The Final Exam – To Have or Have Not

Hodge Jenkins[1] and Scott Schultz[2]

Abstract – The time honored tradition of final examinations has long been a standard assessment tool to evaluate student performance, and to provide a means for students to potentially improve their grades. Students must demonstrate knowledge, critical thinking, and competence through these examinations. While most courses have several components for assessing student proficiency of knowledge and understanding, the cumulative final is typically regarded as the best measure of retained knowledge in a subject area. However, knowledge retention and future application by students is unknown, but truly the desired result of learning.

In many engineering courses student work and assessment includes homework, quizzes, projects, 1-hour exams, papers, class room participation, in addition to a final exam. Of these the final is usually weighted the heaviest. While it has been long recognized that students have different learning styles, little attention has been focused on how best to assess the imparted and retainable knowledge and learned abilities of students. Examinations are intended to do just that. However, does the student who crams for the final exam have more knowledge and ability, months after the course than the student who studied all semester and missed the mark on the final? Is other coursework (homework, projects) by students a better tool for assessing a higher level of learning the application of course knowledge? Or, does having several short exams throughout the semester better predict student performance?

This paper reviews two common engineering subject areas and investigates different means of assessing student learning and the effect of final exams on student grades. Results indicate that the final exam scores correlate well with the other course assessment tools. Thus, assessment components based on activities for which students spend large amounts of their time may yield the same results without the necessity of a final exam. (Students may not remember what was on their final exams within a short time period of the final examination; however, they more likely will always remember projects and papers they created.) While not the goal of this study, it is conceivable that project work alone may be a better means of assessment, however, the final exam has and remains the easiest means to review and score.

In conclusion, student grades analyzed from two different engineering subject areas (Statics, Engineering Economy) over a ten-year period show a similar effect, the final exam does little to change the majority of student grades.

Keywords: Final Exam, Statics, Engineering Economy, Student Performance.

Introduction and Background

In this paper the authors investigate the use of the time honored tradition of the final exam as a tool to assess student learning. This investigation is approached strictly from a quantitative standpoint, comparing student grades before and after administration of the final exam.

The academic literature of engineering education has given significant attention to investigations of student assessment and the facilitating of student learning. Steif and Hansen [1] have shown the potential of using concept inventories in a curriculum to improve student performance. Pendergras [2] has shown how non-traditional learning approaches such as cooperative teaching, active learning methods and creating communities of learners has good effects on learning outcomes. Catalano [3] also shows student centered learning methods (non-traditional) to be

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good vehicles to increase student learning. Leydens [4] indicates the use of qualitative learning and approaches to be more successful in learning than current approaches.

Very little has been demonstrated or investigated regarding the use of final exams in true learning outcomes. However, one study has shed some light on the accuracy of faculty grading. Green [5] has shown faculty assessment has a likely uncertainty between 10 to 15 percent with a best case the standard error around 7 to 10 percent. This certainly calls into question the relevance of some evaluation instruments.

The premise for this investigation into the effect of final exams on student assessment (grades) resulted from a general observation by the authors. They observed that in most courses, student grades determined prior to the final examination do not change significantly when the score of final exam was included. To support this observation, they analyzed student grades from two engineering subject areas (courses) taught every semester at most universities, Statics (EGR 232) and Engineering Economy (EGR 312). While the courses are very different, they show a similar effect, the final exam does little to change the majority of student grades. The data presented here covers many offerings of these two courses over 10 years.

PREPARATION OF DATA

Student grade data for the courses investigated here (Statics and Engineering Economy) were readily available and permitted calculating scores considering all inputs but the final exam. Four main evaluation components of student work included in the courses were homework, quizzes, 1-hour exams covering the various topics in the course, and the comprehensive final examinations of 3-hours length. In determining the course grades without the final exam, the final exam score was removed, thereby increasing the weighting of the other 3 evaluations. It should be noted that weight of the various components varied over the 10-year interval. Weighting of each grading component was keep consistent with the grading rubrics of the offering.

In Statics the homework weight varied from 5% to 20% of the final grade, with quizzes varying from 10% to 20%. The sum of all 1-hour exams (2 or 3) varied from 40% to 45% and the weighting of the final exam varied from 25% to 35%. In Engineering Economy, the weighting of the final exam remained constant at 25% over the 10 year study period.

Several measures of evaluation have been used in this study for comparison purposes. These measures are provided by course instances data sets. Ten course data sets were used for Statics and eight course data sets were available for Engineering Economy. The same faculty member taught all course instances in the course data sets in a subject area. Thus, two faculty members provided data for the study, one for Statics and the other for Engineering Economy.

The measures of student performance used in this study are listed in Table 1.

Table 1 Measures of Student Performance

Average Course Grade w/Final	Average Course Grade w/o Final
Percent of Students who did better including a Final	Percent of Students who did worse including a Final
Average Change in Grade including a Final	Average Absolute Change in Grade including a Final
Whole Letter Up	Half Letter Down
Whole Letter Down	Half Letter Up
Total whole Grade Changes.	Total Half Grade Changes

RESULTS

The measures of student performance (Table 1) are summarized by course and listed per course instance. Table 2 gives the data for the changes in student performance with and without a final exam for Statics, while Table 3 provides the same data for Engineering Economy. Figures 1, 3, 5 and 7 plot the average student course score percentage, the average change in course score per student, the absolute average change in course score, and the occurrence of grade changes for Statics respectively. Similar plots are provided for Engineering Economy in Figures 2,4, 6 and 8. The enrollments in the course instances varied from 16 to 29 students with an average of approximately 24 students.

Table 2 Student Performance Changes in Statics With And Without A Final Exam.

Statics										
Instance	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
AVG w/Final	78.6%	75.9%	77.1%	82.2%	79.9%	79.6%	77.3%	77.7%	82.4%	80.8%
AVG w/o	79.4%	77.1%	77.8%	85.1%	80.4%	80.3%	75.9%	79.1%	82.4%	82.6%
grade ratio F/NF	0.99	0.98	0.99	0.97	0.99	0.99	1.02	0.98	1.00	0.98
% Better w/final	25.0%	23.1%	33.3%	3.8%	34.5%	43.5%	75.0%	34.5%	46.2%	20.0%
Percent Worse	75.0%	76.9%	66.7%	96.2%	65.5%	56.5%	25.0%	65.5%	53.8%	80.0%
Ave.Grade Change	-0.8%	-1.2%	-0.8%	-2.9%	-0.5%	-0.6%	1.4%	-1.4%	0.1%	-1.8%
Abs. Ave. Grade Change	1.7%	1.4%	2.1%	2.9%	1.6%	2.0%	2.1%	2.5%	1.9%	2.2%
Whole Letter Up	0.0%	0.0%	4.8%	0.0%	0.0%	4.3%	8.3%	3.4%	0.0%	0.0%
Half Letter Up	5.0%	0.0%	0.0%	0.0%	6.9%	8.7%	0.0%	0.0%	11.5%	0.0%
Whole Letter Down	5.0%	0.0%	0.0%	0.0%	3.4%	0.0%	0.0%	3.4%	0.0%	0.0%
Half Letter Down	5.0%	26.9%	14.3%	26.9%	0.0%	13.0%	0.0%	13.8%	7.7%	25.0%
Total Half Grade Changes	10.0%	26.9%	14.3%	26.9%	6.9%	21.7%	0.0%	13.8%	19.2%	25.0%
Total whole Grade Changes	5.0%	0.0%	4.8%	0.0%	3.4%	4.3%	8.3%	6.9%	0.0%	0.0%

Table 3 Student Performance Changes in Engineering Economy With And Without A Final Exam.

Engineering Economy								
Instance	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
AVG w/Final	81.4%	86.8%	89.3%	87.9%	85.7%	85.1%	85.7%	85.0%
AVG w/o	82.3%	88.0%	90.4%	89.4%	87.5%	86.9%	86.3%	86.2%
grade ratio F/NF	0.99	0.99	0.99	0.98	0.98	0.98	0.99	0.99
% Better w/final	18.8%	34.5%	36.8%	19.0%	28.0%	5.9%	44.0%	25.9%
Percent Worse	81.3%	65.5%	63.2%	81.0%	72.0%	94.1%	56.0%	74.1%
Ave.Grade Change	-1.0%	-1.2%	-1.1%	-1.5%	-1.8%	-1.8%	-0.6%	-1.3%
Abs. Ave. Grade Change	1.7%	1.8%	1.9%	2.0%	2.2%	1.9%	1.5%	1.9%
Whole Letter Up	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Half Letter Up	0.0%	0.0%	0.0%	4.8%	0.0%	0.0%	4.0%	14.8%
Whole Letter Down	1.6%	3.4%	5.3%	9.5%	0.0%	0.0%	4.0%	0.0%
Half Letter Down	1.1%	20.7%	10.5%	19.0%	20.0%	5.9%	12.0%	14.8%
Total Half Grade Changes	1.1%	20.7%	10.5%	23.8%	20.0%	5.9%	16.0%	29.6%
Total whole Grade Changes	1.6%	3.4%	5.3%	9.5%	0.0%	0.0%	4.0%	0.0%

Figure 1. Average Student Course Score Percentage In Statics With And Without A Final

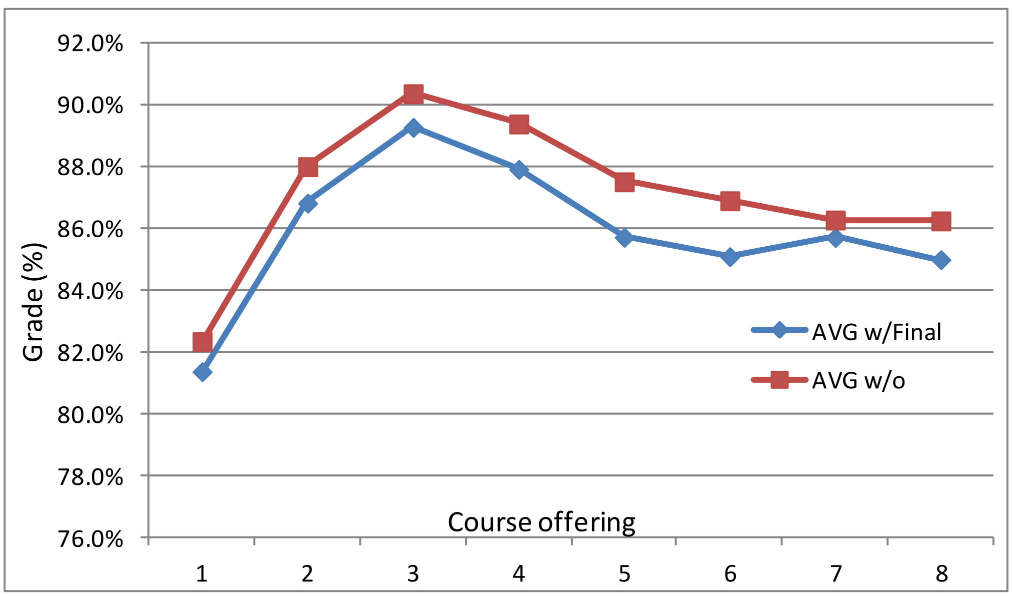

Figure 2. Average Student Course Score Percentage In Engineering Economy With And Without A Final

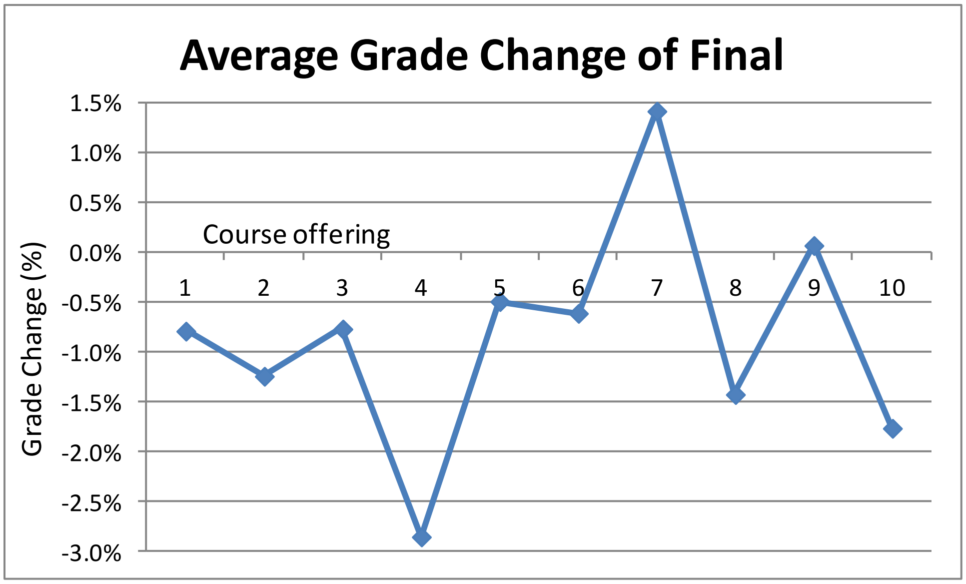

Figure 3. Average Student Course Score Change In Statics With A Final

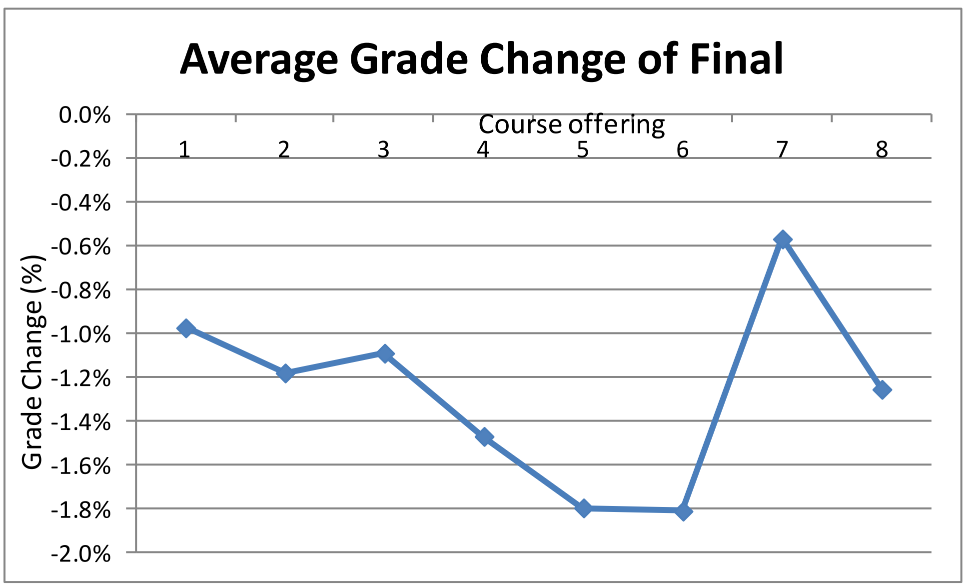

Figure 4. Average Student Course Score Change In Engineering Economy With A Final

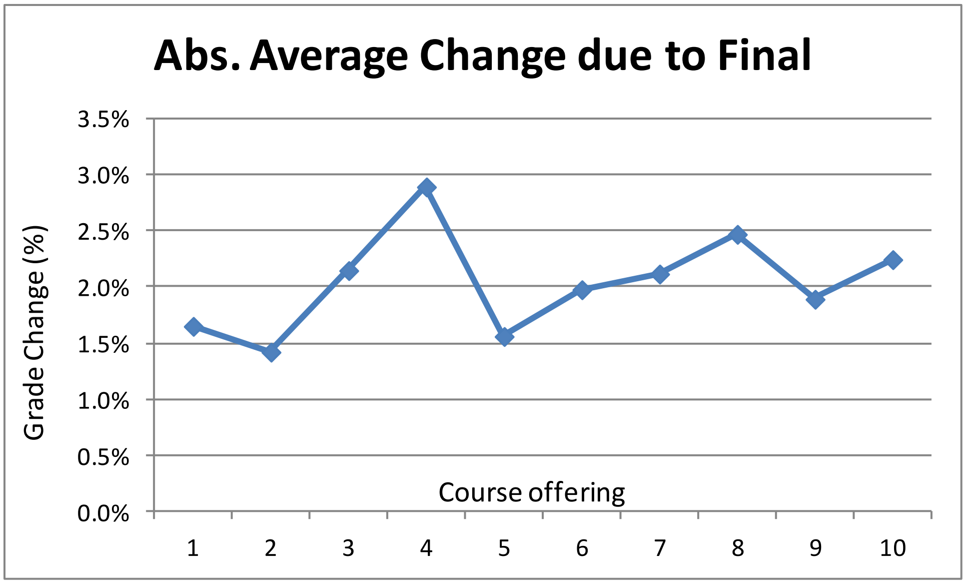

Figure 5. Average Absolute Student Course Score Change In Statics With A Final

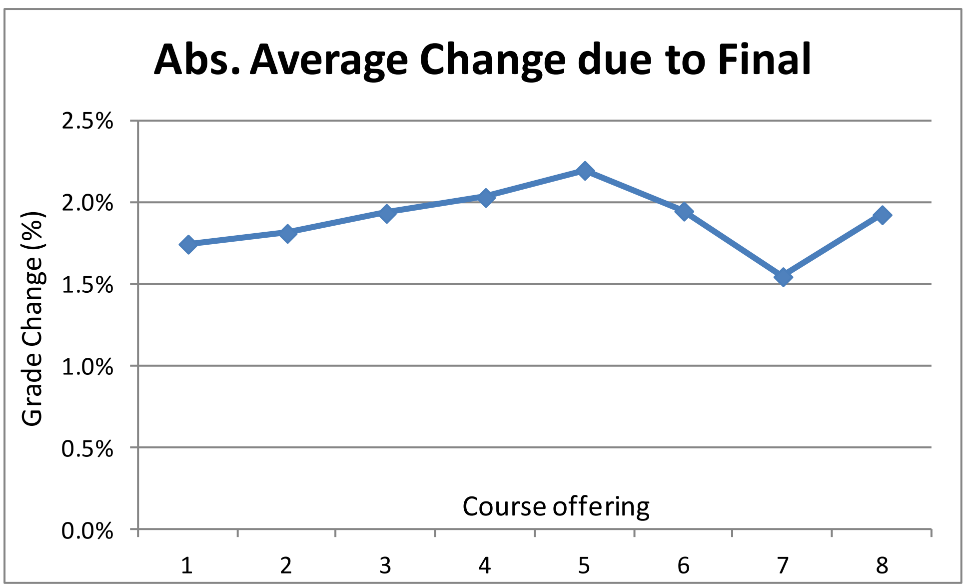

Figure 6. Average Absolute Student Course Score Change In Engineering Economy With A Final

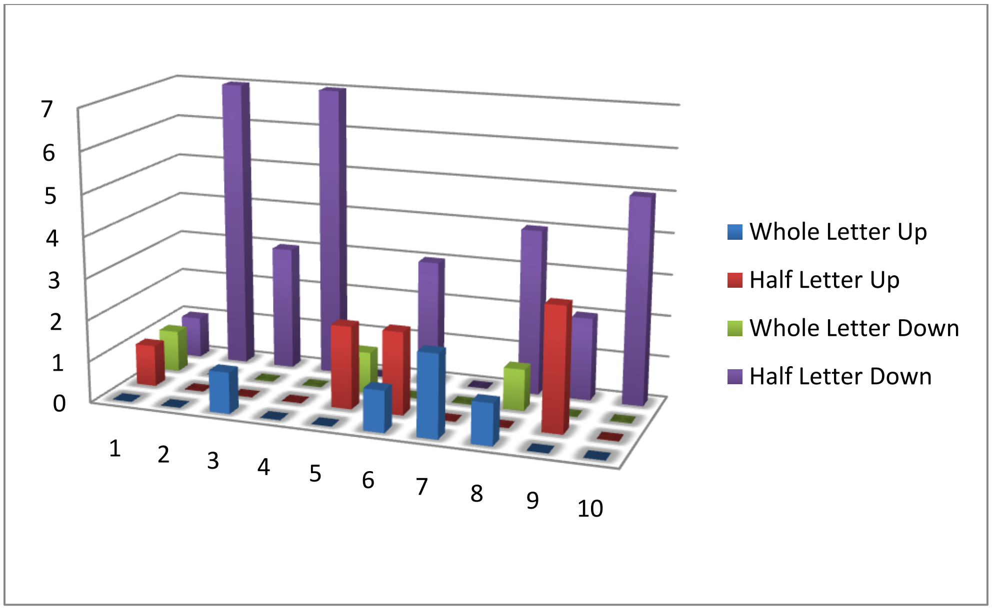

Figure 7. Occurrences of Letter Grade Changes in Statics with a Final

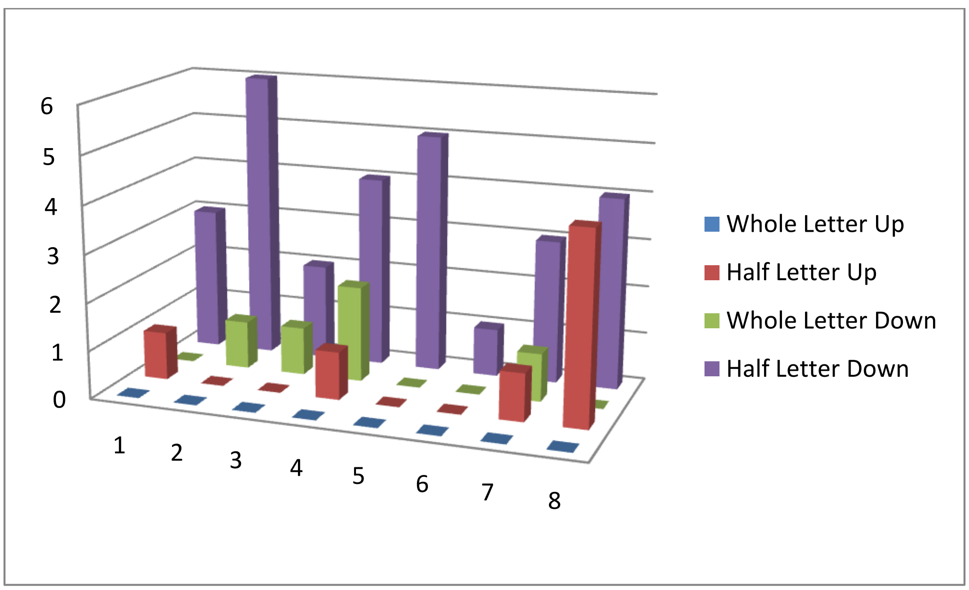

Figure 8. Occurrences of Letter Grade Changes in Engineering Economy with a Final

RESULTS DISCUSSION

In examining the data, similar results are observed for both courses. Trends and effects indicate that final examinations do not generally improve student grades. Note however, there were two instances of average improvement for Statics, while there were no instances for Engineering Economy. More typical is that the average numeric grade decreases with a final examination. Changes were usually on the order of 2% and in no instance was the change 3% or larger. This is well within the faculty assessment error and uncertainty as shown by Green [5].

The largest effect of the final exam was in causing grade changes. Approximately 18% of the students realized grade changes after taking the final exam. 15% of the students realized a decrease in their final letter grade. Most of the grade changes happen near the grade cut-off regions, and constitute a half letter grade change. Approximately 3% of the students did receive a full letter grade change after taking the final exam.

No evidence in the literature has been provided that indicates the final examination improves learning retention. Nor does this study attempt to answer this question. This quantitative investigation indicates that the overall average numeric grade changes little upon inclusion of the final exam. And for the majority of the students, there is no impact on their final grade.

While the final exam may serve as a potential motivator for the goals of additional learning and understanding of material, the data presented here does not support this premise.

CONCLUSIONS

The effect of the final examination on the average numeric course grade is less than 3%, less than one estimate of faculty evaluation accuracy [5]. The majority of students see no change in their grade after taking the final examination. Learning and retention of a subject are accomplished over time and with continued use, thus the flurry of study and preparation of students for a final exam most likely has little effect on this academic goal. The use of a final examination does not seem necessary, especially in courses where information and knowledge is cumulative. A last hour exam given at the end of the regular course meetings is all that may be needed to adequately motivate and assess student performance.

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