

# **Comparison of Student Performance in an Online with traditional Based Entry Level Engineering Course**

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## **Abstract**

The purpose of this study is to compare course performance over time between online and traditional classroom students enrolled in an entry level engineering course. The Introduction to Engineering Course is a three semester-hour course. It provides an introduction to the engineering profession, to engineering problem solving, to concepts of design process, to group work, and to oral and written communications.

The student performance, student satisfaction, and instructor experiences were compared in the two class formats. In addition, the study documented the benefits and limitations of the two delivery alternatives. The students' perception of the instructor and the course with respect to content and delivery were evaluated. The students' comparative perceptions of their experiences within the online course versus a traditional course were also analyzed in the survey. Student suggestions for improvement of the course were also collected

The results show that students appreciated the fact that online courses provide them with convenience and flexibility, self-paced learning, and the opportunity to earn credit while not on campus. The students found the greatest drawback of online courses to be the ease with which one can fall behind, with a distant second being slow internet connections that affected ease of course material access, followed by the lack of student-teacher interaction. The students did not consider the online course to be easier than the traditional course, nor did they find the intellectual challenge to be less than in a traditional course.

## **Introduction**

Online-based course delivery has become an attractive option for expanding its reach to new students and to facilitate the scheduling of existing students. During the last three years, the students at the University of New Haven (UNH) had the opportunity to enroll in such a course. The initial preparation for the online class was time consuming because of the amount of materials made available to the students. It has also been found from experience that it takes much more time to teach and administer online courses. Other online course developers agree that teaching and maintaining an online course takes a considerable amount of time [4]. However, the time is well spent since the material developed in the online courses can

also be used in the regular classroom. Student satisfaction is about the same in the traditional course and the online courses.

Furthermore, the composition of the student population at UNH is more representative of those who might be interested in enrolling in online-based classes. Many of the students in UNH work full or part-time and attend classes at night. Intuitively, it would seem that online delivered classes would be very attractive to this demographic group. Thus, this study may be particularly useful for other institutions in similar situations.

EAS 107, *Introduction to Engineering for non-engineers*, is a three semester-hour course. It provides an introduction to the engineering profession, to engineering problem solving, to design and to various software applications that are used throughout the engineering curriculum, including Excel and PowerPoint. Approximately 100 undergraduate students annually take the course in sections containing approximately 25 students. There is a relatively even mixture of sophomore, junior and senior students that enroll in the class. The pre-requisite is college algebra.

The motivation for teaching Introduction to Engineering in an online format arose from three considerations. First, the UNH Co-op program accommodates many students on co-op assignments across the New England area. Many of these students desire to take required courses while away on their co-op assignments. Second, the online course affords convenience for student with unusual schedules and for students who do not live close to campus. It provides these students with the opportunity to earn course credits without leaving their communities. Third, offering the course in a distance-based format provides local full-time and non-traditional students with an opportunity to enroll and participate in courses with added time flexibility.

The course is managed using Blackboard software. All course information, assignments, lectures, quizzes, emails, submission of materials, group discussions, etc., are conducted through this one site. Blackboard is a software application that resides on a university server and is accessed on the computer through use of a web browser such as Internet Explorer or Netscape Navigator.

Students normally contact the instructor using email. The instructor checks his email regularly and tries to answer questions as quickly as possible. A "Discussion Board" is available in Blackboard for group discussions. The instructor posts a discussion topic each week and each student is required to participate in the discussion at least once per week. These responses are posted in Blackboard and can be seen by the entire class at any time. The quality of participation, questions, comments, and discussion are graded.

The purpose of this study is to compare the effectiveness of the two online and traditional class formats, as well as to learn from the experience.

### **Course Format Description**

The course offered is an undergraduate introductory course in Engineering. It is a fundamental course, and was selected for this reason. The same instructor taught the two sections. Both sections covered substantially the same material, and completed similar assignments.

Lecture notes are provided, assignments are given and collected, and quizzes are conducted all on a regular schedule via Blackboard. The conditions for taking quizzes were quite distinct for the two course formats. The tests were administered in class for online students and the traditional format section. Quizzes had a time limit that was designed to be sufficiently restrictive to prevent the students' answering

questions by spending a lot of time looking up the material in the text. Students were only allowed one attempt for a quiz and had to complete it within the specified time limit.

The course formats were as follows:

- Online based section (online class): This section was offered almost exclusively on the web. The online class required students to attend four face-to-face meetings during which main topics of the course were discussed and exams of the course were administered, and projects were presented. Course materials in the form of lecture notes, text-based supplementary materials, discussion groups, and testing were offered through the Internet. The course used Blackboard as the course delivery platform. Test questions were drawn from the same test bank used for the traditional section.
- Traditional section: A separate section of this course was offered using a mix of traditional and online based delivery means. The class met regularly for lectures, assignments, and tests, while Blackboard was used to deliver course materials as well as conduct discussions and exams. Testing was accomplished via multiple-choice exams using questions selected by the instructor, and administered in class. The exams and assignments in this section were duplicates of those used for the online-based section. Students receive face-to-face interaction with the instructor and students while at the same time being exposed to online-based learning paradigms such as virtual real-time information, pictures, streaming video and audio clips. Traditional approaches also extend to providing students with both "real" office hours and "virtual" office hours, working in both face-to-face teams and virtual teams.

### **Materials Available to Students**

Available to online and traditional students were the syllabus, Power Point slides, class notes (lecture outlines), textbook publication website, and Internet resources. The online class was identical to the traditional class except for the addition of discussion board assignments for the online students.

### **Requirements**

Two tests were scheduled for the class along with homework assignments, small projects and a final design project. As part of their course grade, the online students only were required to post relevant materials on the bulletin board weekly. The tests and other work were almost identical in both sessions taught by the same instructor with minor variations in the exams. The online students were required to come to take the tests on campus.

### **Methodology**

The sample consisted of 121 students enrolled in the traditional and online sections over the last three years. The number of students enrolled was 63 in the traditional course section, and 58 in the online based course section. Most of the students were juniors. The same instructor taught the two course sections studied, used the same text, similar assignments, and test questions. These common aspects allow for direct comparison.

The students were asked to complete a survey designed to assess their satisfaction with the online and the traditional modes of course delivery. The student assessments evaluated the students' perception of the instructor and the course with respect to content and delivery. The assessment also evaluated the

students' comparative perceptions of their experiences within the online course versus a traditional course. Student suggestions for improvement of the course were also collected. The response rate was 86%. Analysis was performed on the questions to test for differences between the online course and the traditional course.

## Results and Analysis

### Student Performance

Class performance was evaluated by comparing course work scores between the two classes using duplicate assignments, and as an aggregate using overall work averages. The goal was to determine if there were significant differences in student performance between classes.

Type of class		HW (10 points possible)	Quizzes (30 points possible)	Projects (25 points possible)	Final report (25 points possible)	Overall Scores (100 points possible)
Traditional classroom course	Mean	87.7	79.23	81.14	89.8	80
	N	63	63	63	63	53
	Std. Dev	8.9	9.4	9.7	2.3	11
Online course Quizzes (30%)	Mean	89.16	75.99	89	84.5	71
	N	58	58	58	58	58
	Std. Dev	10.56	9.3	13.9	6.8	21.7

**Table 1: Assessment Method Means**

Table 1 shows means, standard deviations, and cell sizes for the student scores on the common homework, quizzes, projects, and final reports for both the traditional classroom and the online courses. The much larger standard deviations shown for all the assessment tools for the traditional classroom are likely due to the very low scores received by some students.

The findings were initially surprising; it was expected that students in the traditional classroom course would perform better on the projects than students in the online course. One possible explanation for the higher performance of the online class is that these students were more experienced in hands-on activities and design process. Another possible explanation is that students in the online class were, on average, better students academically.

A direct comparison of exam scores for three exams administered in the traditional and an online based class was undertaken. As is evident from examining Table 1, there is little difference between average exam scores. The analysis indicates that there is no significant difference between the exam scores. Although exam results are but one out of several criteria normally used in evaluating student performance, in this situation they serve as a readily available measure.

Results from the teaching evaluation survey were also illuminating. It is evident that vast majority of students were satisfied with the online based course offering. There are a number of factors that may have contributed to this perception. From a student perspective, though, two factors come to mind. It is quite likely that the majority of students were self-motivated and self disciplined to find online based courses satisfactory. The second factor is the online students are better academically. The GPA for the online students was 3.4 compare to 2.90 for the traditional student.

Students were asked if they would recommend this course to others. Most students would be willing to recommend this course. There is however, a substantial degree of satisfaction among those students enrolled in the online based class as well as the traditional class. The results show that 82% of the online students reported that they would recommend this internet delivered course if offered to other students while 96% of the traditional students would recommend it to other students.

### **Responses of Traditional Class**

If someone were to ask you if they should take this course, what would you say?

1. I would highly recommend this course because it covers a wide range of topics.
2. It is a very helpful course.
3. Yes, it will help you as an individual, especially verbal and written communication.
4. I would say yes. I have definitely learned a lot and I very much enjoyed the class. It was interesting and informative. And the professor wasn't half bad!
5. I would tell them to definitely take this course with this instructor. I have outlined several things here that I think could use some improvement. But, I would like to say that I thought this was a fantastic course overall. I felt extremely challenged, and also that the instructor sincerely cared about teaching this material. I also enjoyed the discussions and sense of humor of the instructor. Although I felt it was challenging to do well in this class (which is how I think college classes should be) I had a lot of fun and looked forward to coming to school.
6. I would yea, if you want a good grade with some effort.
7. I would tell them it is an interesting course and you will learn a lot.
8. Only if you are willing to do a lot of work for a medium grade.
9. I've already been asked this questions numerous times... My advice is to be prepared to assume worthwhile tasks.... and take no one else besides Professor Orabi.
10. I would and already have said "take this course, you will like it". I enjoyed this class and I liked Prof. Orabi.

### **Responses of the Online-based Class (Online section):**

If someone were to ask you if they should take this course, what would you say?

1. Yes, but it is a lot of work at least the on-line version. It takes up a lot more time than just sitting in a classroom. You need to be able to discipline yourself to do the work.
2. I would recommend them doing so, there is learning in all that we do.
3. Be prepared.
4. Absolutely you will have a blast and leave with a better appreciation for the engineering field.
5. Yes, but there is a lot of work and material to be learned. If you keep yourself disciplined and do the work you will learn a lot about the different types of engineering and will develop a better appreciation for engineers.

6. I would tell them that if they are self-disciplined and want to have a lot of fun to go for it. I would also advise them to take into consideration the group work and the time it consumes.
7. I would say yes, as long as that person can commit enough time to keeping themselves on task.
8. I'm not sure.
9. Yes, it was fun, but think hard about whether or not you are the type of person that is capable of taking an online class.
10. Yeah if you have a lot of time. I do think this course took a lot of my time even though it was on-line.
11. If you are self disciplined, yes; otherwise, no.

Yes, it is a good class to get an overview of the engineering field.

### **Recommendations for Online Instructors:**

For the online delivered course, improvement is necessary from both the students' and instructor's perspective. It is clear that the course delivery, support, and the student's prior mastery of the Internet contributed to the satisfaction levels. Presumably future classes will benefit from some of the lessons learned here, and result in more satisfied students. Some of the things that require improvement are:

- Online-based courses should be clearly designated and advertised as such to prevent student confusion at the time of enrollment.
- Students should be informed regarding course delivery methodology and the requirements for student participation. This is particularly important from the point of view of student satisfaction, as students' expectations must be molded to fit the constraints of online based course delivery.
- Course delivery platforms need to provide more stable and consistent delivery of their content. It would also help if these platforms were more flexible in allowing the instructor to tailor them to meet class requirements.
- Support for online delivered classes needs to be expanded. Both students and instructors require support. Student and instructional needs may differ, but lack of support leads to low satisfaction in both groups.
- Clear and specific specifications for the student's computer hardware, software, and telecommunications must be published prior to course registration so that enrolling students can be ready to participate in the online course.
- A less-opened course structure should be given to help students avoid procrastination; and providing ways to encourage student-to-instructor communications.
- A final area that may be out of the hands of students and instructors is rapid and consistent access to the Internet. Although high speed Internet access is slowly becoming available in urban areas, it will take some time before it becomes widespread. This situation limits the features that instructors can use when delivering web content.

### **Conclusion**

This study that compares the Traditional students with online students shows no significant difference in the learning of students as shown through regular test and other course requirements. However, it is clear there was higher performance in the online student group. In all, students favored the flexibility and convenience of the online course. They appreciated being well informed by the instructor of the expectations, objectives, and concepts of the course, and the overall organized nature of the course. Nonetheless, students identified ways to improve the online course experience.

The key to successful online course development from traditional classrooms is to analyze course material, determine how well existing material will translate online, creating new approaches to communicating with students, and evaluating and rebuilding the course as problems arise.

## **Acknowledgment**

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## **Biographical Information**

ISMAIL I. ORABI, Professor of Mechanical Engineering at University of New Haven. He received his Ph.D. from Clarkson University, and his MS degree from the State University of New York and B.S. from Cairo Institute of Technology (now Helwan University), all in Mechanical Engineering. He has published over 25 technical articles in refereed journals and conference proceedings. His research interests include theoretical and computational investigation in the area of mechanical vibrations and dynamic systems and control. Professor Orabi has taught courses in both undergraduate and graduate level Mechanical Vibrations and Multimedia Engineering Analysis, and undergraduate level thermodynamics, Measurement Systems, Engineering Mechanics and Introduction to Engineering. One of Professor Orabi's most recent projects involves the development of [Learning Modules](#) on the web. These modules provide information, not only about particular course material, but also about more general topics relevant to engineering. He is also working on Computer-Aided Experimentations using LABVIEW. Professor Orabi has received a number of research awards from the State of Connecticut and United Technologies. He has established two Laboratories: the Materials Testing laboratory sponsored by the [National Science Foundation](#), and the Engineering Multimedia Laboratory funded by AT&T. He is a member of [ASME](#) and [ASEE](#).