Quiz re-takes: Which students take advantage and how does it affect their performance?

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Moving from summative to formative through the use of quiz re-grades.

Engineering students are typically given summative assessments to determine how much they have learned. They are not, however, given a chance to use the assessment as a tool for learning itself. More plainly, we often do not allow students to learn from their mistakes. Typically engineering students are given one chance to show what they know in a quiz or exam. Once the quiz or exam is turned back the students may be given a solution but rarely have any incentive to look at it again. Here we discuss how using a quiz for learning (as a formative assessment) can be obtained by introducing the option of a quiz re-grade.

We will specifically discuss how re-grades were incorporated into a large 3rd year Introduction to Environmental Engineering class. Graded quizzes were returned to students with minimal comments. The students then had one or two weeks to return the quiz and correct their mistakes and earn up to 50% of their missed points back. No points were returned unless the students explained what they did wrong and how to correct their mistakes. The instructor was available during normal office hours to help students with their questions about the quiz.

This presentation will address four main research questions based on students' grades and a survey: 1. Who are the students that took advantage of the quiz re-grading? We found that about 90% of the students turned in at least one quiz for re-grade. In addition we found no correlation with initial quiz grade, gender or major. 2. What are the reasons students chose to turn in quizzes for re-grade? We found that students mainly turned in the quiz for re-grade in order to improve their grade. However many students also mentioned wanting to deepen their understanding. 3. How did students prepare to turn in the re-grades? Students mainly turned to their peers and their notes, not to the instructor of the course. 4. What was the result of the re-grades in terms of learning gains and self-efficacy? Our results suggest that re-grading allows quizzes to become more formative as they lead to greater learning gains. In addition they may improve student motivation through increased self-efficacy.

Introduction

In engineering classes student learning is often assessed through quizzes or exams. The students take the quiz and the instructor then assesses their knowledge and ability to apply this knowledge to a problem. This assessment helps the instructor develop "useful information about their students, institutions, programs, and courses and also about themselves" [1]. We can think about this type of assessment as summative: its goal is to evaluate learning at the end of instruction and often to compare results to a standard.[2] However, with today's emphasis on student-centered instruction, assessment should also promote learning and should show students what they should be learning[3]. This distinction is frequently explained as the difference between 'assessment of learning' (for validation and accreditation) and 'assessment for learning' (to support learning and understanding). The latter is known as formative assessment.

When a quiz or exam is used as a summative assessment only, the student may view grades as having a severely detrimental effect on learning.[4,5,6] Often students feel that exams have little to

do with the more challenging task of trying to understand their subject.[7] For example, in one study both undergraduate and graduate students revealed that they felt their education would have been broader if the pressure to receive high grades had been eliminated.[8] In addition a formative assessment may have a negative impact on students' self-efficacy (individual judgment about being able to perform an activity) and therefore their motivation to learn.[9] If the goal is learning, are there ways that we can continue to monitor and measure learning so that students don't feel under pressure and can see the value in grading?

We were interested in exploring how to incorporate more formative assessment into a large Introduction to Environmental Engineering class. While both summative and formative processes are complementary and both address "what has the student learned" more significant learning gains can be made when formative assessment results are used to inform the instructional and learning process.[10] Various forms of formative assessment are used to provide feedback and allow for corrections to be made to student work. One approach, re-grading, has been a cornerstone of the "mastery approach" where students revise and resubmit assignments for re-grading. Integral to this approach is feedback that helps students learn more about their performance and how to proceed when facing difficulties.[11] Another approach, personalized instruction[12], includes peer proctoring and self-proctoring or self-grading. Student evaluation of their own performance supports Gagne's[13] premise that "…the student must be progressively weaned from dependence on the teachers or other agents external to himself." Formative assessment can occur if students have the chance to "incorporate that feedback into further practice."[9] That is, students will benefit most if they are able to receive feedback from their mistakes on a quiz and are given the opportunity to correct their mistakes.[9]

In this paper, we hypothesis that quizzes (or exams) can be used as both summative and formative with the incorporation of re-grades. The introduction of re-grades allows the quizzes to act more as an assessment "for learning" while still revealing what was learned. We have four main research questions: 1. Who are the students that took advantage of the quiz re-grading? This is measured by academic performance in the class, gender and major. 2. Why did the students chose to turn in quizzes for re-grade? 3. How did students prepare to turn in the re-grades? 4. What was the result of the re-grades?

In addressing the questions, we will share data on whether the students who took advantage of this opportunity perform better than expected on the cumulative final exam. We show here that student's learning of the material in a 3rd year Introduction to Environmental Engineering class increases when students take advantage of re-grades. Our findings will also reveal if the assessment moved from summative for formative with the re-grade option. Through the use of survey we have some insights on students' perceptions about an increase in self-efficacy and a decrease in test anxiety. We show that students perceive less stress during the assessment and have a more positive attitude toward the assessment when re-grades are introduced.

Methods and Materials

This study took place within a large (~80 students) Introduction to Environmental Engineering class at Penn State University. The course is taught in a flipped format where students watch a series of short videos and come to class to review, work on homework problems and take mini clicker quizzes. This course is required for all Civil Engineering students who usually take it in their third year. However, there are a number of students from other majors who take the course either to fulfill a technical elective or because they are obtaining a minor in Environmental Engineering.

The students were given seven quizzes through the semester as well as a cumulative final exam. These quizzes took place during a 50 minute class period. The quizzes together were worth 50% of the grade while the cumulative final was worth 20%. The quizzes were graded with little written feedback. Sometimes this meant that only the number of points was taken off. Sometimes one number or word in the problem statement was circled to help students identify their mistake. The solutions were never provided. Students were then given the opportunity to turn back in the quizzes for re-grade for the first six quizzes only. They were not given any restrictions for the re-grade. They could look at their peer's quiz or come and see the instructor. They were given the following statement in the syllabus:

Quizzes can be resubmitted for re-grade one week after they are handed back to receive up to 50% of the missed points. In order to receive these points you must explain what you did wrong the first time and how you have corrected this error.

It was made clear that the students could not simply re-solve the problem but an explanation needed to accompany the problem. If the student did not answer the question on the quiz, they were still required to explain their solution.

In this paper we asked four main research questions:

1. Who are the students that took advantage of the quiz re-grading?

2. Why did students chose to turn in quizzes for re-grade?

3. How did students prepare to turn in the re-grades?

4. What was the result of the re-grades? Did the students who took advantage of this opportunity perform better than expected on the cumulative final exam? Did the assessment move from summative for formative with the re-grade option? Did the students perceive an increase in self-efficacy and a decrease in test anxiety?

In order to answer these questions we compared students quiz grades before the re-grades to their cumulative final exam scores. We only include the grades of the 65 students who agreed to be part of this research study. In addition we asked for student feedback through use of a student survey. This survey was given during class time.

Results

Question #1: Who are the students who took advantage of the quiz re-grading? This will be discussed in terms of academic performance and demographics.

We sought to explore the characteristics of the students who chose to turn in a quiz for re-grade. Table 1 shows that the average number of re-grades did not change significantly with major or gender of students. Each group of students turned in an average of 3 – 4 out of the 6 quizzes for re-grade.

Table 1: Average number of re-grades vs. gender and major.

	Average # of Re-grades
Civil Engineering (38)	3.5 ± 0.5
Other (27)	3.2 ± 0.8
Female (20)	3.2 ± 0.8
Male (45)	3.4 ± 0.6

In addition we hypothesized that students who performed worse on the quiz initially would be more likely to turn in quizzes for re-grades. Table 2 shows that even the majority of high performing students (with an "A" average) turned in quizzes for re-grades. In addition thirty-eight percent of students with a "C" average turned in all 6 quizzes for re-grade. Note that this also shows that only 7 students out of 65 (~10%) chose not to turn in any quizzes for re-grade. Although the trend seems to indicate the students with a lower initial grade turn in more quizzes, the trend is not significant.

Table 2: The number of quiz grades turned in for re-grade based on the average quiz grade before the re-grade. The ± represent 95% confidence intervals.

Average Initial	**# of quizzes turned in for re-grade**							
Quiz Grade	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**average**
A	3 (18%)	4 (23%)	0	4 (23%)	2 (12%)	3 (18%)	1 (6%)	**2.6 ± 1.0**
B	3 (11%)	2 (7%)	4 (14%)	6 (22%)	9 (32%)	4 (14%)	0	**3.0 ± 0.6**
C	1 (7%)	1(7%)	0	0	5 (38%)	2 (15%)	5 (38%)	**4.4 ± 1.1**
D	0	0	2 (40%)	0	1 (20%)	1 (20%)	1 (20%)	**3.9 ± 2.2**

Question #2: What are the reason students chose (or not) to turn in the quiz for re-grade?

If high performing students still turned in quizzes for re-grade, we wondered if the motivation was solely for grades. Students were asked on a survey if they turned in a quiz for re-grade. If they did turn in a quiz for re-grade they were asked for their reasons. If they didn't turn in any quizzes for re-grades they were asked why they chose not to do so. Results show that the student grade is the main motivation for choosing whether or not to turn in a quiz for re-grade. Table 3 shows that 83% of students chose to turn in a quiz for re-grade in order to improve their grade in the class. Similarly, of the students who did not turn in a quiz for re-grade, 64% said they were

satisfied with their grade (Table 4). However, 38% of students commented on the benefit of both an increase in their grade and an increase in understanding when they turned in a re-grade. This finding shows that some of the students saw this as an opportunity to deepen their understanding, not just to improve their grades.

Time was also a factor in the decision to pursue a re-grade. For the students who did turn in a re-grade, 10% of the students did so because the time investment was small and worth the extra points (Table 3). This was usually because the mistakes were "minor" or "stupid." On the other hand, less than half the students who did not turn in all the re-grades mentioned that time was the limiting factor in their choice not to turn in the re-grades (Table 4).

Table 3: Fifty eight students answered the question "Why did you turn in a quiz re-grade?" on the student survey. Their responses are listed below along with example quotes.

Reason	Percent of students	Example quotes
To improve my score	83%	*Grade was below a 93.* *Always looking for a way to improve my grade.* *I would love to get an A in the class.*
Improve score AND understanding	35%	*More point, points motivate me to understand what I did wrong.*
Improve score AND easy points	9%	*Errors were generally minor so they didn't take long and I could get some points back.* *I made several "stupid" errors where I knew how to do the problem, but made a mistake. Re-grade allowed me to correct mistakes and regain points.*

Table 4: Fourteen students answered the question "Why did you NOT turn in a quiz for re-grade?" on the student survey. Their responses are listed below along with example quotes. Some students who turned in at least one quiz commented on why they did not turn in all quizzes for re-grade.

Reason not to turn in re-grade	Percent of students	Example quote
I was satisfied with my grade.	64% 9 students	*My grade was high enough that a re-grade did not make sense.*
Didn't have time	43% 6 students	*Not enough time in my schedule to do the re-grades on top of the homework…*
Not sure of correct answer	7% 1 student	*The ones I did not turn in for re-grade I did not have time to do and/or was not sure of the answer.*

Question 3: How did students prepare to turn in the re-grades?

We were interested in *what* students did to incorporate their feedback into practice. The students were asked what they did to prepare to turn in the quiz for re-grade (Table 5). The students were not given any instruction or recommendations about how to prepare to turn in the quiz for re-grade. In the survey, one third of the students reviewed their notes while one fourth reviewed the homework or asked their peers for help. Surprisingly only 11% asked the instructor either during class or during office hours.

Table 5: Students were asked on the survey what they did to prepare to turn in the quiz for re-grade. More than 20% of the students reviewed their notes and homework and discussed the re-grades with their peers. Students were able to look at their peers' quiz for help. Less than 10% asked the instructor or teaching intern for help.

"What did you do to prepare to turn in your quiz for re-grade?"	Percent of students
Reviewed notes	29%
Reviewed homework	25%
Asked my peers questions	24%
Re-watched lectures	13%
Looked at my peers' quizzes	12%
Searched the internet	8%
Asked teaching assistant during office hours	7%
Asked instructor during office hours	6%
Asked instructor during class	5%
Looked at book	2%
None of the above	1%

Question #4: What was the result of the re-grades? Did the students who took advantage of this opportunity perform better than expected on the cumulative final exam? Did the assessment move from summative for formative with the re-grade option? Did the students perceive an increase in self-efficacy and a decrease in test anxiety?

We hypothesized that quiz re-grades would be truly formative and would improve learning gains. We assessed this by comparing initial average quiz grades (before re-grades) with the final exam score. Figure 1 shows the percent improvement on final exam grade (compared to initial average quiz grades) vs. the number of quiz re-grades that were turned in. Note that the average percent improvement was 0.84 +/-0.03% for all students. This analysis is slightly confounded since there are larger possible percent improvements for students with lower initial quiz averages. Nevertheless, the general trend is that students perform better on the final exam if they turn in at least one quiz re-grade.

Students who did not turn in any quiz re-grades performed statistically worse on the final exam compared to their initial average quiz grade. In addition there is a significant difference (based on 95% confidence interval) between students who did not turn in any re-grades (-9% +/-6%) and those who turned in 5 (7% +/-8.5%) re-grades. The average for the number of students who turned in all six re-grades is confounded by one student who received a 92% on the initial quiz average and an 84% of the final exam. If this student's grade is removed (out of a total of seven students) the percent improvement for six re-grades turned in is 5.8% +/- 5.7%. This graph will be used in subsequent semesters to encourage students to turn in quiz re-grades.

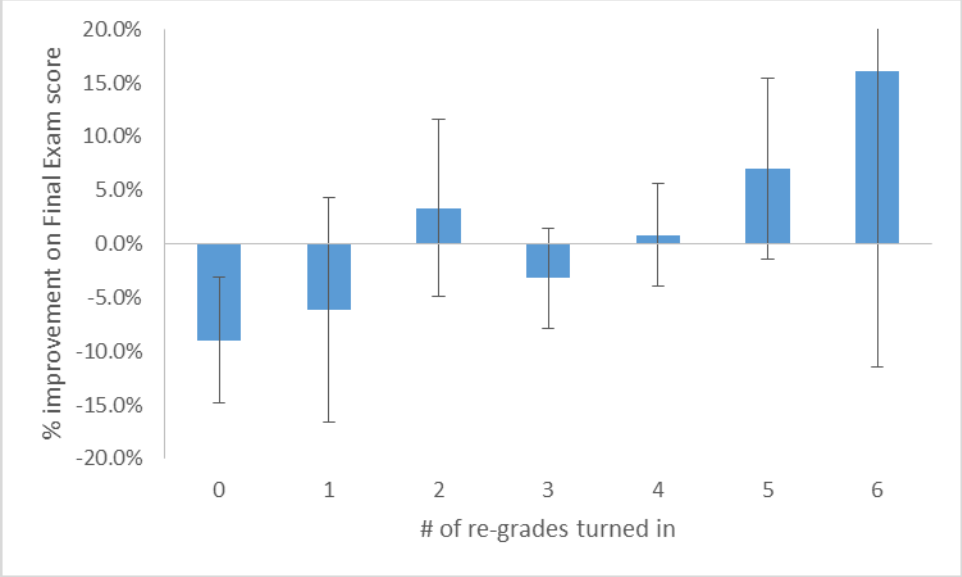

Figure 1: Improvement on Final Exam score (compared with initial quiz grade) vs. # of re-grades turned in. The average percent improvement was 0.84 +/-0.03% for all students. There is a significant difference (based on 95% confidence interval) between students who did not turn in any re-grades (-9% +/-6%) and those who turned in 5 (7% +/-8.5%) re-grades.

In addition we found that the neither the initial quiz grade nor the percent improvement varied statistically with either major or gender (Table 6).

Table 6: Average initial quiz grade and percent improvement on final exam based on gender and major.

	Average Initial Quiz Grade	% Improvement on Final Exam
Civil Engineering (38)	81 ± 4	-2% ± 3%
Other (27)	82 ± 4	3% ± 4%
Female (20)	79 ± 5	3% ± 6%
Male (45)	83 ± 3	-1% ± 3%

Students were asked a number of questions about their perceptions of the quiz re-grades. The questions were designed to measure the students' preference, self-efficacy, test anxiety and

motivation to study. The responses are summarized in Table 7. A student's self-efficacy is directly related to their motivation to learn.[9] These results show that re-grades increased students' self-efficacy. The majority of students stated that the re-grades deepened their understanding of the material and allowed them to believe they would perform better on the final exam. In addition the vast majority (89%) of students stated that they would like to have the re-grade option in all of their classes.

In addition students stated that the re-grade option reduced test anxiety without limiting their preparation for the quiz. The majority of students (78%) stated that the re-grade option reduced their stress while taking the quiz. Even though the students knew that they would get another chance to show that they learned the material, a majority of students stated that they did not study less because of this option.

Table 7: Student responses to questions in survey.
Note that student would like to have the re-grade option in all their classes, found that the re-grades deepened their understanding, reduced their stress and gave them more confidence. Most of the students did not study less or think that the re-grades were unfair.

	Strongly disagree/ Disagree	Neutral	Strongly agree/ Agree
Preference I would like to have a re-grade option in all of my classes.	2%	9%	89%
Self-efficacy I think that being able to turn in re-graded quizzes helped deepen my understanding of the material.	3%	12%	85%
Self-efficacy I think I will do better on the cumulative Final Exam because I was given a chance to turn back in the quizzes for re-grade.	8%	29%	63%
Test anxiety The ability to turn in a re-grade reduced my stress while taking the quiz in class.	5%	17%	78%
Motivation to study I studied less for the quizzes because of the re-grade option.	65%	20%	15%
I think that re-grade option is unfair because it helps poor performers the most.	75%	25%	0%

Conclusions/Recommendations

Most students take advantage of the option to turn in quizzes for re-grades, regardless of their major, gender or academic performance. Primarily students chose to turn in re-grades to improve their grades (or chose not to because they don't need to improve their grades). Secondarily students chose to turn in re-grades to deepen their understanding, or to obtain mastery. The students turn to their peers and notes for help in correcting their mistakes. Finally our results suggest that re-grading allows quizzes to become more formative as they lead to greater learning gains. In addition they may improve student motivation through increases self-efficacy.

One limitation in applying this approach is that re-grades may take more instructor time. In this study instructor time on the re-grade was not quantified. Future work will include a more thorough look at the time spent. There are however, a few hidden time savers that we would recommend. One recommendation is that the instructor limit the written feedback on the student's quizzes or exams. This approach puts the ownership on the student to find their mistake. During the Spring 2015 semester the instructor required that all re-grades be accompanied by the following sheet in order to expedite grading:

Name: _____ Original grade: _____

Section: _____ New grade if all points are awarded: _____

Quiz #: _____

Quiz Re-grade guidelines.

This sheet should be on top. Staple this sheet to your original quiz.

1. For each question that you missed you must explain what you did wrong and what you did to correct your mistake. Please note that you cannot receive points back if the problem was left blank.

2. For each problem please include the number of points you hope to get back on each question. You may receive up to 50% of the points back.

3. If you feel that there was an error in grading you may include this as well for more than 50% of the points back.

Another recommendation is that students are guided on how to prepare to find and correct their mistakes. The instructor can guide the student to various resources (notes, books, peers, instructor) as well as showing examples of appropriate responses in the re-grade. We recommend that students be shown the improvement of final exam score as an added motivation to participate in the quiz re-grade opportunity. Future work will include quantifying instructor time and looking at how students perform on specific learning objectives, not just on the overall final exam.

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