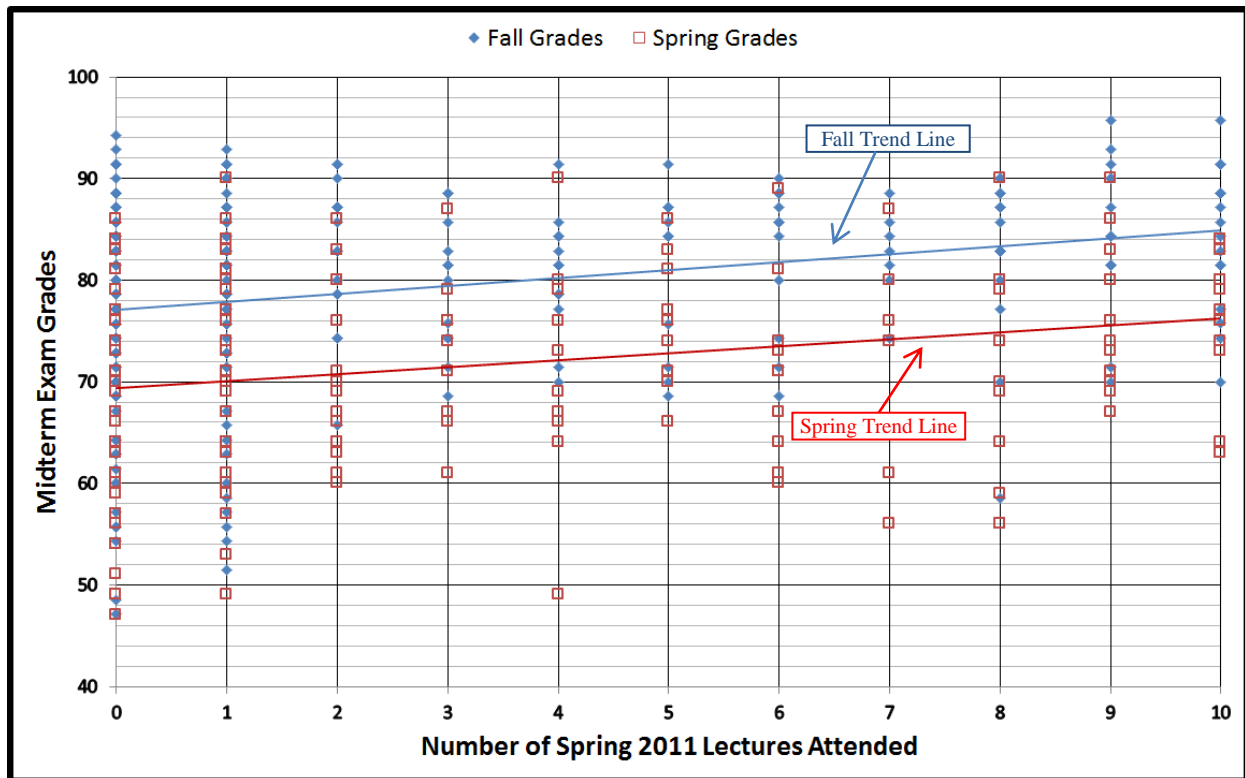
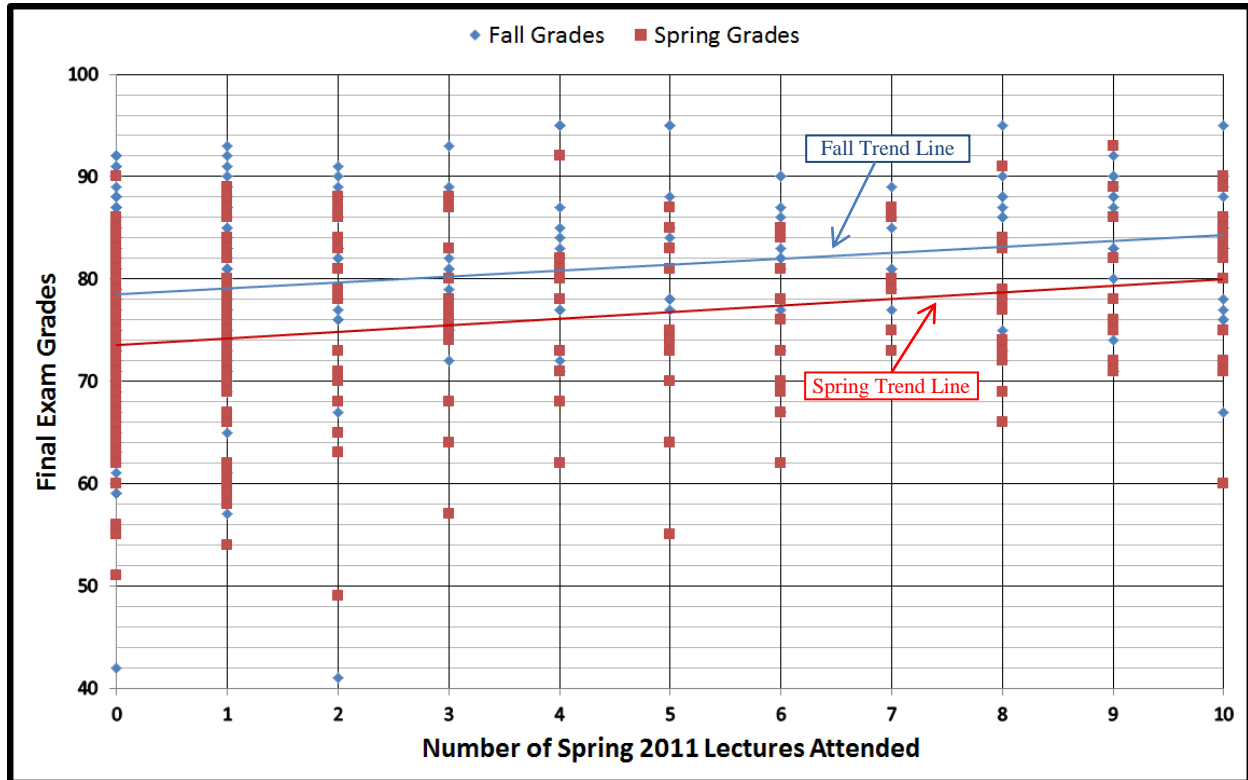


FIGURE 1 - 2010/2011 MIDTERM EXAM GRADES



**FIGURE 2 - 2010/2011 FINAL EXAM GRADES**

number of lectures in the spring are compared to the same students in the fall. For example, in the spring of 2011 sixteen (16) students physically attended eight (8) lectures. The fall midterm grades of those same students are compared to the spring midterm grades in Fig. 1. Likewise, in the spring of 2012 eleven (11) students physically attended nineteen (19) lectures. The fall final exam grades of those same students are compared to the spring final exam grades in Fig. 4. It should be recalled that physical attendance was required of all students in each of the fall 2010 and 2011 semesters.

Fig. 1 shows a comparison between the fall 2010 semester and spring 2011 semester midterm exam grades. Each exam consisted of 70 multiple choice and true/false questions. The spring 2011 results in isolation appear to suggest that students who did not choose to attend lecture, did more poorly on the exam, even though they had the option of viewing the recording. However, when the fall 2010 grades for the same student groups are compared to the spring 2011 grades the same trend emerges. In other words the same students, who chose not to attend lecture in the spring, tended to receive lower scores in the fall too, even though they were present when the lecture was given. The same students, who chose to attend all lectures in the spring, tended to receive higher scores in the fall as well. The spring midterm grades overall are generally lower than the fall midterm grades, presumably because the spring exam was more difficult.

Fig.2 shows a comparison of the fall 2010 semester and spring 2011 semester final exam grades. These exams had 100 multiple choice and true/false questions. The same trends emerge as with the midterm grades.

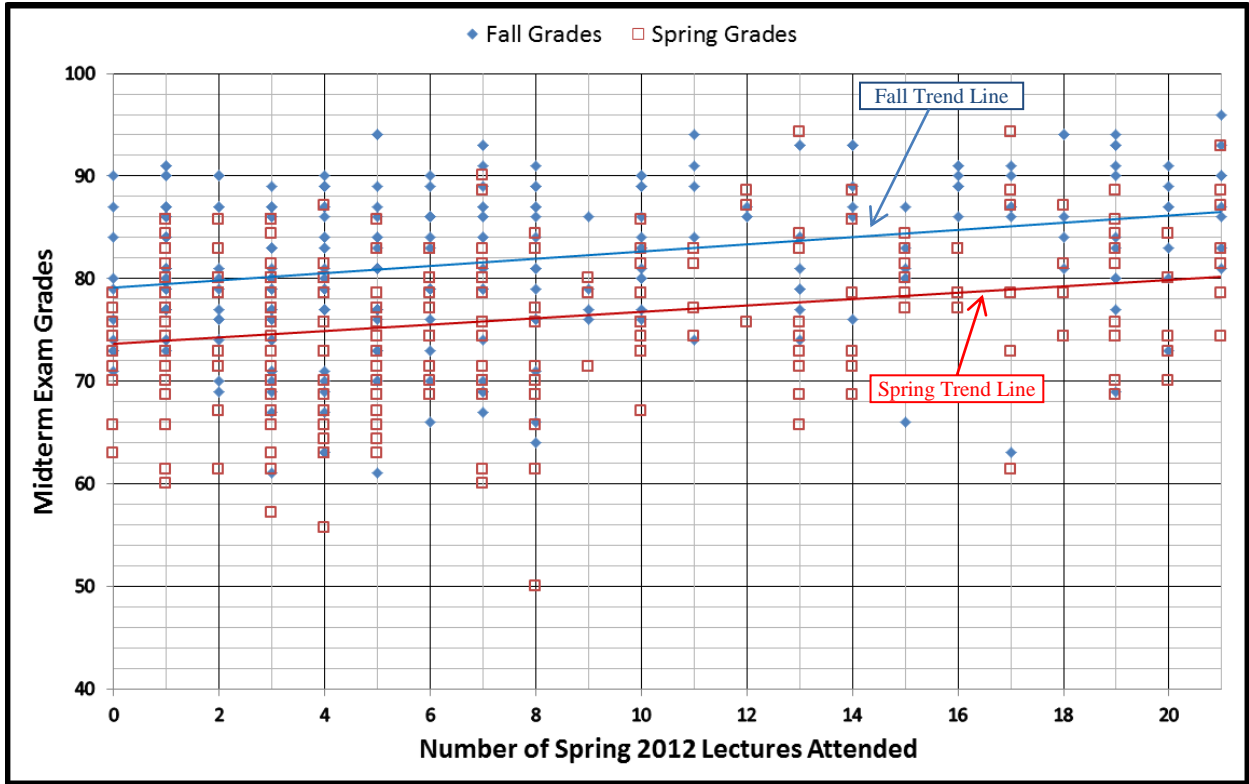


FIGURE 3 - 2011/2012 MIDTERM EXAM GRADES

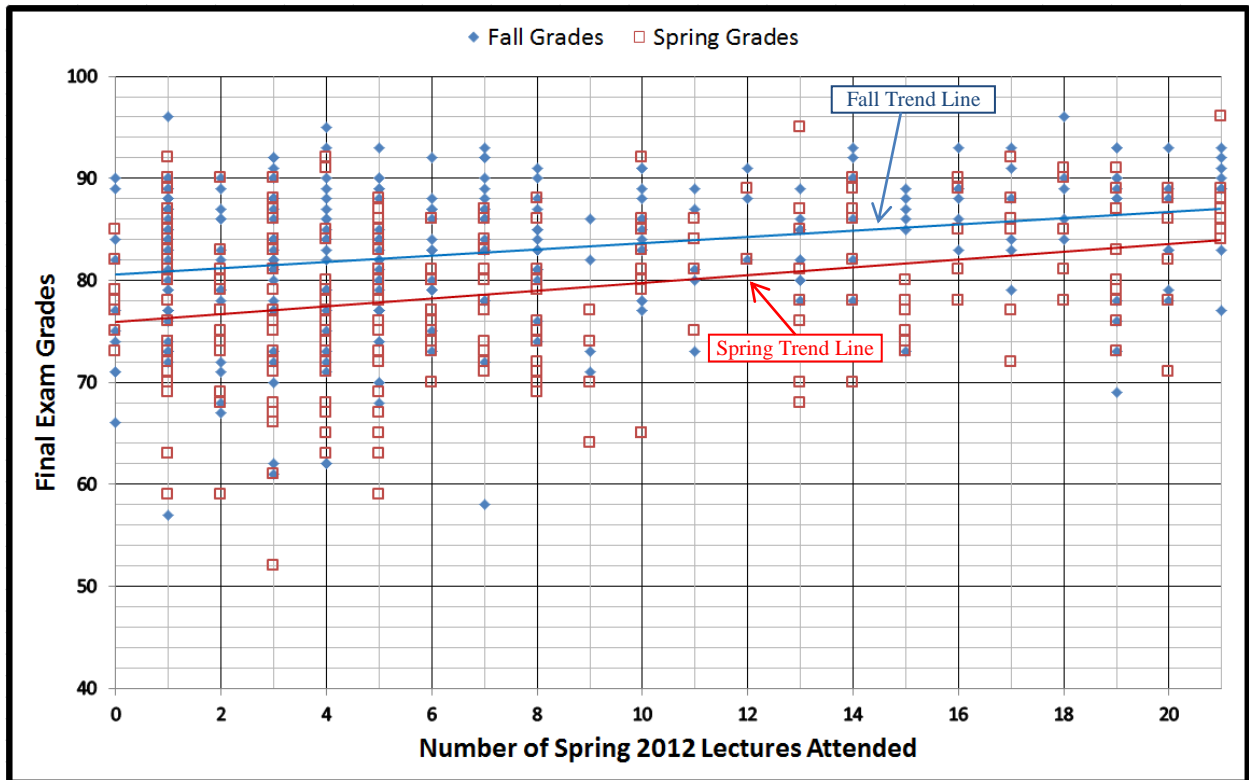


FIGURE 4 - 2011/2012 FINAL EXAM GRADES

In Fig. 5 and Fig. 6 the spring 2012 grades have been normalized to the fall 2011 grades. The mean of all the spring midterm grades has been added to each of the fall midterm grades and similarly for the final exam grades. An interesting trend is observed. The mean grades of students who chose to attend fewer lectures in the spring actually increase relative to the students who chose to attend more lectures. This is seen for both the midterm and final exams.

Table 1 shows detailed numerical results for the 2011/2012 academic year. Table 2 gives correlation results. The top number is the Pearson correlation and the bottom number is the p-value. There is seen to be strong correlation between fall and spring midterm exam means, where the means are the means of grades within each lecture attendance group (0 – 21). The same holds true for the final exams. In each case the results are statistically significant. The difference in correlation between fall and spring midterm exam standard deviations is also strong, but this is not true for the final exam standard deviations. The latter result is not explained.

Finally, it is worth noting that students, who choose to attend the lectures, report that they like the smaller class, whereas students whose choose to only view the recording like the flexibility it affords them with their schedules. Students generally, but not always, chose the same option each week.

| Lectures Attended | Number Students | 2011/2012 Midterm Exam Grades |       |        |       | 2011/2012 Final Exam Grades |       |        |       |
|-------------------|-----------------|-------------------------------|-------|--------|-------|-----------------------------|-------|--------|-------|
|                   |                 | Fall                          |       | Spring |       | Fall                        |       | Spring |       |
|                   |                 | Mean                          | StDev | Mean   | StDev | Mean                        | StDev | Mean   | StDev |
| 0                 | 10              | 78.7                          | 6.5   | 72.3   | 5.0   | 77.9                        | 8.1   | 78.3   | 3.4   |
| 1                 | 36              | 82.3                          | 4.9   | 76.4   | 6.3   | 82.8                        | 7.2   | 78.8   | 8.8   |
| 2                 | 14              | 79.4                          | 6.9   | 75.8   | 6.6   | 79.8                        | 7.7   | 75.9   | 7.4   |
| 3                 | 30              | 78.5                          | 6.7   | 74.7   | 7.6   | 81.4                        | 7.9   | 76.4   | 8.7   |
| 4                 | 24              | 79.3                          | 8.3   | 73.4   | 7.7   | 81.0                        | 8.6   | 75.8   | 7.3   |
| 5                 | 25              | 79.8                          | 7.4   | 73.0   | 5.5   | 81.2                        | 6.8   | 76.9   | 7.6   |
| 6                 | 16              | 80.7                          | 6.9   | 76.1   | 4.9   | 82.3                        | 5.0   | 77.6   | 4.4   |
| 7                 | 18              | 81.6                          | 8.6   | 76.0   | 8.1   | 84.0                        | 8.4   | 79.5   | 5.1   |
| 8                 | 15              | 80.5                          | 8.4   | 71.6   | 9.0   | 83.4                        | 4.7   | 76.7   | 5.5   |
| 9                 | 4               | 79.5                          | 4.5   | 75.4   | 4.6   | 78.0                        | 7.2   | 71.3   | 5.6   |
| 10                | 13              | 83.7                          | 4.8   | 76.5   | 4.9   | 84.5                        | 4.7   | 79.3   | 8.8   |
| 11                | 5               | 86.4                          | 7.8   | 79.7   | 3.9   | 82.0                        | 6.3   | 82.0   | 4.3   |
| 12                | 3               | 86.3                          | 0.6   | 83.8   | 7.1   | 87.0                        | 4.6   | 84.3   | 4.0   |
| 13                | 9               | 82.7                          | 6.7   | 76.7   | 9.0   | 83.0                        | 3.5   | 80.8   | 8.7   |
| 14                | 7               | 88.1                          | 6.1   | 78.8   | 8.0   | 87.3                        | 5.6   | 83.1   | 7.1   |
| 15                | 6               | 79.5                          | 7.1   | 80.7   | 2.7   | 84.7                        | 5.9   | 76.2   | 2.6   |
| 16                | 6               | 89.3                          | 1.9   | 80.5   | 2.7   | 88.0                        | 3.4   | 83.5   | 5.3   |
| 17                | 6               | 84.0                          | 10.5  | 80.5   | 12.1  | 86.3                        | 5.3   | 83.3   | 7.4   |
| 18                | 5               | 87.8                          | 5.9   | 79.1   | 5.4   | 89.0                        | 4.6   | 85.0   | 5.6   |
| 19                | 11              | 84.9                          | 8.0   | 78.2   | 6.7   | 84.3                        | 8.6   | 82.7   | 5.9   |

**Table 1 - Detailed Numerical Results for 2011/2012 Academic Year**

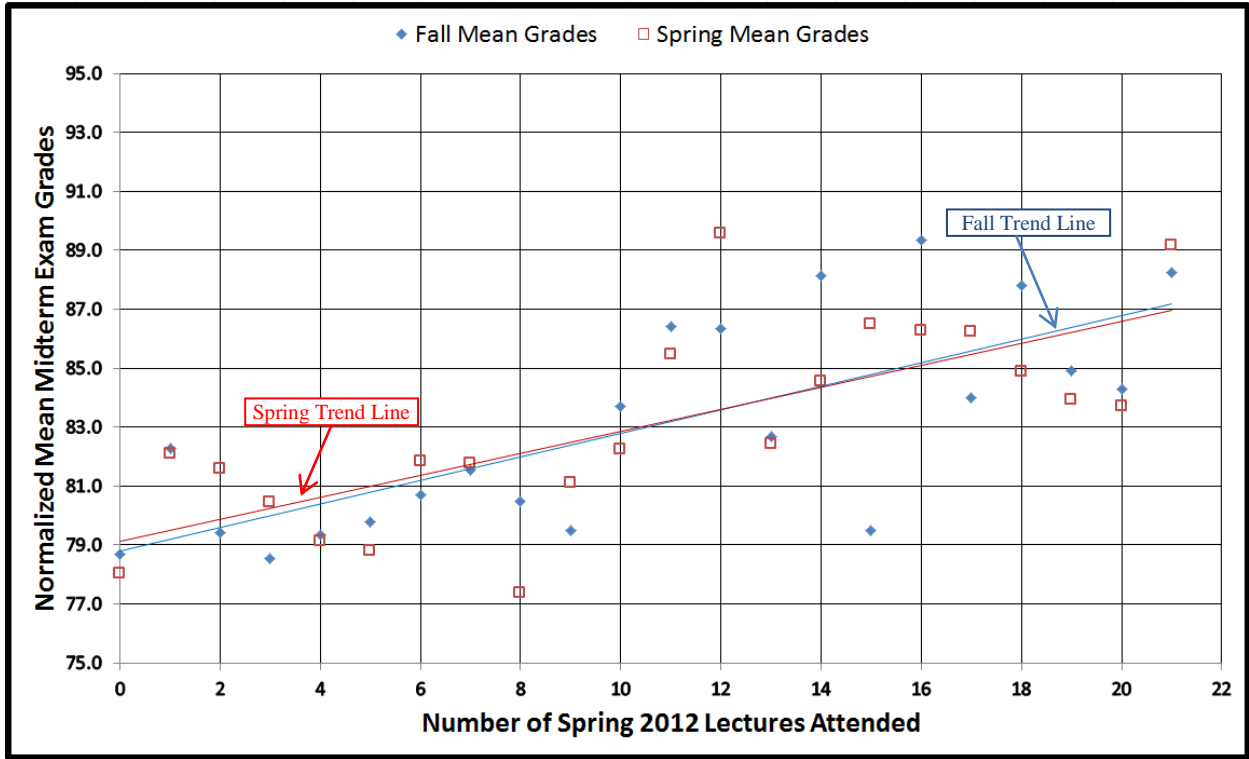


FIGURE 5 - 2011/2012 NORMALIZED MEAN MIDTERM EXAM GRADES

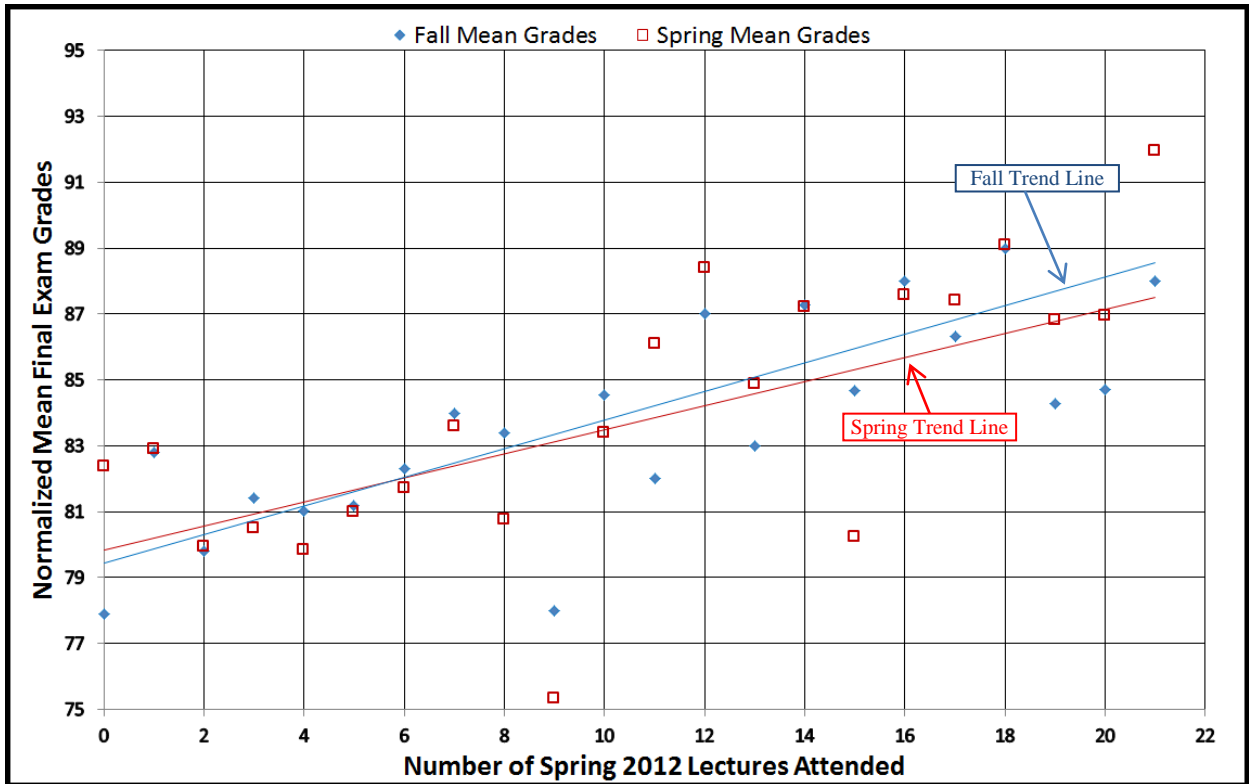


FIGURE 6 - 2011/2012 NORMALIZED MEAN FINAL EXAM GRADES



|                                      |                        | Fall<br>Midterm<br>Exam<br>Mean | Fall<br>Midterm<br>Exam<br>StDev | Fall<br>Final<br>Exam<br>Mean | Fall<br>Final<br>Exam<br>StDev |
|--------------------------------------|------------------------|---------------------------------|----------------------------------|-------------------------------|--------------------------------|
| <b>Spring Midterm<br/>Exam Mean</b>  | Pearson<br>correlation | 0.751                           |                                  |                               |                                |
|                                      | p-value                | 0.000                           |                                  |                               |                                |
| <b>Spring Midterm<br/>Exam StDev</b> | Pearson<br>correlation |                                 | 0.473                            |                               |                                |
|                                      | p-value                |                                 | 0.026                            |                               |                                |
| <b>Spring Final<br/>Exam Mean</b>    | Pearson<br>correlation |                                 |                                  | 0.824                         |                                |
|                                      | p-value                |                                 |                                  | 0.000                         |                                |
| <b>Spring Final<br/>Exam StDev</b>   | Pearson<br>correlation |                                 |                                  |                               | 0.051                          |
|                                      | p-value                |                                 |                                  |                               | 0.823                          |

**Table 2 – Selected Statistical Results**

## Conclusions

It is the conclusion of this study that attendance at the time the spring 2011 and spring 2012 Exploring Engineering II lectures were given did not significantly affect student performance as measured on both midterm or final exams. A comparison of grades on the fall 2010 and fall 2011 Exploring Engineering I lectures with respective grades on the spring 2011 and spring 2012 midterm and final exams suggests factors other than physical attendance affected student performance. It is suggested that student learning was more likely affected by study habits, unrelated to physical lecture attendance. In fact, the data suggest that student learning for students who choose to attend fewer lectures was slightly improved. It is hypothesized by the authors that the option of viewing the lecture video recordings might have enabled some students to learn more effectively.

The results of this study should give some assurance to instructors who choose to allow students to participate in massive open online courses (MOOC) perhaps as an independent study to supplement their regular, more traditional courses. Or instructors who teach flipped courses in which students study video material before class and then engage in discussion or problem solving within the classroom. Of course, strictly online instruction may never be a substitute for the interaction between instructors and students that occurs in a classroom, but there is arguably a place for online instruction in higher education.

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