



Work-in-Progress: Promoting Learning through a Prompt Feedback on Assignments and Quizzes in Peer-to-Peer Meetings with Students in Electronics I Course

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Abstract

In this work-in-progress article, I present descriptive, preliminary analysis on the effectiveness of a peer-to-peer feedback method to promote prompt feedback on students' assignments. Traditionally, homework assignments and quizzes given to students in Electrical Engineering classes are graded a few days or weeks after submission. Although usually the graded works are returned (or are available for pick up), the majority of the students do not review their graded assignments and quizzes to self-correct and learn from their mistakes. Also, a very small group of students (~5%) may contact their instructor or TA to review their works. Among those, the majority are students concerned about their grades, not necessarily about learning and understanding the underlying concepts. Although in good teaching practice, the solution of the given assignment/quiz is posted to the class website shortly after the submission deadline, there is no effective method to find if the students have used the posted solutions for self-correction of their mistakes.

During the pandemic in the school year, 2020-2021, when classes were offered online or in hybrid mode, I developed a method for enhancing student engagement. Every single student in the class of ~40 had to meet (mandatory) the instructor weekly in small groups of 4-6 students on MicroSoft (MS) Teams (virtual meeting) for half an hour. In the meetings, the recently submitted student assignments were reviewed and graded by the instructor. The new method provided prompt feedback to every student. Using descriptive analysis, I find that the mean scores of students participating in the review sessions during the pandemic increased in comparison to those before the pandemic and no review session. and compared to pre-pandemic, the students' grades improved. In order to continue to improve student learning, the instructor scheduled the mandatory MSTEams meetings for the students in Electronics I in the Fall 2021 semester when the course was offered as only in-class participation. I found that there still an increase in mean scores compared to before pandemic, but overall mean actually dropped compared to when the classes were just online. Further data collection and statistical analysis are required to fully understand the effect of this new method on the actual learning of the students. A hypothesis to be tested later is that the meetings had a complementary effect on the online teaching/learning but did not fit well with the student's schedule when taking in-class courses.

Introduction

Electronics I is a junior-level course in the Electrical Engineering program focusing on teaching how to design and analyze simple electronic circuits containing semiconductor devices (i.e., diodes and transistors). Along with acquiring new knowledge in the realm of electronic circuits, the students are expected to enhance their skills of analyzing and designing circuits. The skill development requires practicing various circuits through examples and assignments [1, 2]. The author, a faculty member of a large south-eastern public university, has offered weekly

assignments, quizzes, and exams to his classes over the last 11 years and from own experience realized that the traditional feedback system of grading students' works by TAs and returning them days or weeks after their submissions was not effective enough.

Giving feedback to students has been recognized as an essential element in the education systems from kindergarten to college. While numerical grades have a role in providing feedback to the students on their understanding level, it does not sufficiently provide clarity on ways of improvement to the students. Therefore, an effective feedback mechanism requires correcting students' works and informing the students on where to focus for improvements. There have been research that has reported on the timing and the method of giving feedback [3, 4]. In most web-based assignments, students can receive immediate feedback on the correctness of their response and even receive a short explanation about the correct answer as soon as submitting their response [5]. The usefulness of immediate feedback on online platforms has been shown to be influenced by students learning behaviors, which are related to student's self-efficacy and perceptions on the utility of the course [6]. Some studies suggest that delaying giving feedback can improve students learning [3]. Traditionally, the graded handwritten assignments include notes from the instructor or the course TA pointing at the student's mistake [7]. It is assumed that if the graded work is returned to the students with enough delay, students would review their own work and correct their mistakes for the next assignment/quiz/exam. However, there is no clear evidence to show this method is effective and to ensure that the students have reviewed the graded assignments.

In this article, I present early results using descriptive analysis comparing student grades in Electronics I from groups who participated in the feedback review sessions with those who did not. Additionally, I present results from a short two-item survey asking for student experiences in the review session. These results are preliminary and are documented to review and reflect on the need for alternative feedback providing methods on student homework's, and assignments in order to improve overall participation and learning.

Method of implementation

For this study three groups of students were considered: I) Students in the Electronics I class before the pandemic (Spring 2019, Fall 2019), II) Students during the pandemic participating in the online classes and the weekly MSTeams meetings (Fall 2020 and Spring 2021), and III) Students attending in-class and also participating in the weekly MSTeams meetings (Fall 2021). Table 1 summarizes the three groups. It should be noted that students in the Spring 2020 semester were not included in this study, due to the transition from traditional teaching to online classes in the middle of the semester when the pandemic started.

Each class was scheduled to have 8 homework assignments, 4 quizzes, a midterm, and a final exam; all were individual assignments. With this arrangement, every week, there was either a homework assignment, a quiz, or an exam. Each semester, new problems were designed using examples and problems different than those in their textbook. Therefore, each semester the

students were assigned unique problems and had no access to solutions at the time of doing the assignments. The overall grades were distributed with 40% homework assignments, 20% quizzes, 20% midterm, and 25% final. The total of 105%, provided each student with 5% to spare, in case they missed any assignments, and since it is class policy not to provide make-up exams or quizzes.

Table 1. Electronics I students studied in this work

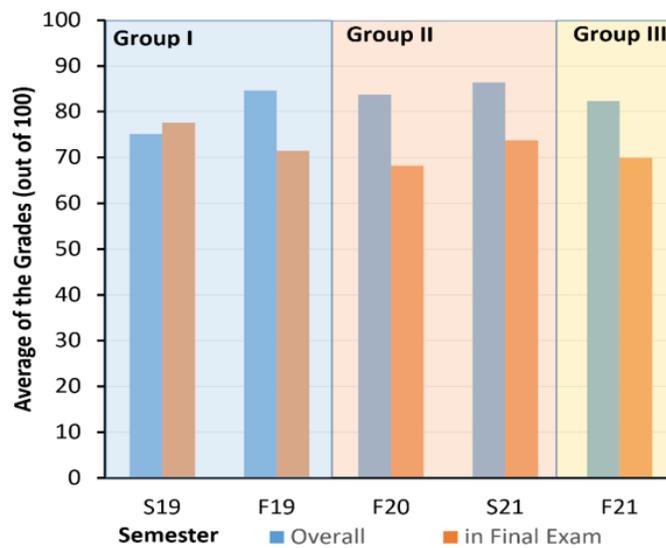
Group	Semester	# students	Review sessions	Collected results from
I (in-class)	Spring 2019	50	No	Grades
	Fall 2019	50	No	Grades
II (online/hybrid)	Fall 2020	58	Yes	Grades
	Spring 2021	46	Yes	Grades
III (in-class)	Fall 2021	40	Yes	Grades and Survey

For group I, the collected homework assignments, quizzes, and exams were graded by the same TA and were available for pick-up (at the earliest) a week after their collection. For groups II and III, the students were organized into groups of 4-6 members per team in MSTeams, forming 8-10 teams each semester. After identifying the most convenient time for each group, starting week 2 of the semester, online weekly meetings were scheduled for half an hour with each group. Due to the students' personal and school schedules, some of the weekly meetings were held in the evenings (some as late as 9:00 PM) and some were scheduled on weekends. During each meeting, with all team members present, students were called by name one-by-one. Each student's recently submitted assignment/quiz/exam was shared on the screen. The student was asked to explain his/her work to the instructor and to the group. The meetings were called review sessions and each session was awarded 2% towards the students' final grades. In the review sessions, if a student had made a mistake, the instructor explained to him/her the correct solution while the other students in the team were listening. Reviewing the students' work in the meetings, their work was graded at the same time. To minimize the potential negative impact of the instant grading on the students feelings, student works were not graded in the presence of the team members if their grade would be very low or when the students asked not to be graded during the meetings.

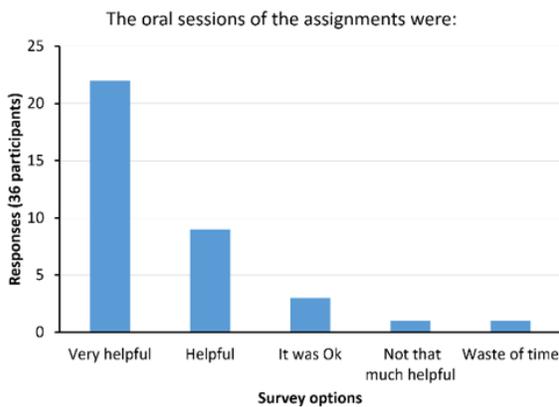
Participation in all MSTeams meetings contributed to 26% of their overall grade (2% for each quiz, homework, and midterm). Students' grades in all three groups were considered to assess the impact of holding the weekly online meetings. Particularly, the overall grades and the Final exam grades were considered. The final exam was the only activity in all the groups that had no review component. Also, a short survey was designed and given to the students in group III at the end of the semester. The results of the studies were analyzed and presented in this work.

Results

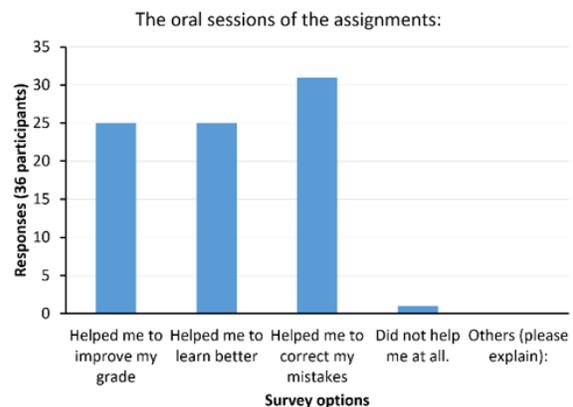
Figure 1.a shows the mean scores of the overall grades and the final exam grades of all three groups. Comparing the overall grades, the mean score in Spring 2019 was 75.1% which increased to 86.44% in Spring 2021. However, the mean decreased to 82.33% in Fall 2021, while still being higher compared to the pre-pandemic term. Although it could be reasoned that the high average grades for groups II and III are largely due to the 26% points from the review session participations (participation rate was always higher than 90%), the mean score of 84.59% in Fall 2019 semester (before the pandemic) suggests that the average of the grades may have not been affected significantly by the review sessions. Considering the difference between the students' final exam grades with their overall grades, there is evidence to suggest that the students have benefited at least by 12% increase in their overall grade because of the review session (see the large difference between the overall and final exam grades for groups II and III).



(a)



(b)



(c)

The results from the two-item survey undertaken by students in group III (Fall 2021) provided additional information and clarity on the value of the review sessions. The first question in the survey was a multiple-choice question asking “the review sessions of the assignments were:”

with five choices of “very helpful, helpful, it was ok, Not that much helpful, waste of time”. Figure 1.b shows that 22 out of 36 students have found the review part was very helpful and 9 more responded as helpful. Only one student claimed it as a waste of time and one more student did not find it much helpful.

The second question in the survey asked about the impact of the review sessions on the students. A few choices were given to the students and they were asked to mark as many choices as applied to them. The choices were: “helped me to improve my grade, helped me to learn better, helped me to correct my mistakes, did not help me at all, others”. Figure 1.c shows the results. 31 out of 36 indicated that learning from their mistakes was the main benefit of the review sessions. 25 students also chose the first two options.

Findings

The new method of having review sessions for every graded activity in the class started in Fall 2020 when the classes were offered in a hybrid form during the pandemic. While only 2-5 students attended each class (all through the semester), the rest of the students followed the lectures through pre-recorded videos. To help reduce students stress level (particularly during the pandemic), online exams and quizzes were given without using any form of proctoring. The questions were posted online at the scheduled time and students had to post a picture of their solutions before the deadline. Considering the possibility of students taking advantage of the situation, the review sessions were originally designed to prevent plagiarism. Since each student had to explain their work in the review sessions, their thought process and the depth of their learning could be monitored for each individual student. Soon after applying the method, it was found that the review sessions were helpful not only to prevent plagiarism but also to improve students learning. Hence, in Fall 2021, when the class was offered only in-person, the review sessions were continued.

Students’ comments in the given survey to group III and from the students’ emails (from both groups II and III) have been analyzed for measuring the effectiveness of the method. Based on the students’ comments, the advantages and challenges of the method are listed below:

Advantages in having the review sessions to review students’ submitted assignment/quiz/exam:

- 1- Instant feedback: Reviewing students’ work shortly (max 4 days) after its submission helped students to correct their mistakes before submitting the next assignment or taking the next quiz/exam.
- 2- Direct feedback: Engaging as the instructor (not the TA) of the course engaging each student in a one-to-one discussion on every submitted work improved the connection between the students and the instructor. It was particularly valuable during the pandemic when the students followed lecture videos. Also, the feedback was helpful to me as the instructor to adjust my teaching pace and focus on the weakness of the students.

- 3- Thought process explanation: Asking students to explain their own work made them process the solution for each question which according to their comments had helped them to improve their thought process. Also, in some cases, listening to a classmate explaining his/her work helped other students in the team to learn alternative methods of solving a problem.
- 4- Reduced the chance of cheating: Group II students appreciated this, but group III students who took in-class exams and quizzes did not consider it as an effective method to prevent plagiarism.
- 5- Student group engagements: Apparently, assembling students into groups of 4-6 students provided an opportunity for the students to work together for preparing themselves for exams and quizzes and also socialize during the pandemic (only for group II).
- 6- Avoided office hours: Weekly meetings with all the students eliminated the need for holding office hours.

Challenges in continuing the review sessions for the future semesters:

- 1- Time-consuming activity for the instructor: Meeting all the students in a class every week was a great burden. On average, 4-5 hours every week was dedicated to the meetings. Although TA help can be a solution, the advantages in the direct feedback will be lost.
- 2- Privacy issues: Reviewing students' works in a review session when his/her teammates were listening was on top of the students' complains. Because of it, I had to ask every single student if they feel comfortable reviewing their work in front of their classmates. Participating students received the review points regardless of whether they agreed to review their work or not.
- 3- Scheduling the meeting times with the students: During the pandemic, when most of the classes were hybrid or online, students had more free time and were willing to meet during working hours. In Fall 2021 when the campus was open, the meetings were scheduled at late evenings and even on weekends, simply because students were not available during the working hours.

Limitations

The study's findings must be understood in lieu of its limitations. The main limitation to the findings of this study is the limited data and its analysis. While the student grades provide an interesting perspective to evaluate effectiveness of the feedback review sessions, it alone can not solely be the deciding variable. The study is also limited by the changes in activities, student groups, and TA's participated across the years included. As a next step in this work-in-progress, additional data will be considered and a rigorous statistical analysis will be performed to identify the full scope of results.

Summary

Based on the limited data that was collected through this study, it is likely that the review sessions were useful for the online and hybrid students during the pandemic. Although the difficulties in scheduling the meeting times during the working hours and due to the students' concerns about their privacy, it is challenging to implement the method in future semesters, this study is still in progress to collect more data and not rely only on the students' grades. The students' strong comments on the benefit of receiving immediate and direct feedback for correcting their mistakes must be considered for developing a more sustainable method of teaching.

Acknowledgments

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References

- 1 Costa, L.R., Honkala, M., and Lehtovuori, A.: 'Applying the problem-based learning approach to teach elementary circuit analysis', *IEEE Transactions on Education*, 2007, 50, (1), pp. 41-48
- 2 Moreno, R., Reisslein, M., and Ozogul, G.: 'Optimizing worked-example instruction in electrical engineering: The role of fading and feedback during problem-solving practice', *Journal of Engineering Education*, 2009, 98, (1), pp. 83-92
- 3 Kehrer, P., Kelly, K., and Heffernan, N.: 'Does immediate feedback while doing homework improve learning?', *The Twenty-Sixth International FLAIRS Conference*, 2013, pp. 542-545
- 4 Shute, V.J.: 'Focus on formative feedback', *Review of educational research*, 2008, 78, (1), pp. 153-189
- 5 Serhan, D.: 'Web-Based Homework Systems: Students' Perceptions of Course Interaction and Learning in Mathematics', *International Journal on Social and Education Sciences*, 2019, 1, (2), pp. 57-62
- 6 Chen, X., DeBoer, J.: 'Checkable answers: Understanding student behaviors with instant feedback in a blended learning class', *2015 IEEE Frontiers in Education Conference (FIE)*, 2015, pp. 1-5
- 7 Gok, T.: 'Comparison of student performance using web-and paper-based homework in large enrollment introductory physics courses', *International Journal of Physical Sciences*, 2011, 6, (15), pp. 3778-3784