

# Work in Progress – Replacing “Traditional Lectures” with Face-to-Face Directed Problem Solving Sessions and On-Line Content Delivery

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**Abstract** - An experimental format is described in which the "lecture content" for a core junior-level ECE course was delivered via on-line streaming video (referred to as "virtual lecture"), and the regularly-scheduled class meeting times were used for instructor-directed, collaborative problem solving sessions (referred to as "directed problem solving"). A "traditional lecture" division of the course was offered simultaneously, to provide students an opportunity to select the course format they felt best matched their individual learning style. Results, including survey data and comparative performance on common exams, are presented for the initial trials conducted.

**Index Terms** – Collaborative learning, Directed problem solving, Virtual lecture.

## INTRODUCTION

There are two, basic instructional problems addressed by the project described in this paper: (a) the general ineffectiveness of the "large lecture" format in conveying course content, given its inherent "group paced" nature and sporadic attendance; and (b) the general ineffectiveness of "handed in" homework in helping students learn the course material, given widespread "cheating" (students copying one another's work) and the difficulty with providing timely feedback.

To address these issues, an experimental format was created for a core junior-level ECE course (ECE 362, *Microprocessor System Design and Interfacing* [1]) in which the lecture content was delivered via video streaming, and the scheduled class meeting times were used as instructor-directed collaborative problem solving sessions. The experimental division was split into multiple sections that each met once/week, facilitating small "recitation-style" settings.

The traditional assigned written homework was replaced by collaborative problem solving by students working in small teams (of two students each). Solutions devised by the various teams were evaluated "on the spot" through "self-grading" (based on an instructor-directed solution walk-through), thus providing immediate feedback and eliminating the time, overhead, and expense associated with homework paper collection and grading. Students' scores for the "homework" part of the course grade were determined based on attendance at their assigned directed problem solving session.

A "traditional lecture" version of the course was offered simultaneously, to provide students with an opportunity to select the course format they felt would work best for them (guidance in making this selection was provided during the first two class meetings of the semester). The traditional offering also served as a control group for providing comparative performance and evaluation data. While allowing students a choice of course format may have introduced some bias, an important finding of this initial study was the fraction of each cohort group that elected the non-traditional option (and the rationale for doing so, based on exit survey results).

A key, underlying goal of this project was to help students learn the basic course content more efficiently and effectively. This outcome was evaluated by comparing scores on common exams. There are three primary learning outcomes in ECE 362, each of which is assessed using a comprehensive, in-lab practical exam: (1) an ability to write programs for a computer in assembly language, (2) an ability to interface a microprocessor to various devices, and (3) an ability to effectively utilize the wide variety of peripherals integrated into a contemporary microcontroller. Each exam consists of three components: (a) standardized multiple-choice questions that gauge understanding of content; (b) analysis/design questions that gauge basic skills; and (c) application programming questions that gauge more advanced (synthesis) skills. Further information about the methodology used to assess these outcomes is provided in [2].

Another goal was to accommodate a wider diversity of learning styles by offering students a choice between two, very different course formats – being required to make a choice forces students to think about how they learn and the environment in which they learn best. This outcome was evaluated based on exit survey data.

## RESULTS

The results of two successive trials, conducted Fall 2005 and Spring 2006, are documented in this paper. In the Fall 2005 trial, the same instructor (the author) taught the traditional lecture division as well as both sections of the experimental division. In the Spring 2006 trial, a different instructor taught the traditional lecture division while the author again taught both sections of the experimental division. The cohort sizes for the Fall 2005 trial were 29 and 55 for the traditional lecture

(TL) and the experimental directed problem solving (DPS) divisions, respectively. For the Spring 2006 trial, the corresponding cohort sizes were 23 and 44. In each trial, then, approximately 65% of the students enrolled in ECE 362 elected the experimental DPS option.

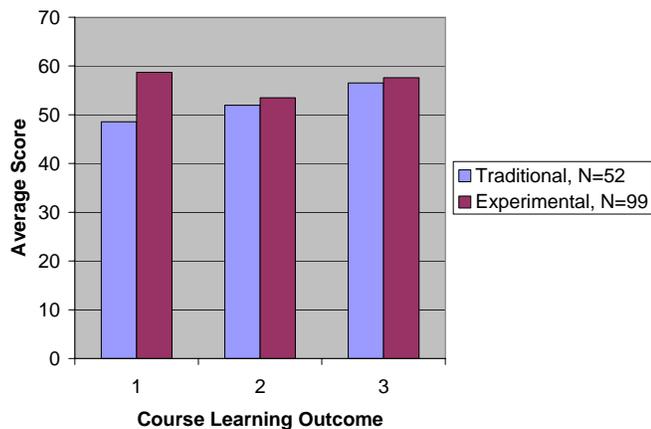


FIGURE 1  
TWO-TRIAL AVERAGE PERFORMANCE ON STANDARDIZED MULTIPLE-CHOICE CONTENT QUESTIONS.

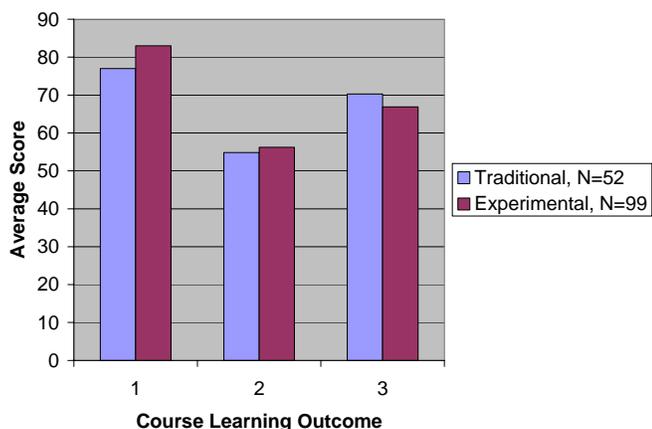


FIGURE 2  
TWO-TRIAL AVERAGE PERFORMANCE ON BASIC ANALYSIS/DESIGN QUESTIONS.

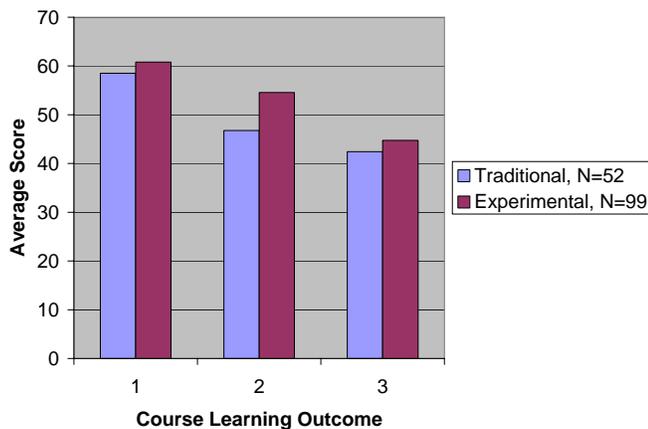


FIGURE 3  
TWO-TRIAL AVERAGE PERFORMANCE ON APPLIED PROGRAMMING QUESTIONS.

Bar graphs comparing the two-trial average performance between the TL and DPS divisions for the various categories of exam questions are provided in Figures 1-3. Note that, with the exception of one case (one outcome/one trial), the DPS average was higher than the TL average for each learning outcome on every category of question type. The effect appears to be more pronounced on exam questions requiring higher-level skills (Figure 3).

In addition to comparing exam performance, a detailed exit survey was conducted in both divisions for each trial. One interesting result is that about one-half of the students in the TL division (8 out of 14, Spring 2006) used the on-line lectures instead of attending the “live” lectures. For that trial, only 3 of the 14 respondents felt like they could have learned the course material better in a traditional live lecture format than in a “virtual” (online) format (12 out of 21 TL students answered this question affirmatively Fall 2005). On the DPS division survey, an overwhelming majority (36 out of 46, Fall 2005 and 27 out of 29, Spring 2006) believed that the on-line lecture and directed problem solving combination helped them learn the course material better. A similar majority affirmed that they would choose the on-line lecture and directed problem solving combination in another ECE course, were it available (31 out of 46, Fall 2005 and 23 out of 29, Spring 2006). One adjustment made for the Spring 2006 trial, based on comments made on the Fall 2005 survey, was to have all the DPS sessions on Mondays (instead of distributed throughout the week). Since all the lab divisions meet on Tuesdays through Fridays, this change maximized the benefit of the DPS session for the lab to be completed that week.

SUMMARY AND FUTURE WORK

Preliminary results, based on both exam performance and survey data, confirm the effectiveness of the experimental course format described in this paper. One of the limitations of this study, however, was an inability to fully decouple effects of the virtual and live lecture formats. This was due to both the public availability of the lecture videos on the course web site, as well as the inability to prevent students in the directed problem solving division from attending the live lectures. To better decouple the virtual and live lecture effects, future trials will be run in a single format only on alternate semesters (e.g., traditional lecture in spring, DPS with virtual lecture in fall). While this eliminates the possibility of choice, survey results indicate that the majority of students apparently selected their course format option “by default”.

ACKNOWLEDGMENT

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REFERENCES

[1] ECE 362 Course Web Site, available at <http://shay.ecn.purdue.edu/~dsml/ece362>.  
 [2] Meyer, D. G., “Strategies for Assessing Course-Specific Outcomes,” *Proceedings of the ASEE 2006 Conference*, June 2006.