

## **Academic Success Without the Use of Tests**

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### Abstract

An experimental class for thirty-two engineering freshmen yielded academic success without the use of the typical two or three tests during the semester and without the time consuming task of grading daily homework. The procedure used a daily quiz, the sum of all quiz grades accounting for 60% of the final grade.

### I. Introduction

The Division of Engineering Fundamentals has been a part of the College of Engineering at Virginia Polytechnic Institute and State University since the late 1960's. Typically, students have been graded in their freshman-level core engineering courses based upon homework assigned each day, approximately one quiz given each week, two to three tests administered each semester, and a two-hour examination taken at the end of the course. For the course associated with engineering design graphics, a semester-length team project has always been included. Students have performed in the typical manner – some cut an occasional class, some fail to pay attention in class, cramming often occurs before tests and exams, and overall performance has been mediocre. Not only is all work graded by the EF faculty without grader assistance, but also each EF faculty member is responsible for advising approximately 120 new engineering students each academic year. As the number of freshman engineering students has increased, the workload on the faculty has increased as well. Some alternative technique for teaching and grading needed to be developed while maintaining and possibly increasing the rigor of the courses.

### II. Narrative

During the second summer session of 1998, an experiment was conducted as part of a two-credit engineering design graphics class with an enrollment of thirty-two students. This freshman-level class is designed to introduce engineering students to the design process and engineering graphics conventions.

The summer semester consisted of twenty-four class sessions, each session being seventy-five minutes in length, held on Mondays through Thursdays of five consecutive weeks. The final grade was based on the following categories:

Quizzes - 60%  
Design Graphics Project - 15% (a team project)

## Final Examination - 25%

A typical class sequence was as follows:

- New homework assigned (1 minute)
- Discussion of the previous day's quiz (up to 5 minutes)
- Discussion of the previous night's homework (up to 15 minutes)
- Discussion of older material (up to 5 minutes)
- Coverage of new material (35 or more minutes)
- Meaningful quiz on material at least two days old (15 minutes)

This order never varied. Students very quickly learned the advantage of attending class. Each portion of each class contributed to mastery of the material.

Homework problems were assigned daily but not graded by the instructor. Students were allowed to solve the problems individually or in teams. Team organization was informal; the instructor did not organize the teams nor have knowledge of team participants. A homework assignment typically required approximately two to three hours to complete. The instructor presented a complete and detailed solution of each homework assignment at the beginning of the following class period. Instructor presentation of homework solutions utilized the blackboard, overhead viewgraphs, and computer displays. Students were encouraged to discuss concepts and ask detailed questions about the homework to ensure a total understanding of the material. They were requested to make corrections and add annotations to their work to ensure that it would be useful when reviewing for the daily quizzes and the final examination.

Topic presentation followed a normal college-level format: lecture inter-spaced with some discussion as well as questions and answers. The class utilized AutoDesk's Mechanical Desktop 2.0 for developing 3D modeling skills and learning the conventional practices of graphic communication. However, pencil and paper work was used exclusively for sketching exercises.

A quiz was given during the last fifteen minutes of each period. The quizzes were graded daily by the instructor. Detailed corrections and comments were added, and the quizzes were returned to the students at the beginning of the following class period. Except for the first quiz, given on the second day of class, quizzes focused on material presented at least two class periods earlier. This two-day delay for quizzing allowed each student the opportunity to master the material before being quizzed on it. A typical quiz consisted of two questions. The first question covered recently presented material. The second question addressed material that could have been covered as early as the first day of class. Thus, each student was required to learn the new material in a timely manner. Staying abreast of the old material was as important as learning the new material, since every quiz covered both old and new topics.

Regular class attendance was considered of utmost importance in learning the material. As a means of motivation, each student taking a quiz received at least a grade of 50 on the quiz. This "carrot" was immediately recognized as a reward for class attendance. Without it, a student who attended class but received a zero on a quiz for missing all questions would receive the same

grade as a student who did not attend class. This grading technique was implemented to encourage regular class attendance. On the first day of class, the instructor illustrated the affect that even a single quiz grade of zero, resulting from cutting the class, would have on the final grade, as opposed to a grade of 50. It immediately became obvious that class attendance was necessary if an average or above average grade were to be obtained.

No period-length tests were given during the semester. Elimination of tests reduced the typical cramming that occurs before tests. Students learned that understanding the material for long-term retention was far superior to memorization. They quickly realized that having an “off” day would only affect a quiz grade rather than a test grade. No loss of learning momentum occurred, as occasionally occurs in the class immediately following a test. Every day followed the same format.

The design graphics project that accounted for 15% of the final grade was assigned early in the semester. The project due date was the next to last day of class, and project presentations occurred during the last two days of class. This team effort was an ongoing project that utilized only a small portion of class time, primarily during the first week of class.

The final examination, which accounted for twenty-five percent of the final grade, consisted of two parts. The computer portion of the examination was take-home and required students to use AutoDesk’s Mechanical Desktop to produce several engineering drawings. Students submitted both hardcopy and a diskette to indicate their mastery of the basic principles of Mechanical Desktop as well as their understanding of engineering graphics conventions. To reduce opportunities for cheating, each student was given a unique object on which his examination was based. The in-class portion of the examination utilized pencil and paper to test sketching ability, visualization, and an understanding of engineering graphics conventions.

This experimental approach required thorough preparation for class by the instructor and each student. The instructor had to be well prepared to ensure that no class time was wasted. Each student was required to study each day as if he had a test the next day and to constantly review. Devoting time to study both new and old material on a daily basis was required if success were to be attained. Becoming stale on any of the older subject matter or failing to learn the newer subject matter could definitely limit the level of success.

Initially, the students reacted negatively to the class format. Some were planning to use the summer class as a time to “lay back”, relax, and enjoy life with occasional periods of panic when required to study for a test. The unstated requirement to attend each class and to be extensively quizzed each day was not appreciated. The requirement to complete and understand the homework each day without receiving any immediate reward for the work completed was considered unduly demanding. But after about one week, the grumbling stopped, meaningful questions were asked, and each student seemed to make an effort to complete the homework and to understand the concepts. Class absence was minimized. An ideal class environment seemed to have been created.

One advantage of this experiment was the reduction of the workload for the instructor. No longer were three or four homework problems graded daily with an occasional quiz added to the

grading load. No longer were lengthy tests developed and given, requiring hours to prepare and grade. No longer was the desire to learn on the part of the students isolated to a day or so before each test, requiring extended office hours during these periods. The instructor was required to prepare meaningful daily quizzes, but this did not seem to be a major task since it utilized only a few minutes each day. And the grading of two quiz problems each day consumed far less time than that of three or four homework problems. The number of problems to grade was less than for a typical class. The quality of work by the students was reasonably high – they knew their work had to be essentially correct to obtain a good grade. The effort expended in grading was less. As any professor can attest, grading a good paper is far less demanding and less time consuming than grading one that is poor.

One might think that the professor could gain an even larger advantage by giving only one or two quizzes per week for a class that meets three times a week. This will definitely not assure high quality learning, associated with regular class attendance. Students might gamble by cutting a class hoping that no quiz would be given. Having an announced quiz daily eliminates this gamble. A quiz a day kept the students at bay – they prepared for class, they attended class, they paid attention, and they learned.

### III. Summary

At the end of the semester, each student was asked to evaluate the class and instructor. Comments were specifically requested concerning the approach used. Remarks were quite favorable, with examples as follows:

1. “I feel that the daily quiz helps a lot.”
2. “I like the detailed explanations of my errors on the quizzes.”
3. “This class was a bear – I had to study every single day.”
4. “I was a little worried at first when you said we would have no tests, but it quickly became obvious that we had a mini-test each day. You wouldn’t let me fall behind.”

The largest and most important gain was an improvement in student performance. Though the percentage of A’s did not increase when compared to the typical class, the number of D’s was less and for the first time in the instructor’s twenty-four year teaching career, there were no F’s. Possibly the sampling of 32 students was too small, but the instructor completed the course with the feeling that his students had gained more knowledge than a class taught utilizing typical approaches.

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Barry Crittenden is an Associate Professor in the Division of Engineering Fundamentals at VPI&SU. After serving four years in the U. S. Army, he began his graduate studies in Aerospace Engineering and obtained a Ph.D. in 1976. Most of his academic career has involved teaching and advising freshman-engineering students. Barry has been active in ASEE since 1974, serving both the Engineering Design Graphics and Freshman Programs Divisions.