Analyzing the Effects of Extra Credit Opportunities on Student Learning, Motivation, and Faculty Perceptions

Timothy W. Mays[1] and Kevin C. Bower[2]

Abstract –This paper presents a specific approach to improving student performance in engineering subject areas that includes providing extra credit problems for students to work, allowing students to self evaluate their performance using provided solutions, and assessing the level of the participating students' increased knowledge by requiring these students to work randomly selected problems from their extra credit submittal without consulting their previously developed solutions. The students' reward for completing the extra credit assignments consists a student specific number of points on each student's final average, increased knowledge of the subject matter, increased student motivation for learning, and improved perceptions of the instructor. This paper presents the overall methodology behind the extra credit assignments, the results of a student survey about the assignments, a statistical analysis of the impact of the methodology on student grades, and a commentary on student motivation made manifest by the proposed methodology.

Keywords: Extra, Credit, Motivation, and Assessment.

INTRODUCTION AND BACKGROUND

It is interesting to note that a topic as mundane as "extra credit" rarely appears in the literature. Although faculty do recognize that extra credit exercises can be used to motivate students, the lack of pedagogical research in this area suggests that the cons of its use may outweigh the pros. On the contrary, a simple search of the Internet reveals that a plethora of college professors provide extra credit opportunities to students in various subject areas. Moreover, a survey performed by Hill et al. [2] found that 82 percent of responding psychology faculty reported the use of extra credit, and a more general survey of various disciplines performed by Norcross et al. [5] revealed that around 25% of participating faculty reported its use in their courses. If extra credit opportunities are as widely used as the statistics suggest, then why is so little research performed in this area? The answer appears to be found in the conclusions of the limited publications that do exist. Norcross et al. [5] performed the first significant study on the use of extra credit and after reviewing the results of a survey of faculty attitudes towards the topic, summarized that "If one wishes to start a verbal brawl at a university faculty club, the desirability of extra credit is incendiary material." Hill et al. [2] performed a similar survey and received negative feedback from many participating faculty as well.

The negative feedback apparently stems from three major disadvantages faculty associate with the use of extra credit. Norcross et al. [5] states that a significant percentage of faculty members feel that it is unfair to offer extra credit to select students (i.e., those in danger of failing), extra credit encourages students to be irresponsible, and that it is impractical to give additional work to a student who doesn't understand the basic material. Other disadvantages cited in the literature include the possibility of the extra credit policy being abused, grade inflation,

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and an indication of low professor expectations and grading standards. Students responding to the same survey indicate a similar ranking of disadvantages.

On the other hand, faculty indicate that extra credit also has three major advantages. Norcross et al. [5] states that a significant percentage of faculty members feel that extra credit can motivate students to work harder, can allow students to explore course topics in greater detail, and can be used if the student has a serious illness or problem. Other advantages cited in the literature include that extra credit rewards personal effort and that it can be used to compensate for poor exam takers that work hard and understand the material. Overwhelmingly, students responding to the same survey indicate that the biggest advantage of extra credit is that it provides students with a second chance.

Using a control group of failing students with no extra credit opportunities provided, Junn [3] determined that extra credit increased the experimental group's likeliness to earn at least a grade of C and made these students less likely to drop the particular course. Specifically, following a midterm exam, the instructor approached all failing students in two identical classes and spoke with the students about good learning habits cited in the literature. The control group was encouraged to perform the activities and the experimental group was given extra credit points for participating in the activities. Statistically, the experimental group's final exam scores increased 18 points from their average on the midterm exam. The control group's final exam average increased only 7.5 points.

In contrast to Junn [3], Thorne [8] describes the use of nonpunitive pop quizzes as extra credit tools that can minimize the disadvantages of extra credit cited in the literature. The author concludes that although the extra credit quizzes have a minimal impact on student course grades (four percent maximum increase on the student's overall grade), they are offered to all students and are found to motivate students, encourage class attendance, increase class preparation, and provide students with study material for the major exams. Student survey results indicate that students strongly appreciate the use of Thorne's extra credit pop quizzes.

Other papers describing exercises and assignments that can by used for extra credit include Bauer and Snizek [1], LeUnes [4], Oley [6], and Sugar and Livosky [7]. Although it is certain that some engineering professors use extra credit, no papers dealing with extra credit opportunities in engineering courses were found in the literature.

It is anticipated that Junn's [3] suggested extra credit allowance for good study habits and Thorne's extra credit pop quizzes should have a similar impact on engineering student performance. However, the methods appear to be faculty intensive and it is commonly accepted that engineering subjects typically require solving a variety of problems in order to better understand the subject matter. Hence, this paper presents a specific approach to improving student performance in engineering subject areas that includes providing extra credit problems for students to work, allowing students to self evaluate their performance using provided solutions, and assessing the level of the participating students' increased knowledge by requiring these students to work randomly selected problems from their extra credit submittal without consulting their previously developed solutions. The students' tangible reward for completing the extra credit assignments consists of a student specific number of points on each student's final average that is a function of the number of successfully completed extra credit problems and the student's scores on assessment quizzes covering the submitted material. The students' intangible reward for successfully completing extra credit assignments includes increased knowledge of the subject matter, increased student motivation for learning, and possibly improved perceptions of the instructor. The average reward for completing the assignment is only a few points on the student's final average and faculty involvement is minimal, yet the methodology has been successfully used for three semesters at the Citadel. This paper presents the overall methodology behind the extra credit assignments, the results of a student survey about the assignments, a statistical analysis of the impact of the methodology on student grades, and a commentary on student motivation made manifest by the proposed methodology.

For all of his lecture courses since the Spring of 2003, the lead author has attempted to optimize the use of extra credit homework problems in order to maximize student gains while minimizing drawbacks commonly associated with extra credit. The idea began as a simple response to a student request for more problems to work/study in a mechanics of materials textbook. The instructor provided restricted access to the class solutions manual so that students could work extra problems from their textbook and check their work. All students were permitted to work extra problems and to check them with the solutions manual, but without tangible rewards, students generally weren't interested. In fact, the requesting student was rarely seen consulting the manual. Since the existing course

was already homework intensive, requiring extra problems seemed illogical. Therefore, the next semester, the instructor created a policy for a structural analysis class whereby students were permitted to work as many extra credit problems out of the textbook as they wished. The unknown was exactly how much each problem would be worth on the student's final average. Some students worked most of the problems in the textbook (150 problems or so), while most students worked less than 25 problems during the semester. The average student in the structural analysis class worked approximately 28 problems. Many lessons were learned from the structural analysis course.

The unmonitored system had many inherent problems such as most students worked only the short problems at the beginning of each chapter, no assessment of the impact of extra credit problems on student knowledge was made, and it seemed as though most students were more interested in finding ways to abuse the system than learning from the extra problems. In a dynamics course the following semester, the extra credit problems were submitted before the student's took a required topic assessment quiz. The number of extra credit problems submitted was multiplied by the assessment quiz score to make certain that students were learning from the extra credit problems. In other words, if a student worked 20 extra credit problems on a particular topic and received a 50% on the assessment quiz, the student was only given credit for 10 problems towards his or her final grade. Although this accountability helped ensure that students were learning from the extra credit, students still attempted to maximize the number of problems worked while submitting solutions that they did not fully understand. In the Fall of 2004, in order to ensure that students fully understood any submitted extra credit exercises, a new assessment action was added. The number of extra credit problems submitted was multiplied by the assessment quiz score and a new extra credit quiz score to make certain that students were learning from the extra credit problems. The new extra credit quiz required all students that submitted extra credit problems for a given chapter to work three randomly selected problems from their submittal without any notes and without consulting their textbook. The randomness was decided by the professor depending on the type of problems worked. In other words, if the student submitted ten problems covering the same topic, the problems selected didn't really matter and three random problems were truly chosen. However, if ten problems covering three topics or more from a chapter were submitted, the professor made certain that problems were selected from as many key topics as possible. The students organized the quiz time and all extra credit quizzes were taken outside of class. This most recent format is the subject of this report. However, the results of the student survey presented in a later section are the results of the dynamics course taught in the previous semester.

THE FORMAT OF EXTRA CREDIT HOMEWORK FOR CIVL 304

This section presents the extra credit format exactly as used for quizzes and exams in a mechanics of materials course (CIVL 304) at The Citadel. The grading format used for the course consists of 25% homework (10 total), 25% assessment quizzes (6 total), 25% midterm exam, and 25% final exam. In addition, students were permitted to work and self check as many extra credit problems as they wished throughout the semester. Each set of extra credit problems on a particular chapter was required to be submitted and signed by the professor before the next chapter's homework was due. In addition, the student was required to take a quiz on the submitted material prior to the following homework assignment due date. For example, extra credit problems covering chapter 4 must be self graded and submitted prior to the chapter 5 homework due date. The chapter 4 quiz over the submitted material must be taken prior to the chapter 6 homework due date. The quiz would be for the student to work three professor selected problems from their extra credit submittal for a given chapter without consulting their book, notes, or prepared solutions. These problems were then graded on an all or nothing basis (i.e., no partial credit was given). The student's "approved" number of extra credit problems would then consist of 1/3, 2/3, or 3/3 times the number of extra credit problems submitted based on their score on the extra credit quiz. For example, if a student turned in 30 extra credit problems for chapter 4 and got 2 out of 3 of the quiz problems exactly right, the student would receive credit for 2/3 times 30 or 20 problems. Students were not told how much the extra credit problems would help their final grade; they were only told that the total number of approved problems would be multiplied by their assessment quiz average (as a decimal and not to be confused with the extra credit quiz) and this value would be multiplied by a professor determined fraction at the end of the semester. The resulting extra credit value would then be added directly to their final exam score allowing them to score over 100 on this exam. The same extra credit format was used in two separate CIVL 304 classes and a total of 40 students had the option of participating.

Figure 1 shows the number of problems worked by all 40 students as related to various topics in the mechanics of materials course. It is required at The Citadel that all civil engineering students pass CIVL 304 with a "C" and as shown in Figure 1, more problems were worked by students after receiving their midterm grade (i.e., post "Diagrams" chapter). Students were not allowed adequate time to fully participate on the final two topics due to the semester's end. All extra credit and extra credit quizzes for these chapters were due one class period after the homework assignment on columns was collected.

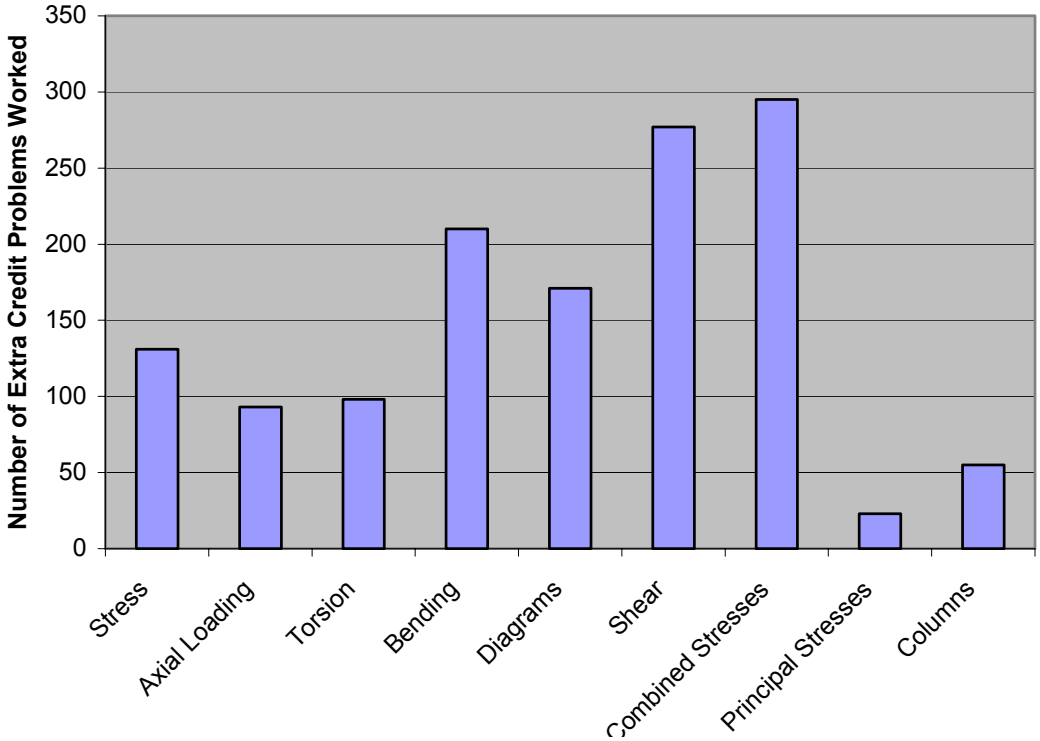

Figure 1. Total number of extra credit problems worked by 40 students in CIVL 304.

Figure 2 shows student responses to a survey given at the end of the semester prior to the announcement that the EC factor would be 0.45 points per problem. Students felt strongly that the format of the extra credit process used in CIVL 304 was fair and that they learn more by participating in the assignments. In regards to participation, it is interesting to note that more students indicate that the extra credit quizzes were more of a deterrent than other activities. Some students provided written feedback on the survey, which included the following:

- "Extra credit quizzes are good because they prevent people from copying from the solutions manual without understanding the material"
- "No extra credit quizzes next time"
- "Don't multiply by the assessment (i.e., not extra credit) quizzes"
- "Don't provide solutions manual to students and make the problems worth more"
- "Assign the value of the extra credit at the beginning of the semester rather than at the end"

CONCLUSIONS

In conclusion, the average student in CIVL 304 completed 34 problems during the semester and received approximately 3 points on his/her final class grade. The student who completed the most problems (108) received approximately 10 points on his/her final class grade. The latest format of extra credit problems used in CIVL 304 seems to have alleviated most of the concerns regarding student cheating. However, some problems with this format still exist. The majority of the problems were worked by students with self reported GPA's ranging from 3.0 to 4.0, which defeats part of the purpose of the extra credit which is to motivate those performing at a lower level. However, following the midterm exam and apparently due to motivation to get the required course grade of "C", several target students elected to participate in the extra credit assignments.

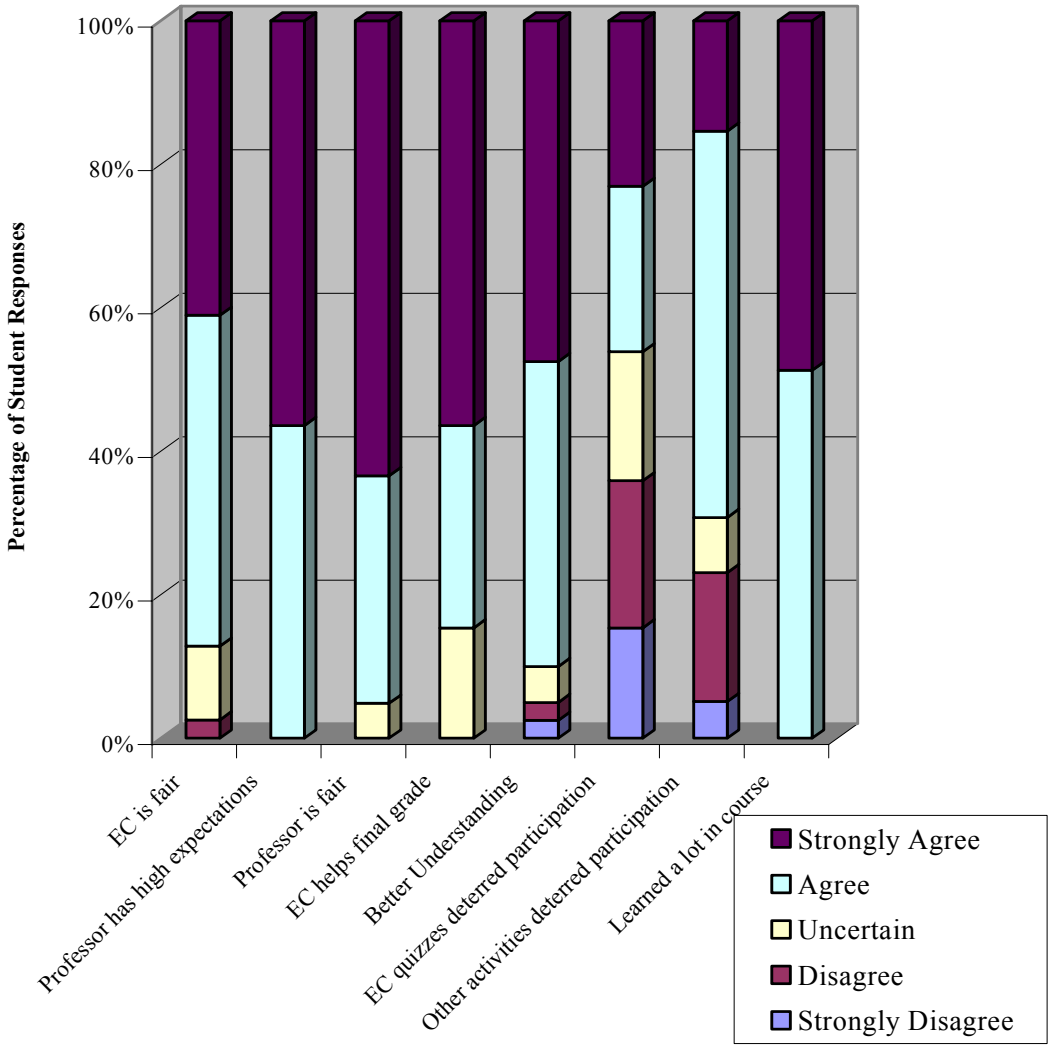

Figure 2. Student responses to survey on extra credit policy in CIVL 304.

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