Assessment Methods for Comparison of On-Campus And Distance Learning Laboratory Courses In an Engineering Technology Program

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I. Abstract

Assessment methodology and results for two Electrical Engineering Technology laboratory courses are shown. In these cases, courses are offered in both the traditional on-campus and non-traditional distance learning format, assessment methods are prescribed, assessment data are taken, and the results compiled and compared. Student comments are included which also support the assessment data. In addition, this paper describes ways in which the laboratory courses are structured in order to make the assessment process easier to manage. Pedagogical issues are addressed that were encountered when constructing the distance learning laboratory courses to assure that the learning experience could equal or exceed that of the on-campus counterparts.

II. Introduction

In the Old Dominion University Electrical Engineering Technology program, there are several laboratory courses that are offered in both a traditional on-campus laboratory format and a distance-learning (henceforth called DL) format. This paper concentrates on two of those courses: EET315W Digital Electronics Laboratory, and EET365W Electrical Power and Machinery Laboratory. Since the outset of offering laboratories in DL format, concerns have been raised that the quality and learning experience in the DL lab courses are at least equivalent to the on-campus lab courses. In order to satisfy those concerns, assessment methods were devised for these laboratory courses that would measure the courses using common criteria. In addition, although each of the DL courses uses a different pedagogical approach, they were both structured so that assessment could be done uniformly and fairly. The results that will be presented in the paper will show that the DL laboratory courses are at least equivalent to their on-campus counterparts in student learning experience.

III. Common Assessment Issues and Methods

From the outset, it was recognized that in order to accurately assess the quality of the learning experience in any DL course when compared to its on-campus counterpart, all other variables must be either eliminated or made equal in both types of courses. For example, when

measuring the class against learning objectives, if the on-campus class and DL class are taught by different instructors, then when the data are compared it becomes difficult to determine if differences exist only because of the delivery method, of if the different instructors (with different teaching methods and grading systems) added other variables that need to be considered. In addition to different instructors, other possible variables that can cloud the results include different grading systems, types and quantity of assignments, tests and exams, course pedagogy, and course material covered.

Since ODU oftentimes delivers its distance courses simultaneously to both on-campus and distance students, the task of eliminating as many other factors as possible was made much easier. For the two lab courses described in this paper, both a conventional on-campus section and DL section of each course were offered during the same semester, the same instructor was assigned to both sections, and the instructor made the same assignments and gave the same tests and exams. When grading papers, the individual assignments and exams from both the on-campus and DL sections were combined and graded as a single group, thereby assuring that the same grading criteria were used for both.

IV. EET315W Digital Electronics Laboratory

The majority of the enrollment in EET315W is made up of transfer students (100% for DL sections). Because of this, EET315W is historically their first exposure to university level laboratory work. On top of this, these transfer students come from a wide variety of community colleges with as equally varied an exposure to digital. For this reason, the labs in this course are meant to be a mixture of basic digital review as well as upper level digital design topics.

Both the on-campus and DL versions of EET 315W labs are divided into two parts. The first half of the course consists of six labs designed, tested and simulated with Multi-Sim 7.0 electronic simulator and one hardware lab. The second half of the lab challenges the student to design, build, test, transfer to wire-wrap, retest, troubleshoot, and then demonstrate a major hardware project. The specifications for the project force the student to use the design theory and techniques developed via the seven labs. The on-campus students have the advantage of the use of the departmental laboratories and equipment while the DL students must develop agreements with local community colleges and/or engineering companies. This is one of several disadvantages that the DL students seem to have. A second one is that unlike the on-campus students, they have to mail their project in to be graded and therefore are not present to see the success or failure of their project.

The writing intensity requirement of the course is met by:

- Four formal lab reports, one of which counts double,
- One project proposal
- One project formal report
- In addition, the student must maintain a legal engineering design journal from the first day of the project conception to the day of project demonstration.

One common course syllabus was developed for both the on-campus and DL sections of the course, thereby making the assignments, grading scale, and class schedule the same for both sections.

The objectives of the course are:

1. Design various flip-flop (T, D, and J/K) circuits to meet prescribed specifications.
2. Design 555 timers, multi-vibrators, and oscillators to meet prescribed specifications.
3. Design decimal and binary up/down counters to meet prescribed specifications.
4. Design various generator or digital time-base circuits and/or gated counters in accordance with the planned project.
5. Design various state machines to meet prescribed specifications.
6. Develop a prototype model of a complete digital circuit to meet a set of prescribed specifications.
7. Develop the ability to maintain a legal engineering journal
8. Develop good technical reporting skills.

The population base of this study consisted of 3 DL sections (43 students) and 4 on-campus sections (68 students). In the results shown in the table to the right, note that the DL sections performed better across the board then the on-campus sections. On first glance this would seem to run contrary to what one would expect. Note that there is absolutely no difference in the way the two different types are graded. On the other hand, besides the two disadvantages the DL sections have that were mentioned earlier, they also do not have a ready access to the professor or to other students who are taking the course as well. The reasons for the data not matching what might have been expected are discussed later in the conclusion.

Course Objective	On-Campus	Distance Learning
1	76.4	88.1
2	85.8	95.8
3	74.4	84.6
4	74.5	89.8
5	80.7	84.5
6	69.7	82
7	73.7	86
8	67.5	89.6

Table 1 – EET315W Assessment Results

V. EET365W Electrical Power and Machinery Laboratory

The on–campus EET365W lab course is a conventional electrical power and machinery course in which students work with motors, generators and transformers, and are given experiments in which characteristics of each are investigated. The DL version of this course uses the same equipment and setting, but the experiments are video taped as the instructor operates the equipment. The students view the videotapes, observe the operating characteristics of the equipment, and make the measurements as the camera pans the instruments. One common course syllabus was developed for both the on-campus and DL sections of the course, thereby making the assignments, grading scale, and class schedule the same for both sections.

Learning objectives were chosen such that one and only one objective pertains to each experiment. The objectives (and experiments) are:

1. Learn how to use the power measurement equipment and instrumentation, and measure the static resistance of a DC machine.
2. Plot and understand a DC machine saturation curve and learn how to reverse the polarity of a DC generator.
3. Measure and understand various properties and losses in transformers.
4. Measure and understand various properties and losses in autotransformers.
5. Investigate the method used to put an alternator on a live power line.
6. Measure and analyze the performance of a 3-phase induction motor.
7. Investigate the characteristics of a single-phase capacitor start motor.
8. Measure the load characteristics of a DC shunt generator.
9. Program and apply a programmable logic controller.
10. Measure the load characteristics of a DC compound generator.
11. Learn how to control the speed of a DC shunt motor.
12. Understand the characteristics of shunt, compound, and series DC motors.

Students were required to submit one written laboratory report for each experiment, thus providing a measurement method for each of the twelve objectives. Additionally, a short (24 questions) final test was developed containing two questions relating to each objective, thus providing additional feedback.

Each course objective result was calculated by performing a weighted average of the lab report numerical grade and the questions on the test that corresponded to the objective. The weighting was the same as that used to calculate the students' final grades. In the results shown in the table to the right, note that, for 9 of the 12 objectives, the DL section of the class scored higher on the learning objectives than their on-campus counterpart. Additionally, with an assessment criterion of 75.0 (C grade), both the on-campus and DL sections met all 12 learning objectives.

Course Objective	On-Campus	Distance Learning
1	90.8	95.9
2	84.6	91.4
3	83.7	86.8
4	84.0	89.2
5	88.6	95.0
6	95.3	93.3
7	87.4	85.1
8	80.9	89.2
9	86.3	85.2
10	85.9	93.0
11	86.8	94.9
12	81.6	90.1

Table 2 - EET365W Assessment Results

VI. Conclusions

Using the assessment methods described in this paper, it can be concluded that for these two courses, the DL students performed better at meeting the learning objectives for the courses than the on-campus students. In the 15+ years that ODU has been delivering DL courses, this has been the norm. It is difficult to determine exactly why this occurs; however, the instructors who have taught DL courses express similar opinions, which are:

- The typical DL student is more mature and motivated than the on-campus student, and therefore performs better at analyzing experimental data, drawing conclusions, and making observations.
- Nearly all DL students are part-time students. A lighter course load allows them more time to concentrate on the fewer classes they take.
- Most DL students work in technical jobs. Therefore, they either write technical reports as part of their job responsibilities, or they are at least exposed to technical reports written by others. Therefore, their overall technical report writing skills are superior to those of the on-campus students. Since these courses are writing-intensive, and since lab reports are graded both technically and grammatically, writing skills impact the grades.

Student comments from the DL sections were sparse, but generally positive:

- "Overall I found the class to be well taught and informative. My only thought in improvement would be more continuity and references to the text to re-enforce what the lab is trying to teach."
- "The lab videos were developed well and professionally done. As always (with this instructor), the class material was up to date relevant and very accessible"
- "The labs were fairly straightforward, easy to follow and reinforced the course material. I do think some were a bit out of order and I informed the instructor of that."

An effort is currently underway to collect additional data for the EET365W class to further support the information reported in this paper. However, this effort is ongoing and the data it will provide will not be available in time to meet the submission deadline for this paper. EET315W is not offered during the current semester; however, data collection will continue in subsequent offerings of the course.

As demonstrated in this paper, it is possible to assess and compare the performance of on-campus and DL courses; however, the process involves "leveling the field" by equalizing all other variables that can distort the data. In doing so, the assessment is based solely on the student performance as measured against the learning objectives.

Bibliography

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