

Professor and Student Response to the Daily Quiz

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In an academic environment where teamwork is stressed, assessing individual competency can sometimes be a challenge. The benefits of students learning by working with other students is clear, unfortunately any grader of homework can readily identify the members of a particular study group through obvious similarities in approach, and more often through the repeated obscure error. The temptation of the 'weaker' or 'busy' student to copy solutions without participating in the learning process is often overwhelming. Further, the continual expansion of topics covered in many engineering courses has placed a greater emphasis on student learning outside of the classroom. Students who are well prepared through completing reading or other preparatory work prior to attending class make the time spent in class more productive. Any method to encourage this behavior is to the advantage of the instructor.

One method that may be employed to assess individual competency is through the use of regular quizzes. However, several days worth of material, even if in the same chapter in a text, may have many fundamental points that are worth stressing. A short quiz is not capable of covering the large number of topics covered if administered on a weekly basis. The intent of the daily quiz is to encourage students to complete class preparatory assignments, maintain complete understanding of homework problems, and provide the faculty with a means of assessing individual student performance over a wide array of course topics. The additional work involved with grading the quizzes is balanced by the elimination of homework grading. Further, daily quizzes covering reading assignments are easily written in true-false, matching, or multiple choice formats for easier grading.

This technique has been used in several courses over the past year, including twice in the junior-level Fluid Mechanics course, and senior-level courses Water Treatment, Wastewater Treatment, and Societal Concerns in CE. This paper will use the data set from the second offering of the Fluids Mechanics course, administered in the Fall of 2004 as it is the most complete data set to date. The class consisted of 39 students, two of whom stopped attending after the first midterm. The students were equally divided between the departments of civil and mechanical engineering, with two women and 35 men completing the course. In addition to the two failures, three students failed to achieve a grade of "C or better" and the class average grade was a 2.51 on a 4.00 scale (B-/C+). A total of 24 quizzes were administered over a 10 week quarter, 11 of which were reading quizzes, 12 of which were homework quizzes, and one was a survey of students' response to the daily quiz format. Homework quizzes were either one of the homework problems, or a similar problem from the text. Reading quizzes were developed from assigned material in the text, and several examples are offered in the Appendix at the end of this paper.

Overall student performance as compared to student's cumulative GPA and their daily quiz average is presented in Figure 1. Cumulative GPAs were only available for Civil Engineering

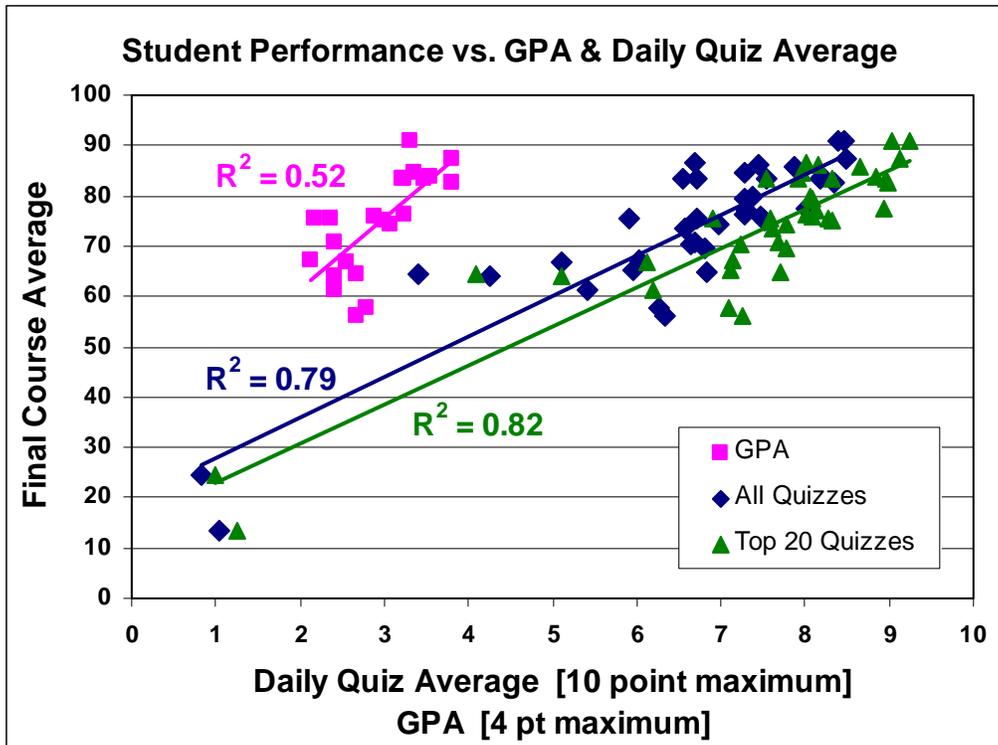


Figure 1. Overall student performance compared to GPA and daily quiz average.

students, and as such is the only GPA data presented. Further, while 24 daily quizzes were administered to the study group, the final grade only included the top 20 (i.e. the lowest 4 quiz grades were dropped). From the data, the dropping of the lowest 4 quizzes seems to have only a minimal effect on the correlation between final grades and quiz average. It is interesting to note that even the students that stopped coming to class seem to be somewhat predictable based on a linear curve fit. Regression analysis performed on the data shown in Figure 1 indicated that all correlations are significant at the 1% level.

The most important observation from this data is the suggestion that the daily quiz average is a better predictor of student performance in this class than is cumulative GPA. Further, while not always true, students with cumulative GPAs in the 2.1 to 2.8 range indicate that the trend is inverse of the entire set. That is to say, the 2.1 student was just-as or more likely to get a grade in the mid 70s, while the 2.8 student was more likely to get a grade in the high 50s or low 60s. One interpretation of this may be that the 3.0-4.0 students perform consistent with their ability that has been historically demonstrated in their past courses, but some of the marginal students benefited by the daily quiz format. This would suggest that the stronger students either had appropriate study habits prior to this course or their natural abilities also carried them through Fluid Mechanics. However, some of the marginal students seem to have been positively influenced by the daily reading or homework assignment and therefore performed at a higher level than their historical performance would have predicted.

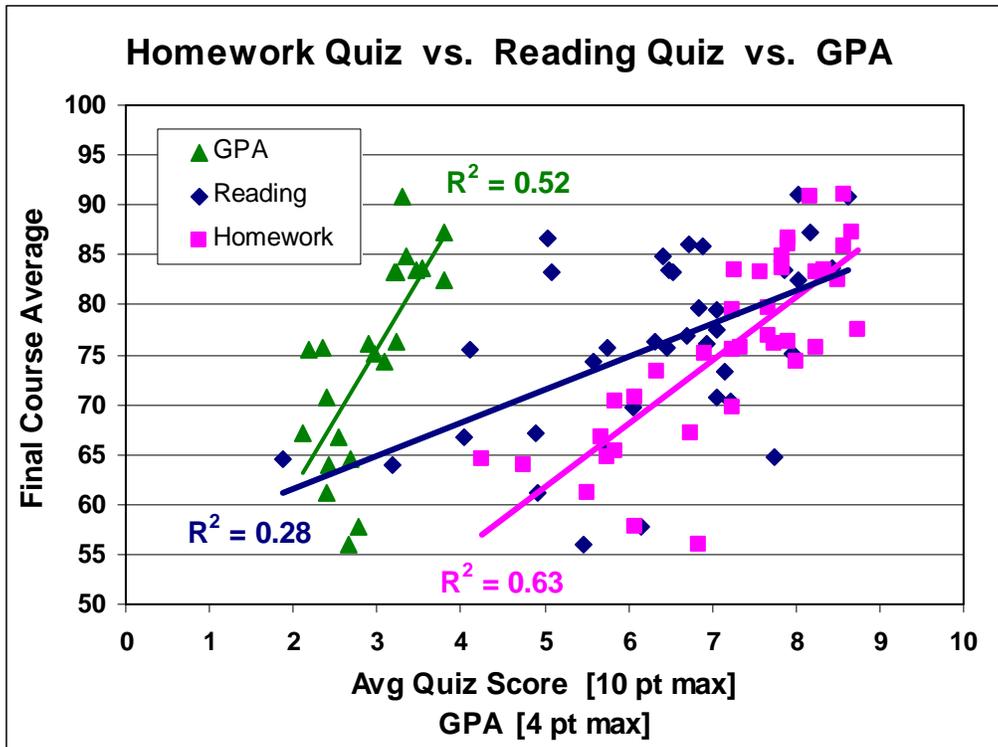


Figure 2. Homework/reading quiz averages and GPA compared to final course average.

For the students that completed the course, the homework quiz average had a better correlation to final course grade than did cumulative GPA or the reading quiz average as seen in Figure 2. While the correlation between the homework quiz and cumulative GPA indicates that the homework quiz is only marginally better at predicting overall course performance, the reading quiz had a significantly lower correlation with final course grade. This would be consistent with student comments that suggested homework quizzes were good practice for the exams, which comprised 80% of the final grade, while the reading assignments did little for student comprehension or their ability to solve problems. Regression analysis performed on the data shown in Figure 2 also indicated that all correlations are significant at the 1% level.

A survey was administered as quiz number 24 during the last week of the class to gauge student response to the daily quiz. A copy of the quiz that includes all questions is included in the Appendix at the end of this paper. Students were asked to respond to each question on the following scale; (1) strongly disagree, (2) disagree, (3) neutral, (4) agree, and (5) strongly agree.

When asked if the reading assignments were closely related to course topics and material covered on the daily quiz in questions 1, 2, and 3 of the survey, 83% of all responses were strongly agree or agree (SA/A) and only 2% of responses were disagree or strongly disagree (D/SD). The responses improved to 99% SA/A and 0% D/SD when asked the same questions with respect to the homework assignments in questions 11, 12, and 13 of the survey.

Questions 4, 5, 14, and 15 of the survey were included to determine if the students felt that the daily quiz encouraged their study habits or if they felt intimidated (scared) into doing the work.

While 87% of students SA/A that the daily quiz encouraged them to do the homework, only 70% SA/A that the daily quiz encouraged them to complete the reading assignment. Less than half of the students (41-46%) responded that they SA/A that the daily quiz scared them into completing their assignments while nearly as many (22-30%) responded that they D/SD that they were scared into doing so. In general, the student responses suggest that the daily quiz was viewed by them as a carrot more so than a whip.

Other questions were used to determine if the daily quiz had a greater impact on study habits in the beginning of the quarter as compared to the end of the quarter. Questions 7 and 17 of the survey asked if the daily quiz guided the students' studying during the first few weeks of the course while questions 8 and 18 of the survey asked if the same were true for the last few weeks of the course. Survey responses showed that 84% of students responded that they SA/A that the daily quiz guided their homework completion at the beginning of the quarter, dropping slightly to 62% that said that this was true for the end of the quarter. An equal number (84%) of students also responded that the daily quiz guided their reading habits at the start of the quarter, however only 24% said that this was true in the last few weeks and over half (54%) responded that they D/SD that the daily quiz guided their reading in the last weeks of the course.

When asked if completing the homework assignment helped the students to better understand the previous lecture or course topic (survey questions 19 and 20), nearly 80% responded that they SA/A, while less than 10% responded that they D/SD. On the contrary, when asked if completing the reading assignment helped the students to better understand the following lecture or course topic (survey questions 9 and 10), only 46% responded that they SA/A, while 31% responded that they D/SD. While 46% is nearly half of the number of students that responded positively to the same question regarding homework problems, it is still the case that nearly half of the students felt the reading assignment was beneficial in grasping course concepts. This is especially encouraging in light of the fact that engineering students usually see themselves as learning better through problem solving rather than reading or writing assignments.

Finally, with regard to survey questions 23 and 24 that asked if it was more beneficial to review the homework daily quiz or to simply provide solutions, 97% of the students responded that they SA/A that the review helped their learning, but nearly the same number (89%) responded that they SA/A that providing the solutions was sufficient. In both cases, 0% of the students responded that they D/SD that review or distributed solutions enhanced their learning.

Another interesting outcome from the Fall 2004 Fluid Mechanics class were the end of quarter course evaluations. While there was a concern that students might use the course evaluation to voice their frustrations caused by daily reading and/or homework assignments and quizzes most class periods, the results from the course evaluations suggest that this was not the case. Table 1 presents course evaluation scores (on a 4.00 scale) from the Fall 2004 Fluid Mechanics course as compared to the instructor's historical evaluation scores from the past 9 years. Most positive written comments about the quizzes related to keeping students on track throughout the entire quarter. Most negative comments about the quizzes centered on the reading quizzes. Several students suggested the elimination of the reading quiz, but didn't mind if they were replaced with additional homework quizzes.

Table 1. Results from Fall 2004 fluid mechanics course evaluation compared to instructor's historical averages (4.00 scale).

| Evaluation Questions | | This Course | Historical Average |
|----------------------|---|-------------|--------------------|
| Q 1-7 | Organization and presentation effectiveness; answering questions; use of examples; presentation/text material; assignments; exam content; grading | 3.64 | 3.37 |
| Q 10 | Overall quality of instruction in course | 3.89 | 3.49 |
| Q 11 | Amount of learning | 3.49 | 3.14 |
| Q 12 | Level of difficulty | 2.86 | 2.69 |
| Q 15 | Should this Professor be considered for the college teaching award Y/N? | 94% Yes | 65-70% Yes |

In conclusion, it appears that the daily quiz is viewed by the students as reasonable means to encourage completion of daily assignments, especially in the first few weeks of the quarter, while the reading assignments were generally not completed towards the end of the quarter. Many students prefer the traditional problem solving homework assignments and subsequent quiz, however nearly half of the students strongly agreed or agreed that completing the reading assignments was helpful in understanding the course material. Additionally, while overall student performance in the course correlates well with performance on the daily quiz, there is a stronger correlation with the homework quizzes than there is with the reading quizzes. Finally, students appreciated the educational value of reviewing daily quizzes after they were graded.

Also, while it would appear from the data that performance in this course for students with GPAs above 3.0 is consistent with their past academic performance, some of the students in the marginal-to-average GPA range seemed to benefit from the daily quiz. Is the number of students that benefited from this format worth the effort required by the other students or the instructor? Since the grading of homework disappears in this format, the additional grading of quizzes by the instructor is not overwhelming. As for the students who would have performed well in any format, most commented that the workload was comfortable and kept them on task throughout the quarter, with less time required for study in the day or two before an exam.

Further, the total time allocated to quizzes ranged from 3-4 minutes (reading quiz) to 10 minutes (for some homework quizzes). Faculty would need to determine if this was valuable use of their time resources. One possible means to reduce time spent on homework quizzes is through the use of FE Exam style problems, which are written with an expected solution time of 2-4 minutes.

Finally, reading assignments and quizzes without similar types of questions on the exams certainly caused the students to discount the significance of these assignments. The obvious conclusion is to remove the reading assignments and quizzes in favor of more homework quizzes, or include the reading material on the exams. The decision on which path to take would depend on the desired outcomes for a particular course (or particular instructor).

APPENDIX

Examples of Reading quizzes and a copy of the end of quarter student survey

CE 340 – Fluid Mechanics
QUIZ 5

Name _____

1. Pressure is caused by *shear* or *normal* forces. (Circle one answer)
2. Pressure is a *scalar* or *vector* quantity. (Circle one answer)
3. Considering the rectilinear space coordinate system (x, y, z):
 - a. Pressure varies with position in the x -dimension. *True* or *False*
 - b. Pressure varies with position in the y -dimension. *True* or *False*
 - c. Pressure varies with position in the z -dimension. *True* or *False*
4. The magnitude of the prevailing atmospheric pressure varies with your location on the Earth's surface. *True* or *False*
5. The magnitude of the US Standard atmospheric pressure varies with your location on the Earth's surface. *True* or *False*
6. It is possible to have a negative value for pressure. *True* or *False*
7. The mercury barometer is an example of one type of manometer. *True* or *False*
8. The best choice of manometer to measure very small pressure variations accurately is
 - a. U-Tube Manometer
 - b. Inclined-Tube Manometer
 - c. Piezometer Tube
9. Capillary action could affect the manometer reading. *True* or *False*

CE 340 – Fluid Mechanics
QUIZ 8

Name _____

1. The buoyant force applies only to bodies that are completely submerged. *True* or *False*
2. Write the equation used to calculate the magnitude of the buoyant force.
3. The buoyant force passes through the centroid of the displaced volume. *True* or *False*
4. The buoyant force has a direction that is the same as the body weight. *True* or *False*
5. Submerged bodies are said to be *stable* or *unstable* when the center of gravity falls above the center of buoyancy.
6. Floating bodies require the center of gravity to be co-linear with the center of buoyancy.
True or *False*

CE 340 – Fluid Mechanics
QUIZ 15

Name _____

1. The linear momentum equation is a statement of Newton's Second Law. *True* or *False*
2. Linear momentum is a *scalar* or *vector* quantity.
3. The moment-of-momentum equation involves:
 - a. torques
 - b. angular momentum
 - c. both of the above
 - d. neither of the above
4. The angular momentum equation is derived from Newton's Second Law. *True* or *False*
5. The energy equation (circle all that apply):
 - a. is a statement of the first law of thermodynamics
 - b. involves stored energy
 - c. involves heat transfer
 - d. involves work
 - e. can be simplified using a stream tube
 - f. can be written in terms of enthalpy
 - g. has similarities to the Bernoulli Equation
 - h. accounts for energy loss due to friction
 - i. may be written with terms that have units of "head"

CE 340 – Fluid Mechanics
QUIZ 22

Name _____

1. Write the mathematical relationship between depth of water upstream of a sharp-crested weir (d), the height of the weir (P_w), and the depth of water above the weir at an upstream location (H).
2. The volumetric flowrate over a rectangular, sharp-crested weir is proportional to
 - a. $H^{1/2}$
 - b. $H^{3/2}$
 - c. $H^{5/2}$
 - d. $H^{7/2}$
3. The volumetric flowrate over a V-notch, sharp-crested weir is proportional to
 - a. $H^{1/2}$
 - b. $H^{3/2}$
 - c. $H^{5/2}$
 - d. $H^{7/2}$
4. The volumetric flowrate over a V-notch, sharp-crested weir is proportional to
 - a. $\tan(\theta)$
 - b. $\tan(2\theta)$
 - c. $\tan(\theta/2)$
 - d. $\tan(\theta/3)$
5. Theoretical weir equations give flowrate estimates that closely approximate actual flows.
True or ***False***

Rate your response to the following statements, with regard to the **READING QUIZZES**.

(5 - Strongly Agree) (4 - Agree) (3 - Neutral) (2 - Disagree) (1 - Strongly Disagree)

1. The *reading assignments* covered material that closely related to the *course topics*.
2. The *daily quiz* covered material that closely related to the *reading assignments*.
3. The *daily quiz* covered material that closely related to the *course topics*.
4. The daily quiz *encouraged* me to complete the reading assignment.
5. The daily quiz *scared* me into completing the reading assignment.
6. I rarely completed the reading assignment, or only read it in class the day of the quiz.
7. The daily quiz guided my studying via reading the text during the *first* few weeks of class.
8. The daily quiz guided my studying via reading the text during the *last* few weeks of class.
9. When I completed the reading assignment, I better understood the *following lecture*.
10. When I completed the reading assignment, I better understood the *course topic*.

Rate your response to the following statements, with regard to the **HOMEWORK QUIZZES**.

(5 - Strongly Agree) (4 - Agree) (3 - Neutral) (2 - Disagree) (1 - Strongly Disagree)

11. The *homework assignments* covered material that closely related to the *course topics*.
12. The *daily quiz* covered material that closely related to the *homework assignments*.
13. The *daily quiz* covered material that closely related to the *course topics*.
14. The daily quiz *encouraged* me to complete the homework assignment.
15. The daily quiz *scared* me into completing the homework assignment.
16. I rarely completed the homework assignment.
17. The daily quiz guided my studying via working problems in the *first* few weeks of class.
18. The daily quiz guided my studying via working problems in the *last* few weeks of class.
19. When I completed the homework assignment, I better understood the *previous lecture*.
20. When I completed the homework assignment, I better understood the *course topic*.
21. I learned more when the *homework quiz* was a problem from the *homework assignment*.
22. I learned more when the *homework quiz* was a problem that was *not assigned in the text*.
23. I learned more when the homework quiz was *discussed/solved* in a following class.
24. I learned more when *solutions* to the homework quiz *were distributed* in a following class.
25. If you used the FE Reference handbook, I feel the handbook was an adequate resource.
26. The homework quiz would be *easier* if I was allowed to use the text.
27. The homework quiz would have *greater educational value* if I was allowed to use the text.