Promoting Student Success: Goodbye to Graded Homework and Hello to Homework Quizzes

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Abstract

In higher education, an ongoing issue is assessment of student learning. We wonder how to assess, how often to assess, why we are assessing, and even how are we, as faculty, going to handle all the grading and management of assessment. Engineering students are frequently assessed on homework, quizzes, projects, and exams, but given today’s connected world, students may be copying or sharing homework solutions. Often, they do not realize how working problems is integral to their success in a class as well as to their understanding of engineering. In addition, across the disciplines we are more aware of how students study and that they often do not select the most productive studying techniques. In an effort to ensure students are studying effectively and working their own problem sets, students in an upper-level aerospace engineering course are assigned weekly homework, but instead of turning in the worked problems, they are given a quiz relating to the homework material. Because the quiz performance is now the result of the student’s own effort, the instructor is not uncomfortable increasing the contribution of homework performance to the final grade which, in turn, further helps to motivate the students to put the effort originally intended into working out and understanding homework solutions. While an attempt to determine whether or not this approach benefited student performance by comparing exam and final course scores before and after the in-class homework quizzes were employed was inconclusive, the anecdotal evidence seems to indicate that it does benefit student understanding, and there is no question that the grading workload of the instructor is reduced, allowing more time to be spent on instruction where it has a positive impact.

Introduction

Engineering students are expected to learn beyond class time by doing readings, homework, and projects. Homework, in particular, is intended to improve student learning by giving them time to practice and to learn on their own. A strength of homework is that it is practice distributed in small doses over extended periods of days or weeks. Typically, homework is done to reinforce course material, cover additional material, stimulate intellectual discipline, and increase student self-confidence and time management skills. Homework is notably part of the engineering curriculum for it “…unquestionably reflects the nature of engineering practice, wherein problems are solved in an open setting in marked contrast to time-constrained and closed-book test conditions.” There are, however, some drawbacks to homework, the most notable being that it is easy for students to find solutions on the Internet and copy and share them with classmates.

Another drawback to homework may be students’ inability to manage their own learning. There is a body of knowledge around self-directed learning that is defined by Knowles as “a process in which individuals take the initiative, with or without the help of others, in diagnosing their learning needs, formulating learning goals, identifying human and material resources for learning, choosing and implementing appropriate learning strategies, and evaluating learning
outcomes.” Do students’ lack of self-direction hamper their study skills and homework abilities? There is evidence that students’ study skills are fundamental to academic success and yet students often rely on ineffective strategies they believe are effective.

Faculty workload is another consideration when it comes to homework. Not only must time be allocated for timely evaluation of homework and recording of grades, but additional time is needed to create new and relevant problems. Given that homework solutions are readily available from multiple sources, reuse is limited.

A veteran aerospace professor concerned about student lack of performance sought ways to combat this dilemma and is now instituting the replacement of graded homework with in-class quizzes based on the homework. Homework assignments are still given, but instead of being collected and graded on the homework “due date,” students are given a very short in-class quiz that comes directly from one of the assigned problems. If the student has worked through the assignment and understands it, the quiz should be quite straightforward. After the in-class quiz, the answer is discussed and later, the solutions to the entire homework set are posted, as was done before the implementation of the in-class quizzes. If no homework assignment is made for a particular week, a short in-class quiz is given that is directly based on the material covered in lectures presented during that week. In this way, students are motivated to review the lecture notes more frequently than just before scheduled exams, as seems to be the case otherwise. In computing the contribution of the homework quizzes to the final grade, the two lowest quiz scores are dropped.

The main goal of this paper is to introduce the concept of using in-class quizzes based on the homework to better achieve the desired result of homework assignments, with the additional benefit of reducing instructor time spent grading these assignments. We begin with a literature review of related work regarding quizzes, and then discuss the details of the courses in which the homework quizzes employed. In an attempt to ascertain if the homework quiz approach benefits student performance, students’ exam scores and overall course performance were compared with those of previous sections of the same course in which the homework was assigned and graded in the traditional manner. Although somewhat inconclusive, the results of this comparison are discussed. Finally, student perceptions of the approach, based on a pre- and post-course survey are summarized and discussed.

Related Work

There is not a single definitive approach as to how to best assess students’ learning. We can, however, use assessment to not only monitor learning, but to promote learning. Assessments that promote learning should show students what they should be learning and homework can serve that purpose. Research indicates that homework is an important part of improving academic achievement, but the relationship between time spent on homework and academic achievement has not been fully clarified. Quizzes also play an important role in advancing student learning. Some contend, however, that quizzes may produce short-term results and that they also can create student anxiety and result in an adversarial relationship between the instructor and the student.
The issue of whether a quiz or homework improves a student’s learning in a course has not been extensively studied, although there have been some studies that have addressed the question. In a study by Bjerkaas and Wolberg, the effectiveness of assigning just homework, just quizzes or a mixture of both was examined. Their results indicate that a mixture of both homework and quizzes has the greatest effect on performance overall. A study found that quiz performance is an indicator of test performance, but did not find a correlation for graded homework performance in most courses. In a study of electrical engineering courses that eliminated graded homework sets and replaced them with ungraded study problems and short periodic in-class quizzes, it was found that test and comprehensive final exam performance was similar to case with graded homeworks.

In a Faculty Focus blog, Weimer looks at the evidence that supports quizzing and states, “the results are mixed; they are more positive than negative, but still, a significant number of researchers don’t find that quizzes affect learning outcomes.” While overall the research she found indicated students read and study more when given quizzes, and that they were more motivated to come to class prepared and earn improved overall course grades; however, not enough details were provided to understand the conditions needed to result in successful quizzing.

The benefits of homework or quizzes are realized when students are prepared and participating. Yet many students do not practice good study skills. For example, Dunlosky offers ten ways to improve student learning. Specifically, he cites Gurung who noted that teachers should begin with a practice quiz (with feedback) on the most important ideas as a means to improve student learning. Additionally, he also produced evidence that two techniques may prove helpful today in educating college level students: practice testing (self-testing or taking practice tests on to-be-learned material) and distributed practice (implementing a schedule of practice that spreads out study activities over time). The focus on this paper is to report on the results of changing the homework paradigm and its impact on the performance of aerospace students.

**The Courses**

The homework-quiz approach has been used in a large junior-level required course, as well as in a senior-level technical elective. Both of these courses have been taught for a number of years, and homework-quizzes employed for the past several years.

The junior-level course, Aeronautics, students are introduced to the basic concepts of aeronautics by covering the estimation of the forces of flight and how these forces are used to predict the performance of atmospheric flight vehicles. Students who successfully complete this course should be able to:

1. perform basic computations of aerodynamic forces and moments acting on an aircraft in flight;
2. perform basic computations of propulsive forces and performance;
3. perform basic stability and control computations; and
4. perform basic performance calculations for the overall air vehicle.
The enrollment of this course is approximately 100 students per year. The final grades are based on two one-hour examinations, each worth 25% of the overall course grade, a final examination worth 30% of the grade, homework quizzes (12) account for 15%, and collected and graded projects, 5%. The homework quizzes were first used in this once-per-year offered course in 2014, and have been used one additional time since then.

The senior-level course, Theoretical Aerodynamics, gives students an appreciation for the practical benefits of applying classical theoretical methods to the analysis and design of airfoils and wings. Typically, the enrollment in this course is approximately 30 students per year. The course material includes complex analytic function theory and how it is used, along with boundary-layer theory, to predict forces and moments on aerodynamic bodies. Students who successfully complete this course will be able to:

1. apply classical theoretical methods to the analysis and design of airfoils and wings.
2. use methods based on complex analytic functions, along with boundary-layer theory, to predict forces and moments on aerodynamic bodies.
3. approach aerodynamic design problems and use theoretical and computational tools to work toward an optimum solution.

Grades are calculated from seven homework assignments, including several computer/design projects. The homework assignments were concerned with providing practice and reinforcing the desired objectives. Before the introduction of homework quizzes, grades were based on two one-hour examinations, each worth 25% of the overall grade, a final examination, 30%, project assignments, 10%, and the homework grades 10%. With the introduction of the homework quizzes, the overall grade breakdown included only a single one-hour examination worth 30%, a final examination worth now worth 40%, projects now worth 5%, and the homework quizzes (13), 25%. Because the homework quizzes now assess the learning based on the homework assignments and are the result of a student’s personal effort, one midterm examination has replaced two, and the contribution of the homework quizzes to the final grade is almost the same as that of the one-hour examination. The use of homework quizzes was first used in this once per year offered course in 2011 and has been used every year since then.

The quizzes are scheduled one-week in advance. In addition, the students are told at the beginning of the semester that the quiz results will replace graded homework assignments, along with the reasoning behind this approach and the impact it had on students who had taken the course earlier. While the homework assignments are intended to help students develop a deeper understanding of the course content and, as such, should support students being able to deal with problems on exams, the homework quizzes are very brief and to the point. Their goal is simply to motivate students to put the effort into the homework that is required to understand it. Consequently, quiz questions are such that if one understands the homework, the answer should be very easy and straightforward. If the student has not worked through the assignment, however, it is unlikely that they will be able to figure it out in the time allotted. As noted, the quiz answers are discussed immediately after the quizzes are collected, while the solutions to the entire homework set are posted just after class, as was done previously just after homework assignments were collected on the due date.
Student Survey Results

To ascertain some student perspectives on the use of quizzes in lieu of graded homework, the students in the senior elective course were given a short questionnaire. Of the 29 students, 25 expected to make either an A or B in the class, while only one anticipated a D. They were asked to give scaled responses to three questions. The first question asked them to state how beneficial (using a scale from not beneficial to very beneficial) to their learning they found the homework quizzes in this course. Only one student found them not beneficial, while the majority found them at least somewhat beneficial. When asked to compare the homework quizzes to graded homework on a scale from worse to about the same to better, on average they found them to be about the same. The final scaled question asked them to state yes or no as to whether or not they thought the use of homework quizzes should be continued and then explain their answer. They were about even on whether or not to continue with these quizzes. Those who think it should be continued offered insights such as, “it works,” “encourages students to learn the material,” “it is less stress doing and thinking through your homework if it is not graded,” “when the homework is done before the quiz, the quiz is very beneficial to summarize the learning aspect,” and “when you base the quizzes on the homework, they force you to actually do and understand the homework. They also force you to study each week and not just for the exam.” Those students who do not advocate continuing the homework quizzes stated, “I just prefer to do homework and turn it in,” “with the homework quizzes, all the material must be studied with no in-depth look into any one subject. I learn by practice and actual graded homework will give more examples,” “the anxiety and the hype associated with the quizzes causes you to perform poorly, despite knowing the answers,” and “could still get a bad quiz score.”

Students were asked to provide advice for future students about the use of homework quizzes. One simply wrote, “if you do the homework, the quiz will not be a problem.” Ironically this student does not think the quizzes should be continued. The most common advice is not surprising, “do the homework, it will help you understand the material.” A couple took that advice a step further by adding, “know everything and do all of the homework” and “start homework early and ask questions.” The importance of class and the notes came out with advice like “pay attention in class” and “start working on the homework so if you get stuck you have time to ask questions in class.”

Finally, from the survey results, it was found that these students, on average, spent 3.7 hours a week outside of class studying the course material.

Faculty Assessment and Discussion

All in all, several of the advantages of the in-class homework-quiz approach are quite obvious. It certainly reduces the grading workload of the instructor or teaching assistant, and that time savings can be employed for additional contact time with students and review sessions. In addition, because it ceases to be advantageous for the student to copy homework to turn in without fully understanding it, and the performance on the homework quizzes are a direct result of a student’s own effort, the instructor is not uncomfortable in increasing the contribution of the “homework” effort to the final grade. As a consequence, one hopes that the effort put into homework assignments increases, with the desired effect of a better understanding of the course
Another advantage of homework quizzes is that some of the material that would ordinarily be tested on an exam can be covered on one of the quizzes, and the emphasis and feedback that results on this material reinforces student understanding and consequently allows the instructor to go into more depth or cover additional material. This, in turn, can provide the opportunity for problems on exams to cover different and/or more-in-depth material.

An attempt was made to assess the impact of the homework quizzes on learning. The student performances based on the average score on mid-term exams, final exams, and the overall course score were compiled for semesters before and after the implementation of the homework quizzes. For the junior-level course, while there are many semesters of data before the homework quiz approach, there are only two semesters of data after, while for the senior elective course, there are also many semesters before, and five semesters post. While the sample size is small and the trends are difficult to separate from the scatter, perhaps the most compelling finding is a 5-percent improvement on the final exam score averages for the junior course and a 10-percent improvement on the final exam score averages for the senior-level course. While notable, it is perhaps more important that because the homework quizzes allow some concepts to be highlighted and reinforced by a quiz and the accompanying feedback, which clearly supports student learning, which, in turn, allows the instructor to go into greater depth in course material and some of the questions on the exams reflect this. Consequently, while the exam and course averages are not significantly improved, the increased difficulty of the exams suggests that student learning is improved. This is, in fact, the direct opposite to the findings of work exploring the decrease in student performance over two decades, in which there was not a significant decline in exam averages and grades, but a readily identifiable reduction in the level of exam difficulty that maintained these averages and grades. In this case, the exam averages and grades are also maintained, but are accompanied by an increase in the level of exam difficulty.

With regard to the homework-quiz approach, the only obvious downside, although a minor one, is that the quizzes take up approximately ten minutes of instructional time. On the positive side, research demonstrates that quizzes facilitate learning, while the reduced instructor workload is undeniable. Some of the student negativity indicated in the survey results seems to come primarily from the fact that it is a new approach and they are just not used to it. Interestingly since initially being employed several years ago, other faculty in the department have adopted similar strategies and, as the students become more familiar with homework quizzing, their negative reactions seem to be less and less.

**Concluding Remarks**

The homework as a quiz model has been found to have potential in these aerospace courses, as well as in other courses. This approach maintains students’ grades, reduces instructor workload, and is, for the most part, well-received by the students.

While it may be difficult to get all students to buy into the homework quizzes approach, it has been helpful to be explicit with the students about the reasoning behind this approach. In the future, the instructor will make an effort to help students with their study skills so that they are better able to monitor and assess their own best strategies for success.
References


