Perspectives on an Innovative Homework Policy

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Abstract

Students and faculty in mechanics and introductory engineering courses benefit from an innovative homework policy that accounts for the availability of solutions, student investment in instructor feedback, and faculty time management. Homework should encourage formative learning through practice and immediate feedback. A dual-submission homework policy puts the responsibility for learning on the student, reduces grading time for the professor, and embraces available support for struggling students. In the first submission, students attempt to solve each problem, submit their solution through an online learning management system, and earn 70% credit for the assignment regardless of performance. The students then assess their work compared to an instructor solution, either indicating correct answers or correcting their solution noting any points of deviation. The second submission consist of this assessed homework, submitted in hard copy and earning the remaining 30% credit. Results from faculty reflection and student surveys support this innovative homework policy.

Keywords

Homework, Engineering Mechanics, Student Perspectives

Introduction

The digital revolution and changing student expectations have made the common process of homework assignment and assessment increasingly challenging in engineering education. Most student learning takes place outside the classroom (*1*); for many engineering courses grade-earning homework is the primary learning tool. Yet, students often see homework as a nuisance, nothing more than an obstacle to overcome as quickly as possible. As a credit-earning exercise, the pressure to perform within the time constraints of busy and distracted lives make cheating an ever-present temptation. A student may short circuit their own learning in more ways than ever before. Beyond previous semester notes and solutions that float around many college campuses, publisher solutions and crowd sourced homework solution websites are readily available to the struggling student. This greater access to information could serve as a great help for student learning, but more often, critical thinking and deep engagement give way to simply copying solutions. The problem of shallow learning is further compounded by a cultural fascination with multitasking that runs counter to the deep, focused thinking required by engineering work and active learning. One student commented to an author how thankful he was for dual monitors for his computer; it allowed him to have Chegg (*2*) open on one screen and Netflix running on the other while he solved homework problems. This is not the habit of successful, lifelong learners.

Professors experience their own challenge with homework. Grading requires time that might be better spent in research, service, or lecture preparation. Grading can also be emotionally taxing as professors struggle to interpret sloppy submissions and incoherently copied internet solution

while still providing meaningful feedback. The emotional burden is further compounded when students, having received graded homework, merely observe their score and throw the homework away on their way out of the classroom or merely complain about point deduction instead of learning from their mistakes.

These challenges leave faculty seeking a way to reduce their grading load while still providing students the learning opportunities they need. Methods like random problem grading or grades for completion are faster but fail to provide comprehensive feedback or to enforce student reflection on their efforts. In light of these challenges, students still need practice, repeat exposure to the content and the opportunity to learn from their mistakes. Faculty in The Citadel School of Engineering developed a homework policy for encouraging student learning through practice and immediate feedback. Students and faculty benefit from this innovative, dual-submission homework policy that accounts for the availability of online solutions, student interest in instructor feedback, and faculty time management.

Homework Policy

A good homework policy should transparently address how grades are earned, firmly place responsibility for learning on the student, openly acknowledge outside resources, motivate student engagement, and provide immediate feedback on student performance. The following excerpt from the syllabus of a sophomore level engineering mechanics class describes the method and expectations.

Syllabus Excerpt

Homework is *for the student*, for his or her learning, practice and assessment. Many of the homework problems represent intentionally-challenging, real world problems. Working engineers and engineering students must practice problem formulation, problem solving, and solution documentation. Therefore, a proper solution format is required. Students may work together on homework assignments *to gain additional understanding*. More than any other academic activity, continuous practice of concepts establishes long-term mastery. Students should consider the assigned homework as the minimum required practice.

Please see the following book on problem formulation, solving, and documentation:

> Polya, G., and Conway, J. H. (1945). *How to Solve It: A New Aspect of Mathematical Method.* Princeton University Press, Princeton, NJ.

"A cadet does not lie, cheat, or steal, nor tolerate those who do" (*3*). Society places its trust in engineers to ensure public safety. Accordingly, neither the Citadel Honor Code nor the engineers Code of Ethics will tolerate any form of cheating (*4*, *5*). Any evidence of direct copying of homework assignments may result in an honor violation; therefore, students should not share homework.

All homework must be properly documented. Students must document any help received from supplemental instruction, classmates, reference books, or the internet. Information from the course textbook (equations and outlines of procedures), class notes, or the professor is considered immediately available to all students and requires no documentation. For written homework, insert documentation at the point the help was received, stating who and what assistance was provided.

The use of solutions during homework attempts is strongly *discouraged*. Relying on solutions from previous classes, the textbook, or the internet will result in poor performance during the exams. Nevertheless, if published solutions reveal errors, subsequent corrections require proper documentation.

Homework grading by problem emphasizes effort, completeness, and timeliness. Each homework problem can earn up to 10 points (100%). The grade is composed of 70% credit for a complete, on-time homework attempt and 30% for self-assessment of the homework attempt. Students will submit each problem twice:

1. *Initial Homework Attempt:*
   A CitLearn (Blackboard) submission of homework before the solution posts.
   Each problem will be evaluated based on *timeliness*, *effort* and *completeness* for up to 70%. A problem missing any sections, appropriate diagrams, or a good faith effort at the solution in the required homework format will receive no credit. Problems must be uploaded as PDF documents. Free document scanning apps available for smart phones include Genius Scan, Microsoft Lens, and Dropbox. The Daniel Library also has document scanners available for use.
2. *Homework Self-Assessment:*
   A hard-copy (HC) submission of self-assessed homework after the solution posts.
   The remaining 30% will be awarded for submitting a hard copy of the *complete* and *self-assessed* homework problem. The professor will provide a minimum of 36 hours for homework assessment. An incomplete hard-copy problem will receive no additional credit.
   - Assessment should provide clear documentation of corrections made in a different color.
   - A minimum of a check mark in a different color next to the correct answer is required.

Typically, four potential grades can be earned per problem as seen in Table 1.

Table 1. Potential grades per problem based on timely, complete, homework dual submission.

CitLearn Attempt	*Hardcopy Self-Assessment*	*Maximum Grade*
On-time and Complete	On-time and Complete	100%
On-time and Complete	Late or Unsubmitted	70%
Late or Unsubmitted	On-time and Complete	60%
Late or Unsubmitted	Late or Unsubmitted	0%

This homework policy transparently communicates the availability of full credit for every student. The student should be using the homework as a two-step process for establishing learning: once when attempting the problem the first time, and again when evaluating their method and results against an established solution. Outside sources are addressed explicitly while simultaneously placing ownership for learning on the student. Feedback is immediate and required as students must review their homework against the solution. The percentages and weights have worked well for one author, though others have used the same homework policy with different weights. Other faculty may not offer a homework amnesty day. Nevertheless, the dual-submission homework policy clearly meets the measure a quality homework policy.

Faculty Perspective

In general, the faculty perceive the new homework policy as a substantial improvement over more traditional homework policy. The new policy increases the potential for student learning through repeat exposure and active engagement while simultaneously reducing the time required to administer homework. Grading is much faster; a quick count of online and hard copy homework problems provides an immediate grade for the grade book. Assignment grading that formerly took two to four hours now moves from student submission to completion in under an hour. Faculty frustration is lower because students are responsible for interpreting their own efforts. More and more faculty at The Citadel are embracing the dual-submission homework policy to the perceived improvement of their teaching effectiveness.

Student Perspective

Five civil, construction and mechanical engineering professors surveyed 248 students in 13 sections of five different sophomore and junior civil and mechanical engineering classes about their perspectives on the dual-submission homework policies. Figure 1 shows student responses to three statements about learning engagement: (a) "During the dual-submission homework process, I feel engaged in my learning while attempting the homework the first time.", (b) "During the dual-submission homework process, I feel engaged in my learning while assessing homework against the instructor's solution.", and (c) "I prefer the earned grades for the dual-submission homework process compared to previous experiences with detailed instructor-assigned homework grades." Figure 1.a shows that the vast majority of students feel engaged by the first submission of their homework attempt. This is the part of the policy is no different from any other homework policy. Figure 1.b shows a slight increase in engagement (total number of agree and strongly agree) during the homework assessment process. Figure 1.c shows a slight polarization in preference for the new homework policy; the majority of the students favor the new policy, though a few students felt strongly that they preferred a more traditional homework process. The overall engagement level supports the dual-submission homework policy as a viable way to encourage student learning through homework.

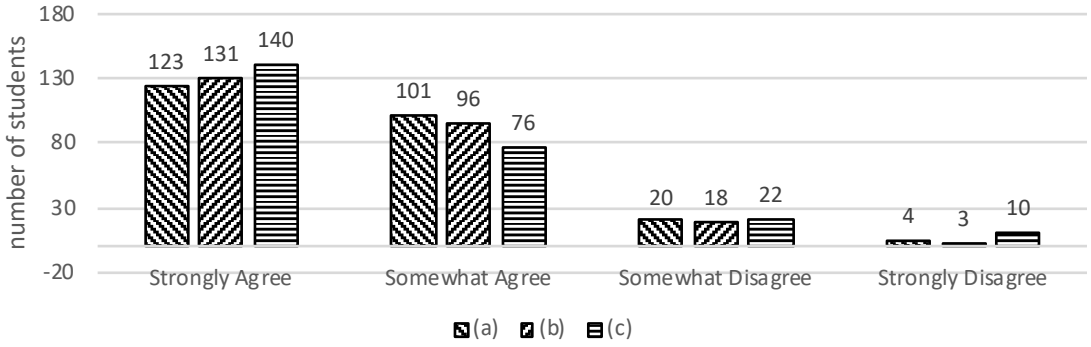

Figure 1. Student perception responses to the statements (a) "During the dual-submission homework process, I feel engaged in my learning while attempting the homework the first time." (b) "During the dual-submission homework process, I feel engaged in my learning while assessing homework against the instructor's solution." and (c) "During the dual-submission process, I feel more engage in learning compared to previous experiences with instructor-graded homework."

Figure 2 shows student responses to two statements about grading and credit: (a) "I believe the earned grades to the dual-submission homework process is fair." and (b) "I prefer the earned grades for the dual-submission homework process compared to previous experiences with detailed instructor-assigned homework grades." Students appear to strongly feel that the grading of the dual-submission method is fair. This seems reasonable as the homework method does give every student the potential to earn 100% credit. The rapport building nature of fully available credit for professional and timely submissions combined with the perceived increase in engagement supports the use of the dual-submission homework policy.

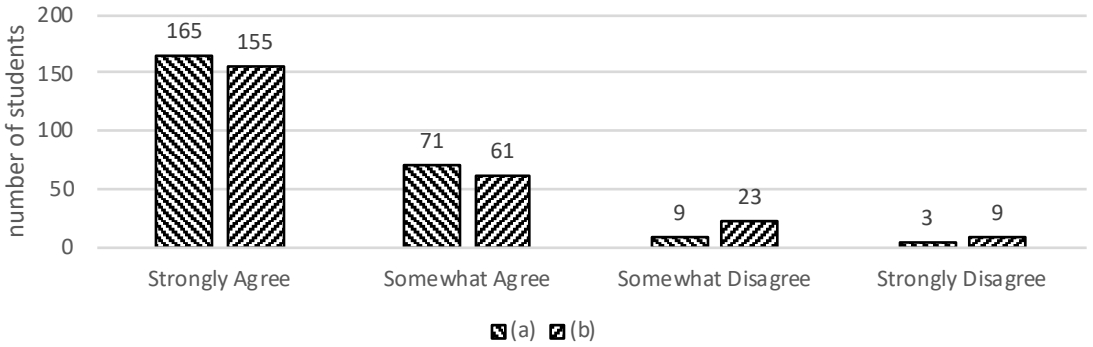

Figure 2. Student perception responses to the statements (a) "I believe the earned grades to the dual-submission homework process is fair." and (b) "I prefer the earned grades for the dual-submission homework process compared to previous experiences with detailed instructor-assigned homework grades."

Figure 3 shows student responses to the statement "I hope more professors will use the dual-submission homework process." This data most strongly illustrates student preference for the dual-submission homework method. Most of the students hope to see this style of homework in future classes.

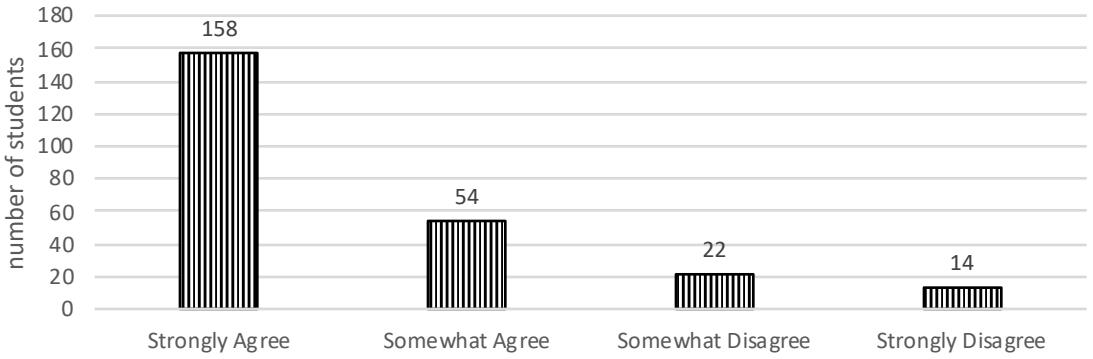

Figure 3. Student perception responses to the statement "I hope more professors will use the dual-submission homework process."

Conclusion

Students and faculty both benefit from a dual-submission homework policy. Faculty members appreciate the method for its efficiency and emphasis on student engagement in learning. Students also appreciate the repeated engagement with the homework policy and the ability to ensure high homework grades. The authors hope this innovative homework policy sees wider implementation to the benefit of students and professors throughout engineering education.

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