

GRADING HOMEWORK AS FORMATIVE ASSIGNMENTS – THE SOLUTION TO CHEATING?

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ABSTRACT

Homework assignments are common assessment tools used to assist learning in Engineering. Since they are meant to assist students in acquiring the material presented, they should be considered formative assessments with no grade given. Student's engagement in homework assignments is time consuming (as real learning is) so students want to be rewarded for their effort i.e., they want their homework assignments to count towards their final grade in the course. This, however, increases the stakes for students making it more tempting to cheat if the problems turn out to be too difficult or if students run out of time. If students split tasks and mindlessly copy one others' solution, copy some solution manual, or buy a solved solution form such service e.g., Chegg, the learning goal of the homework is however not met. A perfect solution that does not originate from the student contributes to much less learning than a not completely perfect solution from the student's own effort. The learning process comes from the effort and being given timely feedback to correct all misconceptions. The author of this paper therefore in 2016 stopped giving a grade for homework in two bachelor's degree courses and gave only a feedback. Just by turning in the homework students get a full score for their effort. By doing so the incentive to cheat has been eliminated and students are rewarded for their effort. To evaluate the effects of this change three sources of information are used: student teaching evaluation surveys, students' final grades and instructor's reflections. Students repeatedly state they like this approach and say it is often a breaking point in them deciding to work on the homework in those courses instead of other courses where the homework is harshly graded. Homework assignment solutions suspicious of cheating have also reduced significantly.

KEYWORDS

Homework, Formative Assessment, Reduce cheating, Standards: 1, 2, 3, 6, 7, 8, 10, 11.

INTRODUCTION

As common in undergraduate Engineering courses, in the Heat Transfer and Fluid Mechanics courses taught in Bachelor Degrees in Mechanical and Chemical Engineering at University of Iceland, there are weekly homework assignments throughout the semester. The purpose of homework is to train students in solving problems based on the course material and it is, therefore, important that they learn from their mistakes in order for them not to repeat their mistakes. To acknowledge that students put a lot of effort into those, they count 10% towards

the final grade of the course. The author of this paper has always given a generous score for homework even though there were some errors or misconceptions because she believes it is important to encourage students to try even though they might not have mastered the material yet. She has always viewed the homework as formative assessment, and the grade as just compliments for their effort. But it was evident that students did not experience it in that way, only looked at the grade, missed an opportunity to learn from the feedback, and what worried her most was how many students seemed to be copying each other's solution or a solution manual. This paper discusses how making changes in grading the homework assignments can affect students learning, reduce cheating but also empower them in their learning.

LITERATURE REVIEW

Formative vs. Summative Assessment and the link to homework assignments

Feedback needs to be student and learning focused (Carless, 2015) and can be split into two categories: formative and summative (Rowntree, 1987). Summative assessment is meant to measure students' expertise in a certain field and rank them. Detailed feedback is not needed in summative assessment unless it is meant to justify the grade. Formative assessment, however, is meant to aid students in their learning (Rowntree, 1987). Therefore, in formative assessment the feedback is crucial. Giving a grade can hinder students in their learning since if they receive a grade and feedback they focus on the grade (Race & Pickford, 2007). They often neither fully understand the grade nor learn from the grade where they need to improve and how (Black & William, 2001). In addition since they do not focus on the feedback they miss an opportunity to learn from it (D. Nicol & Macfarlane, 2006). No teacher wants students to be too fixated on the score itself. Neither do teachers want students to be shy to try to work on the problems even though they might not have fully mastered the material yet. Formative feedback supports students learning most if it is fast, personal, directed to each student's needs, understandable to students, concise and in a format that fits students best (Rowntree, 1987). One cannot stress enough the importance of giving feedback while the material is fresh in students' memory. It helps students to realize themselves at what level their learning currently is, and that ability is of great importance for future learning development (D. J. Nicol & Macfarlane-Dick, 2006). Formative assessments works particularly well for learning because students realize they can improve if they put in the effort (Entwistle, 2009). It, therefore, also works especially well for those students that are less academically strong.

Not distinguishing between formative and summative assessment is very common both among faculty and students, leading both to that instructor gives detailed feedback on summative assignments and students not realizing that formative assignments are meant to learn from to improve on next similar assignment or the final exam of the course. When the author of this paper started teaching with no pedagogical training, she did not make the distinction between formative and summative assessment meaning a lot of unnecessary effort on feedback on summative assessments. So, she could have saved herself and her students a lot of effort and frustration by emphasizing the difference between formative and summative assessment both in her actions and actively talking to students about it (D. J. Nicol & Macfarlane-Dick, 2006).

Regular homework traditionally used in many Engineering, Science and Mathematics courses is meant to help students master their learning, so it is expected that they have not mastered it yet when they start working on it. Working on homework has been associated with better outcome in a course (Trautwein, 2007) and engineering practices (Widmann, Shollenberger, & Kennedy, 2007). Since its purpose is to learn the author of this paper would argue that it

calls for formative assessment meaning the feedback and not the grade are of utmost importance. Despite this, the author of this paper has not seen any study on the effects of homework only receiving formative feedback and no grade. Hugo and Brennan (2016) report giving no grade for homework in some courses but also likely no feedback since there is no mentioning of feedback. The author of this paper questions if that is the correct approach especially in light of Serrano, Blanco, Calerón, Gutierrez, and Serrano (2021) report on continuous assessment. There all students report wanting “some kind of evaluation”, almost 87% want weekly problem sets to be evaluated and about 74% said they would not work on weekly assignments if they were not evaluated. Admittedly only 24 students were in the course. Formative quizzes have been used previously (Pick & Cole, 2021) leading to higher level of engagement by students, increased summative score and helped students to self-assess their knowledge. Pick and Cole (2021) further showed that failure to participate in one or more formative quiz was a good indicator for poor summative score. Yalcin and Kaw (2011) also showed that giving a grade for homework had no significant effect on students’ final grade in a course but collecting multiple homework did. Lauritsen (2017) report that students like to get a lot of feedback but like personalized feedback even more.

Academic Misconduct

Academic misconduct has been an issue since the beginning of academic studies. Passow, Mayhew, Finelli, Harding, and Carpenter (2006) found out by surveying 643 engineering students in 11 universities that factors influencing cheating in homework differed from cheating in exams. Predicting homework cheating proved challenging but factor as students feeling personally responsible to report cheating and that the school had dishonesty policies reduced cheating on homework but thinking it was OK to cheat to relieve stress obviously increased the likelihood of cheating on homework. First year students also cheated less than second year students on homework. Alemayehu, Logan, and Barhorst (2015) explored ways to assess homework to reduce cheating by seeking solutions from 10 colleagues and then trying those changes in a 3 yearlong study. Their colleagues’ suggestions included some obvious suggestions like not using the same problems year after year, use problems from a book with no solution manual, make their own problems from scratch, make problems with multiple solutions, let the problems count less in their final grade and use quizzes. Their results show that by using this approach cheating was reduced to 46% which they say low in comparison to 90% reported elsewhere (Widmann & Shollenberger, 2006). The author of this paper finds the fact that 46% of students cheat to be completely unacceptable and is sure most instructors agree. What is striking is that there is no distinction made between formative and summative assessment in this study and not surprisingly one of their results is that even though they say homework assignments are meant to learn from their students did not view them in that way.

Ali, Sultan, and Aboelmaged (2021) did a bibliographic study on academic misconduct between 2000 and 2020. One of their foci was on contract cheating i.e., students outsourcing their assignments to others, which turns out to be a growing issue. In recent years filesharing websites have been on the rise leading to easier opportunities in contract cheating. Lancaster and Cotarlan (2021) explored the file sharing homework help site Chegg and came to the conclusions that it has exam-like questions which 85% are answered within a short while. They also show that between 2019 and 2020 the requests for answers in a five-month period (April to August) nearly doubled in five subjects within Science and Engineering. They claim Chegg solutions are used for cheating despite Chegg’s (seemingly ineffective) honor code. Hill, Mason, and Dunn (2021) further confirm that conclusion showing that measures against contract cheating are far behind easy to find assignment help providers. Walsh et al. (2021) explored why students believed their peers cheated more while courses were forced to go

online during COVID-19 and came to the conclusions that students' reasoning was more linked to assessment modality rather than the pandemic. Students are more likely to cheat if they believe their peers do. Walsh et al. conclude that stressing the importance of academic integrity with students and relieving pressure on students is essential. As mitigation solutions to contract cheating, stringent regulations (Bretag et al., 2019), exams rather than assignments (Harper, Bretag, & Rundle, 2021), applications of forensic techniques (Johnson & Davies, 2020) and possibly higher fines are also mentioned (Ali et al., 2021). Doerr (2021), however, claims that cheating is an inevitable resisting to testing and originates from unequal power relations. Based on Doerr's analysis it is hard to see how the mitigation solutions suggested above can be a realistic solution to contract cheating.

Student Evaluation of Teaching

Student evaluation surveys are a commonly used to improve teaching and for administrative purposes (Hammonds, Mariano, Ammons, & Chambers, 2017). Many tend to dismiss those because they do have shortcomings but countless research on those in the past several decades confirm that they can provide valuable information on teaching effectiveness (Darwin, 2012).

METHOD

Based on the suggestions in the literature the author of this paper decided that from Spring 2016 in two of the courses she teaches, Fluid Mechanics and Heat Transfer, to only give individual written feedback on homework, with the exception that in Fall 2021 the feedback was oral via Canvas Speedgrader. The feedback emphasizes what is good in that student's homework, what can be improved and how the student can improve it. The feedback is given no later than the day after the homework is due and the solutions to the homework are always available just as the deadline passes. Everyone that does an honest attempt to complete the homework receives a full score (not written on the homework). Completing 10 homework assignments in the courses (12-13 homework in total in each course), counts 10% in students' final grade in the course. The remainder of students' grade consists of in class problems (5%), midterms (10%), laboratory in Fluid Mechanics and computational project in Heat Transfer (15%) and a final exam (60%). The enrollment in each course varied from 29 to 76 students with 40 being the average number of students per course. In the first lecture of those courses, also written in the syllabus, the teacher explains this process and emphasizes that homework assignments grading is formative assessment meant for them to deepen their learning. The instructor tells them it is by no means mandatory to turn in homework but generally students that do so do better in the course. The instructor, also, emphasizes that students gain nothing from copying a solution: their grade will be the same no matter if their results are correct or not and they miss an opportunity to learn by trying to figure out the solution themselves.

To judge the effects of the changes there are three means, explained in detail in following subchapters:

1. Effects on students' exams and final grades
2. Author's own observations on students' learning and academic integrity
3. University wide students' teaching evaluation surveys
 - a. Midterm – held in week 6 of a 14-week semester
 - b. End of term – held in week 13 and 14 of a 14-week semester

Effects on students' exams and final grades

The effects of having homework only graded with individual feedback and not with a grade on students' final exam and final grade in the course was explored. This was done by looking at the final exam score and the final score in the course given in Fluid Mechanics 2014-2015 (homework graded) versus 2016-2021 (no grade only feedback) and in Heat Transfer 2015 (homework graded) versus 2016-2020 (no grade only feedback).

Author's own observations on students' learning and academic integrity

The author of this paper has been an academic staff member in Mechanical Engineering at University of Iceland since August 2014. During that time, she has taught multiple undergraduate and graduate courses either in teaching teams or entirely by herself. Prior to that she was a part time teacher in two graduate level courses at Reykjavik University and a Teaching Assistant in nine undergraduate courses at University of California Santa Barbara. In all those courses grading homework was one of her obligations, giving her a good overview of grading practices across three universities and over multiple years. In particular, she has been the primary grader in the courses in question, so she has had the opportunity to detect changes in homework solutions before and after the change in homework grading.

University wide students' teaching evaluation surveys

University of Iceland has two surveys for students to evaluate teaching in order to maintain quality of teaching. Information from those sources can give valuable information on the effects of homework assignment grading method. The first survey is the formative midterm teaching evaluation survey where only the course is graded from 0-10 and it has also open-ended replies. This is meant to make adjustments midterm to improve the current course. Then there is a summative end of term teaching evaluation survey with 24 5-point Likert scale questions, 15 of which are on the course, 9 are on the teacher, and also with open-ended replies. This survey is meant for improving the course next year and for administrative quality purposes.

None of the Likert scale questions address the homework directly and fluctuations in the Likert scale questions cannot be linked to changes in homework grading. However, analyzing the open-ended answers to the midterm and end of term teaching evaluation surveys of Fluid Mechanics 2014-2021 and Heat Transfer from 2015-2020 when the author of this paper taught the courses, the 24 comments were found addressing homework grading. Those were analyzed with a thematic approach (Creswell, 2014). It is worth mentioning that in Heat Transfer Spring 2016 and Fluid Mechanics Fall 2016 end of term teaching evaluation surveys the instructor specifically asked students to address this issue in the open-ended replies, resulting in particularly many replies addressing homework assignments in those surveys or in total 18 of the 24 replies addressing this issue.

RESULTS

Effects on Students' Exams and Final Grades

No obvious trend was detected in the final grades in the courses after the change in homework grading. The exam grades and final grades varied as does academic proficiency of different cohorts, but it was not statistically higher or lower before or after the change. It can, therefore,

be assumed that having homework not graded but rather with only feedback does at least not hinder students in acquiring the material covered in those courses.

Author’s Own Observations on Students’ Learning and Academic Integrity

The author did not detect any major changes in academic proficiency of the homework solutions after the change in the grading. She did, however, observe that copying reduced after the change, but it did not vanish. There were still solutions that were suspicious of copying or students were at least working together on homework. Often it is hard to tell the difference between the two. Instructors obviously do not want them to copy since they learn nothing from that, but has shown benefits that they build learning communities (Lenning & Ebbers, 1999) and work together in the initial stages of their homework but should preferably finish their solution separately.

University Wide Students’ Teaching Evaluation Surveys

23 positive comments were given in the student evaluation surveys on homework and only the following negative (translated from Icelandic by the author):

“I don’t see the purpose of giving audio feedback, it would be more beneficial to have it visual inside the homework solution.” (from the Fluid Mechanics midterm Fall 2021 survey)

The negative aspect of the feedback was therefore not on the feedback itself but rather on the media used to transfer the feedback.

In the positive feedback i.e., all the comments in the teaching evaluation surveys explicitly mentioning that they liked to get feedback instead of a grade for homework assignments, many just expressed that they were pleased with the setup without explaining why (5 comments). Others gave an explanation, and a few themes were detected: **usefulness – learn more** (8 comments), **speed of feedback** (2 comments), **encouraging/more likely to turn in the homework** (7 comments), **less pressure** (5 comments), **less cheating** (4 comments), **nice to get comments/not used to getting this detailed feedback** (4 comments). Several students made comments touching on multiple themes which explains why the total count of all the themes being mentioned is higher than the total number of comments on the homework assignment grading. Some examples of the comment’s addressing each theme are shown in tables 1 - 6, respectively in the same order as listed above.

Table 1. Examples of comments on the theme **usefulness - learn more**

| Student comment | Survey |
|--|--|
| I found it much better to get feedback rather than a grade on the homework. A grade is not very telling on what went wrong and much better to get an explanation. | Heat Transfer End of term Spring 2016 |
| Very clever to get feedback instead of a grade for homework. It meant (for me at least) that I always turned in my homework to see if I was misunderstanding anything. | Heat Transfer End of term Spring 2016 |
| Very clever to get feedback instead of a grade for homework. It meant (for me at least) that I always turned in my homework to see if I was misunderstanding anything. | Fluid Mechanics End of term, Fall 2016 |

Table 2. Examples of comments on the theme **speed of feedback**

| Student comment | Survey |
|---|---|
| Grading of homework exemplary and usually only takes a few days. | Heat Transfer Midterm Spring 2016 |
| Returns homework in a timely manner with written feedback which is uncommon in other courses. | Heat Transfer End of term Spring 2019 |

Table 3. Examples of comments on the theme **encouraging - more likely to turn in the homework**

| Student comment | Survey |
|---|---|
| The course evaluation was fair and encouraged me to do well in the course, learn the material at an even pace during the semester.... I found it encouraging to get feedback on the homework. | Heat Transfer End of term Spring 2016 |
| I was particularly happy with the grading/arrangement of the homework. I was taking [name of another course] at the same time and the arrangement of homework was completely different. There every single detail was harshly penalized even writing something correct but with an untraditional form. So, I found it very encouraging in Heat Transfer that I knew that even if I did not have time to turn in a perfect homework solution, I would get a full score and I learned more from trying than I had if I had not. In the other course I knew even though I tried my very best I would get a bad score. As a result, I turned in many more homework assignments in Heat Transfer than in the other course even although my interest on the subjects is the same. | Heat Transfer End of term Spring 2016 |

Table 4. Examples of comments on the theme **less pressure**

| Student comment | Survey |
|--|---|
| "It relieves pressure on students to get homework back with feedback rather than a grade. So, I really liked it. Students are also more likely to turn in their homework even though it is not perfect (no one likes to get a poor score). | Heat Transfer End of term Spring 2016 |
| The grading method for homework assignments made things much more comfortable. I didn't feel this immense pressure to complete them perfectly rather just to do my best tackling them. | Fluid Mechanics End of term Fall 2016 |

Table 5. Examples of comments on the theme **less cheating**

| Student comment | Survey |
|---|---|
| Very good to get feedback rather than a grade for the homework assignments because then you try to understand yourself and turn your own solution in instead of copying and not understanding a thing. | Fluid Mechanics End of term Fall 2016 |
| Great to get no grade for homework but rather full score for an attempt. This encourages everyone to try it on their own terms, make the calculations they consider correct and then receive feedback on their solution. I learn a lot from that, rather than being stressed out about the grade I receive for the homework assignment and copy a solution from somewhere as is the tradition in other courses. Good arrangement with the homework. | Heat Transfer Midterm Spring 2018 |

Table 6. Examples of comments on the theme **nice to get comments - not used to getting this detailed feedback**

| Student comment | Survey |
|--|---|
| Good to get feedback on homework on what can be improved rather than just correct/not correct, as in other subjects. Also, good not to have to be stressed about having all the homework correct, but rather it is enough to try your best. That means I dare to try to do it myself, read about the material and try my best. If we got a grade, it would be likely that most would be copying each other's solution without understanding. | Fluid Mechanics Midterm Fall 2016 |
| It is not often that teachers bother to give feedback on homework so to kudos to that. | Fluid Mechanics Midterm Fall 2019 |

DISCUSSION

In this paper the effects of giving only feedback on homework assignments and not a grade, but rather give full score for an honest attempt. In the student evaluation surveys only positive open-ended replies were given on the issue with the exception in 2021 where one student preferred a visual rather than audio feedback. Students claim getting feedback instead of a grade for their homework assignments solutions is more useful for their learning, encourages them to work on the problems, reduces cheating and reduces pressure on them. The teacher did not see worse solutions to the homework than previously but did see indication that fewer students were copying the solution from some source. No effect was seen on final exam grades or the final grades in the courses.

As presented in results only one negative comment was given to the current homework grading arrangement and the negative aspect of the feedback was not on the feedback itself but rather on the media used to transfer the feedback. This was the first time the teacher tried this audio feedback because it was now readily available in Canvas Speedgrader and because it did save time for the instructor i.e., she was able to give more detailed feedback in shorter amount of time than in the written form. When the teacher asked students during lecture about the negative comment point of view no student present agreed. She did, however, send a message to all students proposing that everyone that wanted to have visual instead of audio feedback should let her know and she would make sure to have their feedback always visual. Sadly, no student replied even though it is clear that at least one student felt this way. In the future she plans to make this statement at the beginning of each course i.e., asking students preferring visual feedback to let her know at the beginning of the course. The goal is to present the feedback in a mode that is clearest to all students.

Some may argue that with this arrangement students get too much credit for poorly done homework but the total score for returning all homework (12-13 in total) in the courses is only 10% of the final grade, most students are not trying to game the system and the author of this paper believes what is gained for them trying to solve all homework is much more valuable than the inflation that comes from those 10% in their final grade.

Some may also argue that students that copy other student's solutions or the solution manual should not get any points for completing the homework and that is probably true. But the burden that puts on the instructor to proof that a homework solution is copied (and who is copying who) is in the authors mind too high with such low stakes in their final grade. Students'

major loss in copying is by far the lack of an opportunity to learn from trying to solve the homework themselves and that will be very evident in the final itself. Those students rarely pass a course and at least never with a good grade, so the author believes those worries are not necessary and the benefits of full credit only formative feedback for homework assignments by far outweighs the drawbacks. The author of this paper, therefore, only sees positive effects of using feedback instead of grades for homework.

One view is worth discussing. Is it cheating if students do not independently work on their homework solution in formative assessment? The definition of cheating is to act dishonestly and unfairly to gain an advantage and as the author of this paper has repeatedly explained to her students, they gain nothing from turning in a perfect solution not done by themselves. Their grade is the same no matter how their solution is but what they miss a learning opportunity. So maybe it is wrong to call it cheating and academic misconduct. Yet, in the coffee room discussing with colleagues the talk often focuses on how to prevent cheating on homework and they consider it academic misconduct (admittedly much less severe than on tests). Most also agree that the purpose of homework is to learn from and therefore should be considered a formative assessment (not all of her colleagues are familiar with the term formative assessment but agree on that is exactly how homework should be when explained what it means). So, cheating is what most academics (I would also argue students themselves) call the action when students do not work independently on homework despite homework being formative. The author of this paper would argue that it does not matter if we call this action cheating or something else. Our goal is to assist students in mastering their learning on a subject and they are more likely to reach that by working independently on their homework. So, finding ways to increase that students work independently on homework is immensely important, no matter what we call the action when they do the opposite.

The shortcoming of this study is that that even though it covers 7,5 years it only addresses two courses with on average 40 students each. The measurement tools used to detect the influence are not particularly made to address this issue and therefore only give a sense of a tendency rather than being a concrete measure of the effects. Final grades of a course can vary with cohorts so one would expect only drastic changes in student learning could be detected by looking at those. The intuition of the instructor is a common measurement tool in educational studies, but it is limited since it will always be tinted of her own experiences and views no matter how much she will try to be neutral. The general student teaching evaluation surveys do not address the homework directly even though the instructor did ask students to address it in the open-ended replies in one of the years in question. Students may have strong opinion on the homework but still not bother to address it in the open-ended replies or might not have participated in the survey. Students that are indifferent about the homework feedback are also probably less likely to express their opinion making the replies biased towards both extremes. Despite those shortcomings, the fact there was no open-ended reply showing anything that works against the current grading format of homework assignments the author of this paper would argue that strongly suggest giving feedback only for homework has many positive aspects but few (or even no) negative aspects in students' minds. Furthermore, those results are in agreement to what students have expressed in conversation with the author of this paper. Furthermore, despite the shortcomings listed above, the findings are supported by the literature and the author believes those findings can be a solid starting point for more rigorous research on this issue. The author of this paper strongly believes the importance of such research to be immense and that instructors have a great responsibility to find homework grading methods that serve students best.

CONCLUSIONS

This paper addresses the positive effects of using feedback instead of a grade to deal with students' homework solutions as the literature on formative assessment supports. The student teaching evaluation surveys of 7,5 years in two courses in Bachelor Degree in Mechanical and Chemical Engineering suggest that students experience learning more, feel more encouraged to try to solve the homework assignments, feel less pressure and cheat less. Instructor's experience supports those findings. It can at least be stated that students experience was improved and likely their learning too.

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BIOGRAPHICAL INFORMATION

Asdis Helgadóttir has a PhD in Mechanical Engineering and is an Associate Professor in Faculty of Industrial Engineering, Mechanical Engineering and Computer Science at University of Iceland. Her research focus is on developing and implementing numerical methods for complex Computational Fluid Dynamics problems. She has also worked on some research projects on Engineering Education. Asdis completed a Postgraduate Diploma in Teaching Studies for Higher Education at University of Iceland in 2019. In 2021 Asdis was chosen to be one of the 11 founding members of the Icelandic Teaching Academy which is meant to encourage pedagogical development and good teaching practices at the public universities in Iceland.

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