

The Mock Exam: Preparing Students for Your Exam

Paul M. Furth
Department of Electrical and Computer Engineering
New Mexico State University
Las Cruces NM 88003
pfurth@nmsu.edu

Abstract

In order to be successful in a course, students must not only master new material, but also learn the methods, expectations, and viewpoint of their instructor. In a required lower-division engineering course, exam scores are typically the largest determinant of a student's final grade. Thus, preparation for these exams is very important, both to the student and the instructor. This paper describes a tool aimed to help prepare students for *your* exam, called the mock exam. The mock exam is scheduled one class prior to the real exam. Its value is far less than that of the real exam. Students work in teams during the first thirty minutes of the mock exam and on their own for the last twenty minutes. Data from students surveyed indicates some of the strengths and weaknesses of a particular administration of the mock exam in a required lower-division electrical engineering course at New Mexico State University.

Introduction

As part of ABET 2000 [1], each course must have a syllabus detailing the objectives for that course. For example, in the course *Electronics I*, a required course for a baccalaureate degree in electrical engineering at New Mexico State University, two of the objectives are:

- Analysis and design of single time-constant circuits, linear opamp circuits, and linear power supplies
- Building and testing functional circuits with breadboards, function generators, and DC and/or AC power supplies

The goal is that each student that completes the course with a C or better satisfies most or all of the objectives. Many objectives can be directly assessed through exam questions. In particular, the first objective listed above for *Electronics I* can be assessed by exam questions, whereas the second would be assessed in a laboratory environment.

ABET 2000 [1] further requires that the syllabus state the relationship between the course and the program objectives. In particular, one objective of the Electrical Engineering Program at New Mexico State University [2] that relates to the course *Electronics I* is that our graduates are "able to apply critical thinking skills to solve problems." Critical thinking can be assessed through exam questions, as explained more fully below.

According to Cyrs [3], questions can deal at many levels – memory, comprehension, application, and critical thinking. The memory, or recall, level is the lowest level. At this level, students are asked to state rules, principles, and facts without necessarily understanding them. The next highest level is comprehension, in which students must explain or describe concepts. At the application level, students apply rules to new situations or problems. At this level, the rules are selected by the instructor. At the highest level, critical thinking, students must select which rule to apply to help solve a particular problem.

At the critical thinking level, or problem-solving level, students integrate previously learned material to new situations, and actually *expand* their problem solving ability [3]. For exams that deal in part or in total at this level, students may benefit greatly by the introduction of mock, or practice, exams during class time. The instructor cannot just tell students that, in order to prepare for your exam, they

need to memorize notes from the last ten lecture periods, or be able to work the last twenty homework problems that were assigned. Critical thinking requires students to understand, apply, and select rules to new problems.

The five goals of the mock exam are to:

1. Help students become familiar with the exam format prior to the real exam
2. Help students review the scope of topics covered on the real exam
3. Give students experience with the level of difficulty on the real exam
4. Allow students to work with, learn from, and/or mentor another student
5. Help students improve their real exam score

Administration of the Mock Exam

The mock exam is scheduled one class period prior to the exam. It is in class. The mock exam has the look and feel of the real exam – the same number of questions, the same formula sheet, the same question format. The major differences are that:

- The mock exam is worth only one quiz grade
- The mock exam time limit is 50 minutes, rather than 90
- Students have no review prior to the mock exam
- Questions on the mock exam and real exam are not identical
- Students work in groups of two for the first thirty minutes
- The instructor actively engages students in problem solving
- The mock exam is only partially graded by the instructor

Worth a Quiz Grade

If the mock exam is worth nothing, students will likely put little effort into it. Making it worth one quiz grade assures that students will make a serious attempt to read, understand, and solve each problem on the mock exam. The real exam is worth approximately fifteen times that of the mock exam.

Time Limit

In order to relieve the pressure of time, the real exam is offered in the evening with a time limit of 90 minutes, rather than the 50 minutes used for the mock exam. Students often do not have adequate time to complete every problem on the mock exam, whereas they have ample time to work through every problem on the real exam in 90 minutes.

No Review

Students are not encouraged to review prior to taking the mock exam. In fact, a short homework assignment is due the day of the mock exam. Solutions to the mock exam are provided at the conclusion of the exam. As such, the mock exam can serve as a diagnostic tool to help students identify what topics they need to study.

The time between the mock and real exams is typically three days. Students have those days to study for the real exam. Since the real exam is offered in the evening, the class time on the day of the exam is used as a general review session. During the review session, students ask questions or ask the instructor to work through problems on any topic of their choice. Thus, students are much better prepared for the real exam than for the mock exam.

Questions Not Identical

Critical thinking requires not only the recall of information but also the correct application of principles to a new problem. Since critical thinking is an objective of the electrical engineering program that relates to the course *Electronics I*, mock exam and real exam questions must necessarily be non-identical. Changing the numbers isn't enough. Instead, when covering one topic on the mock exam, the problem may require design of a particular circuit to some required specifications. For the same topic on the real exam, the problem may require analysis of a similar, but non-identical, circuit. Therefore, it is intentional that questions on the mock exam are not repeated on the real exam. Students who strictly memorize solutions from the mock exam will not, in general, do well on the real exam.

Working in Groups

McShannon and Hynes [4] report that students have four different preferred interactive learning styles. Some students prefer interacting with faculty during class time, or instructor-student formal interaction. Others prefer interacting with instructors outside of class time, known as instructor-student informal interaction. A third group prefers learning from peers, or student-student interaction. The last group prefers learning alone, known as student-self interaction.

Most of the lecture periods in *Electronics I* feature instructor-student formal interaction. On the other hand, during the first thirty minutes of the mock exam, students are asked to work with another student. Thus, the mock exam allows students a significant period of time to learn from peers, or student-student interaction. The students in *Electronics I* are asked to work with a new person during each mock exam and to choose a person that is not their lab partner. In that way, students do not feel stuck working with a particular partner and are required to communicate with a variety of students.

During the first thirty minutes, the groups of two, or at most three, are required to spend ten minutes working on each of the three problems. Thus, all students get a review of the major topics covered in the exam. During the last twenty minutes, students work independently, going back to any problem that is incomplete. At this time, the classroom becomes hushed for the most part, closely simulating the real exam environment.

Instructor Engages Students

During the mock exam, the instructor is available to answer questions. When not answering questions, the instructor has time to work individually with a group of students, to look over their responses, question their assumptions, or give them hints, as appropriate. Thus, students do not remain stuck during the mock exam for a significant period of time.

Partially Graded

Prior to administering the mock exam, neither the students nor the instructor know which problem will be graded. In that way, students will not focus on one problem or topic. After the mock exam, the instructor selects one random problem, or one-third, of the mock exam to be graded and recorded as a quiz. The reason for grading only one third of the mock exam is exclusively to save instructor time.

Student Evaluations of the Mock Exam

During the fall 2001 semester, the students of *Electronics I* were asked to anonymously evaluate the five goals of the mock exam stated earlier. The evaluation instrument listed these goals. For example, for the first goal, a statement read: "The mock exam helped me become familiar with the exam format prior to the real exam." Students responded to each statement on a scale of 1-5, where 1 meant

“Strongly Disagree” and 5 meant “Strongly Agree.” The averaged results are shown in Table 1. Twenty-four students anonymously took the survey during class time. From Table 1, we see that, overall, students felt the mock exam helped them become familiar with the exam format, with an average response of 4.7 out of 5. On the other hand, we also note that, on average, students felt that the mock exam was only a small help in improving their score on the real exam, with an average response of 3.6 out of 5.

The mock exam...	Average Response
1. helped me become familiar with the exam format prior to the real exam.	4.7
2. helped me review the scope of topics covered on the real exam.	4.1
3. gave me experience with the level of difficulty on the real exam.	3.8
4. allowed me to work with, learn from, and/or mentor another student.	4.2
5. helped improve my real exam score.	3.6

Table 1: Survey questions about the mock exam and average responses on a scale of 1-5, where 1 is “Strongly Disagree,” 2 is “Disagree,” 3 is “Neutral,” 4 is “Agree,” and 5 is “Strongly Agree.” Total number of students responding is 24.

The survey also contained two open-ended questions, allowing students to (1) freely recommend specific ways to improve the administration of the mock exam, and (2) highlight strengths or positive outcomes of the mock exam. The responses to these open-ended questions were analyzed by grouping and counting responses that were similar in content. Table 2 summarizes the six most common suggestions for improving the mock exam. Table 3 summarizes the five most common strengths or positive outcomes of the mock exam. Students were allowed to offer more than one suggested improvement or more than one strength. As a result, the total number of comments exceeds the total number of students responding.

	Number	% Total
Make mock exam questions more like real exam questions.	5	20.8%
Warn students NOT to focus on mock exam problems.	3	12.5%
Give students a day to review prior to the mock exam.	3	12.5%
Make mock exam questions more complex.	3	12.5%
Omit multiple-choice questions from mock exam and real exam.	3	12.5%
Give partial credit on multiple-choice questions for mock exam and real exam.	3	12.5%

Table 2: The most common suggested improvements, additions, or deletions to the mock exam, with the number of students making that, or a similar, comment and the percent of the total students responding. Total number of comments is 30. Total number of students responding is 24.

	Number	% Total
The mock exam gives a good sample format of real exam.	13	54.2%
The mock exam helps students see areas of weakness.	5	20.8%
Mock exam solutions help students study.	4	16.7%
Working and interacting with another student is helpful.	4	16.7%
The mock exam helps review the range of topics on the real exam.	4	16.7%

Table 3: The most common strengths or positive outcomes of the mock exam, with the number of students making that, or a similar, comment and the percent of the total students responding. Total number of comments is 35. Total number of students responding is 24.

Discussion

According to the student feedback presented in Table 1, not all of the goals were equally met. The average response across all questions was 4.08. For those responses above this average, students tended to either agree or strongly agree that the mock exam (1) helped them become familiar with the exam format, (2) helped them review the scope of topics, and (4) allowed them to work with another student. On the other hand, for the responses that were below the average, students tended to either agree with or were neutral toward the statements that the mock exam (3) prepared them for the difficulty of the exam and (5) helped improve their exam scores.

In Table 2, we see that the most desired improvement to the mock exam is that questions are more similar to those found on the exam. However, as stated earlier, questions are intentionally unique on the two exams so that students apply critical thinking skills. The second suggested improvement is to “warn students not to focus on mock exam problems,” but rather to focus on the application of known relationships, or rules, in new situations. The mock exam and real exam have the same formula sheet. At the end of the semester, there are approximately 45 formulas to choose from, none of which are identified for the student. Therefore, students must choose carefully which formula to apply when solving a particular problem. It is perhaps this level of difficulty, the critical thinking level, that students felt most uncomfortable with, as suggested by the low average response of 3.8 out of 5 to the statement, “The mock exam gave me experience with the level of difficulty on the real exam.”

The most common strength of the mock exam is just a re-wording of the first objective, “The mock exam gives a good sample format of real exam.” The next most common strength was that it helps identify student areas of weakness. Thus, they use the mock exam as a diagnostic tool to let them know what areas they may need to prepare more than others. The third most common strength was that the mock exam solutions help students study. Besides homework solutions, students can use a sample test to see how a particular problem might be solved. This goal might also be accomplished by placing old exams and their solutions on line. In the course *Electronics I*, mock exams from the previous semester are available for students to download.

Real exam scores, which have a huge impact on final grades, seem to matter most to students. The average response to the statement “The mock exam helped improve my real exam score” was only 3.6 out of 5, as indicated in Table 1. Below, Table 4 shows the relative improvement in scores from the mock exam to the real exam over the last four semesters. The data in Table 4 suggests that the percent improvement in scores during the fall 2001 semester, 22.6%, falls somewhere in the middle of the improvements over the last four semesters. On the other hand, the real exam scores are lowest for the fall 2001 semester, at 70.1, the semester that the survey was administered. It is likely that if students had been surveyed during other semesters, the average response to the statement “The mock exam helped improve my real exam score” would have been higher than 3.6.

Semester	Average Mock Exam Score (Scale 0-12)	Average Real Exam Score (Scale 0-120)	Percent Improvement from Mock to Real
Fall 2001	5.72	70.1	22.6%
Spring 2001	5.41	76.5	41.4%
Fall 2000	6.24	75.3	20.7%
Spring 2000	6.68	77.9	16.6%

Table 4: Average mock and real exam scores and relative improvement over the last four semesters.

A major change to the exam format in the fall 2001 semester was the introduction of multiple-choice questions. The last two of the most common suggested improvements to the mock exam were basically the abolition of multiple-choice questions. Students seemed unfamiliar with this exam format in a required electrical engineering course, wanted partial credit for work shown in the margin, and did not

like being penalized for wrong “guesses.” Average scores on the multiple-choice questions were significantly lower than average scores on other portions of the test, where partial credit was given and there were no penalties for wrong answers. The introduction of multiple-choice questions may be a major reason that average student exam scores were low during the fall 2001 semester.

Summary and Conclusions

This paper described a tool for preparing students for your exam. Not only must students learn new material prior to taking an exam, they must also learn about the instructor’s methods, expectations, and viewpoint. The mock exam is designed to give students experience with the format, level of difficulty, and scope of topics covered on the real exam. The administration of the mock exam allows students to interact and learn from one another in a classroom setting.

One objective of the mock exam is improved exam scores, which was only weakly satisfied for the fall 2001 course offering of *Electronics I* at New Mexico State University. A major reason exam scores were lower in the fall 2001 semester may be the introduction of multiple-choice questions that semester.

The use of the mock exam may be particularly well suited to courses that require critical thinking, that is, courses that require solving new problems with a wide range of rules to choose from. As such, it is important for the instructor to emphasize critical thinking as a major component of the exam, so that students practice rule selection as a main component in problem solving.

- [1] Accreditation Board of Engineering and Technology, *EAC Criteria 2000-01*, http://www.abet.org/downloads/2000_01_Engineering_Criteria.pdf.
- [2] Program Self-Study Report for Electrical Engineering, New Mexico State University, Submitted to ABET, June 2000.
- [3] Thomas Cyr, *Essential Skills for College Teaching: An Instructional Systems Approach*, New Mexico State University, Las Cruces NM, 1994.
- [4] Judith R. McShannon and Patricia C. Hynes, New Mexico State University, Las Cruces NM.



Paul M. Furth received the BS degree in engineering from the California Institute of Technology, Pasadena, CA, in 1985. From 1985 to 1989 he worked as a project engineer for TRW Technar, Irwindale, CA. He received the M.S.E. and Ph.D. in electrical and computer engineering from Johns Hopkins University, Baltimore, MD, in 1992 and 1996, respectively. He is currently an Associate Professor of Electrical and Computer Engineering at New Mexico State University, Las Cruces, NM. He teaches courses in electronics, analog VLSI, and digital VLSI. His research interests include analog image and speech processing and low-power analog circuit design.