

Does preparing homework really help EE Students pass the final exams?

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INTRODUCTION

As a part of the on-going attempt to improve academic teaching, a lot of research work is directed at new approaches and new methods in teaching. Much of the effort is placed on e-learning and examining what are the preferred methods for e-learning and distant learning and how well they assist in academic teaching [1-4]. Other research papers deal with more fundamental aspects of learning such as the differences between students from urban and rural backgrounds and between female and male students [5], how does working in groups contribute to the individual student [6], what is the role of laboratories in undergraduate studies [7] and how does accreditation affect students' performance [8]. More recent research works tried to measure how a course grade can affect students' future choices [9], how classifying exercises can support individual learning [10], and how midterm exams affect the final grade in a set of courses [11].

Most undergraduate Electrical Engineering (EE) courses incorporate homework (HW) assignments, as a part of formative assessments, in the course syllabus. In some cases HW is graded according to the accuracy of the solution, in other cases according to the effort done by the students to solve the questions (regardless of whether they solved correctly or not), while in some cases just the actual submission counts. Sometimes HW grades have a certain weight in the final grade of a course and sometimes the submission of HW is a condition for attending the final exam. Solving HW during the semester is supposed to help students stay tuned and focused throughout the course but those it actually affect their ability to succeed in the final exam? This paper tries to answer this question.

In 2003 Trussell and Dietz [12] tested whether grading the homework was time effective and concluded for one specific math course that graded HW led to significantly higher scores in the final exam. In 2009 Geide-Stevenson [13] tested if collecting and grading HW assignments had an impact on students' achievements in

an introductory course and pointed out that inexperienced college students benefit from graded assignments more than experienced students. These and other research work focused on single courses and did not give a broad view on the importance of assigning HW.

In the current work the author presents a survey of 733 undergraduate college students across four years of EE studies. The survey addressed 9 courses in which HW assignments were given approximately once a week. The HW was graded only for effort and not on the basis of accuracy of the results and the incentive for submitting the HW assignments was a 10% addition to the final exam grade. The HW assignments were not obligatory so students could choose whether to submit them or not. At the end of each semester the author divided the students to three groups: those who chose not to submit any HW assignments, those who submitted but fewer than 80% of the assignments and those who submitted at least 80% of the HW assignments. Finally, the average grade in the final exam for each of these groups was compared, and thus the correlation between the willingness to submit HW assignments and the achievements in the final exam was examined.

It is important to mention that the homework assignments referred to in this text are printed questionnaires with open-ended questions. To answer the questions correctly the students must be able not only to understand the lectures and class recitations but also to apply the knowledge they obtained and to relate and examine new issues with respect to those shown in class. In other words, the homework assignments at hand are placed within the two middle levels of Bloom's taxonomy [14].

Assigning homework to students has only benefits, however grading homework and using this grade as a part of the final grade has quite a few drawbacks. It is very difficult for the course staff to find whether students prepared the assignment alone, were aided by other students or simply copied solutions from their classmates. Grading the assignment according to the accuracy of the solution does usually motivate the brighter students to pay attention when solving an assignment, but at the same time it motivates the less competent students to copy the results from others rather than to risk losing points. Homework assignments help the students to keep up to date with the material taught and not to stay behind, but too many assignments turn it from a helpful tool to a burden.

In the suggested work the author tried to measure the correlation between preparing homework and succeeding in the final exams. To eliminate the presence of copied solutions, as much as possible, the author tested courses in which the assignments were not obligatory and the grade was given for the attempt to solve and nothing else. In the following paragraphs we first present the database used to determine this effect, next we show and analyze the statistical properties that we draw from the database, later we attempt to explain why we obtain such results and finally we conclude.

1 THE DATABASE

Nine EE courses were examined in this survey that covered data from 2011 to 2016. Since the 1st year contains mainly Mathematics and Physics courses only one EE course was taken, namely "An Introduction to EE". From the 2nd year the three courses used were "Analogue Circuits", "Introduction to Communications" and "Signals and Systems". From the 3rd year the two courses used were "Signal Analysis" (very similar to "Signals and Systems" but taught at a different college), "Signal Processing" (very similar to "Signals and Systems" but taught to software engineering, SE, students) and "An Introduction to Semiconductor Devices". Finally, from the 4th year courses the author used "Digital communications" and "Optical Communications". 168 students took the 1st year course, their final grade, midterm grade and homework submission percentage were recorded and placed in a chart. A partial data chart can be seen in Table 1. The term NA (Not applicable) refers to a task a student did not perform (e.g., she/he did not attend the midterm exam).

Table 1. Partial data of homework submission percentage, Midterm exam grade and Final exam grade in the course "Introduction to EE", NA (Not applicable) refers to a task a student did not perform.

HW Submission (%)	Midterm Grade	Final Grade
40	51	NA
42	96	43
60	35	64
60	56	65
60	58	67
72	56	2
78	79	76
80	NA	99
100	79	85

175 students took the 2nd year courses and their data were also recorded. Note that the number of student in three 2nd year courses is similar to the number of student in one 1st year course, this reflects that fact that many students drop out after the first year. 291 students took the 3rd year courses and their data were also recorded. Note that the number of students rose by 54%; this is due to the fact that there are more Software Engineering students than Electrical Engineering students. Finally, 99 students took the 4th year courses and their data were also recorded. This number is the lowest number of students since the courses are not obligatory courses.

2 EXPERIMENTAL RESULTS

We first observe 1st year students as shown in Fig.1. In Fig.1a we can see that 76% of first year students who did not submit any HW assignment did not attend the final exam (that's about 19% of the total students), fewer than 5% of these students passed the final exam. From those who submitted fewer than 80% of the HW only 28% passed the final exam and from those who submitted more than 80% of the HW, 69% passed the final exam. In Fig.1b we can see that the average grade for students who submitted more than 80% of the assignments is 68 (this is a filtering course so the grades are usually low) while it is less than 50 (failed) for the other two groups.

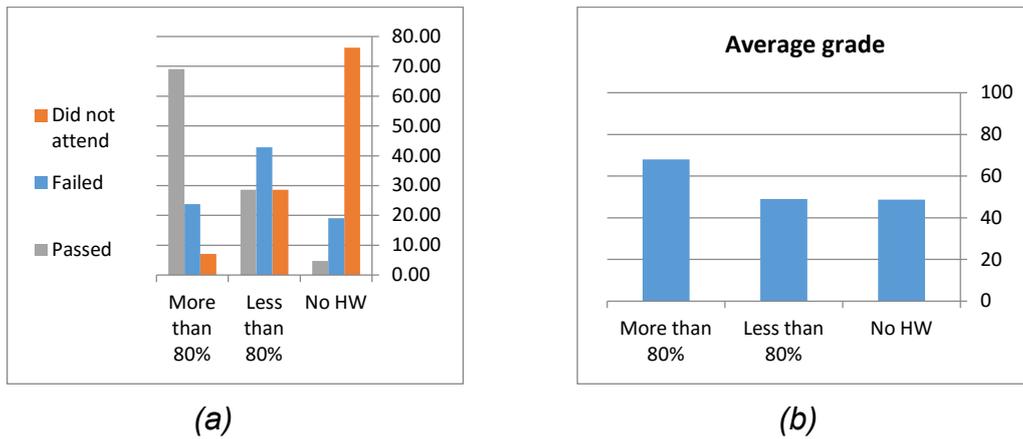


Fig. 1. (a) Percentage of Students who passed the final exam, failed the final exam or did not attend the final exam in 1st year courses, divided into three groups: those who handed-in over 80% of the homework assignments during the semester, those who handed-in homework assignments during the semester but fewer than 80%, and those who did not hand-in even a single homework assignment. (b) The average grade of 1st year students who handed-in over 80% of the homework assignments during the semester, students who handed-in homework assignments during the semester but fewer than 80%, or students who did not hand-in even a single homework assignment.

For second year students, 19% of those who did not submit any HW assignment did not attend the final exam, approximately 35% of these students passed the final exam. From those who submitted fewer than 80% of the HW 52% passed the final exam and from those who submitted more than 80% of the HW, 82% passed the final exam. These results are given in Fig.2a. In Fig.2b we can see that the average grade for students who submitted more than 80% of the assignments is 77, for those who submitted fewer than 80% it reaches only 70 and for those who did not submit HW assignments the average grade is 58.

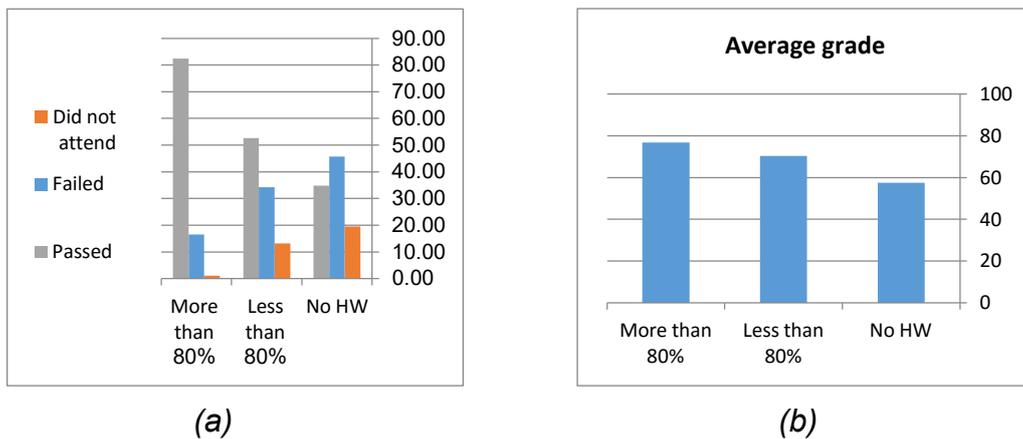


Fig. 2. (a) Percentage of Students who passed the final exam, failed the final exam and did not attend the final exam in 2nd year courses, divided into three groups: those who handed-in over 80% of the homework assignments during the semester, those who handed-in homework assignments during the semester but fewer than 80%, and those who did not hand-in even a single homework assignment. (b) The average grade of 2nd year students who handed-in over 80% of the homework assignments during the semester, students who handed-in homework assignments during the semester but fewer than 80%, and students who did not hand-in even a single homework assignment.

When comparing Fig.1a and Fig.2a we see that the majority of 1st year students who did not hand-in HW assignments gave up on the course and did not attend the final

exam while 2nd year students did not give up and approximately 81% of them attended the final exam (although 45% failed).

Fig.3 refers to third year students. As can be seen in Fig.3a, 78% of the students who submitted over 80% of the HW passed the final exam while only 34% of those who chose not to submit HW passed. It is notable that 38% of the students who chose not to submit HW did not attend the final exam – twice the percentage given for second year students. Students who submitted over 80% of the HW obtained an average of 79 in the final exam while those who failed to submit even a single HW assignment obtained an average of 53 (failure), as seen in Fig3b.

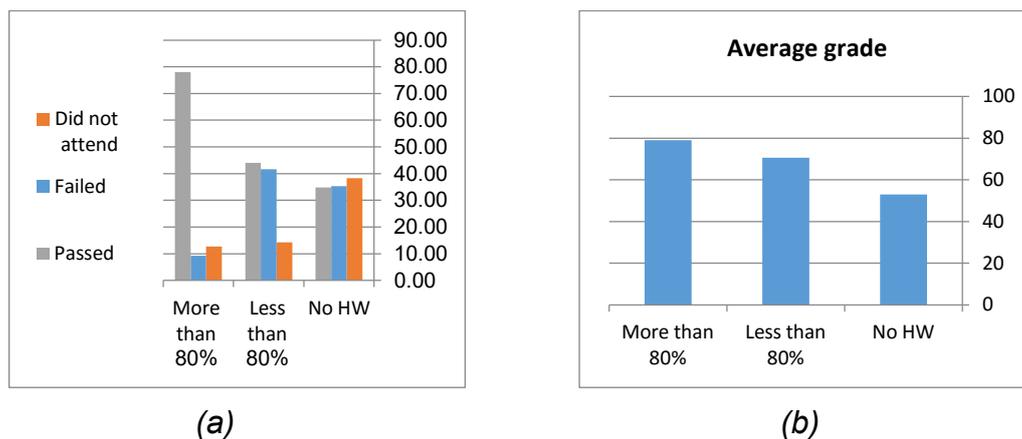


Fig.3. (a) Percentage of Students who passed the final exam, failed the final exam and did not attend the final exam in 3rd year courses, divided into three groups: those who handed-in over 80% of the homework assignments during the semester, those who handed-in homework assignments during the semester but fewer than 80%, and those who did not hand-in even a single homework assignment. (b) The average grade of 3rd year students who handed-in over 80% of the homework assignments during the semester, students who handed-in homework assignments during the semester but fewer than 80%, and students who did not hand-in even a single homework assignment.

For the fourth year results we observe Fig.4. Fig.4a demonstrates very small differences between the three groups and the number of students who pass the final exam is quite high in all the groups (82%-93%). The average grade, as shown in Fig.4b, is also quite similar between all groups and varies between 81 and 86. When comparing the 4th year results to the previous years we must keep in mind that the two 4th year courses used are non-obligatory courses, meaning that the students who took these courses did it because they were interested in either Digital Communications or Optical Communications.

Finally a comparison of submission trends between the four different years is given in Fig.5. While in the first year and second year the amount of students in each submission group is similar (50% vs. 52% full submission, 75% vs. 73.7% partial to full submission, respectively), in the third year there is a significant rise in the amount of students who submitted HW (59.4% full submission, 88.3% partial to full submission). In the fourth the tendency changes and the amount of students who submitted HW decreases (45.5% full submission, 60.6% partial to full submission).

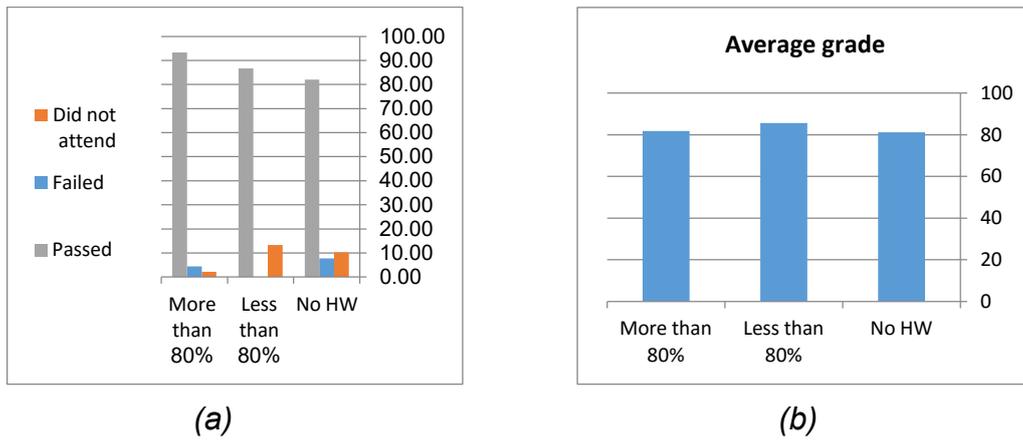


Fig.4. (a) Percentage of Students who passed the final exam, failed the final exam and did not attend the final exam in 4th year courses, divided into three groups: those who handed-in over 80% of the homework assignments during the semester, those who handed-in homework assignments during the semester but fewer than 80%, and those who did not hand-in even a single homework assignment. (b) The average grade of 4th year students who handed-in over 80% of the homework assignments during the semester, students who handed-in homework assignments during the semester but fewer than 80%, and students who did not hand-in even a single homework assignment.

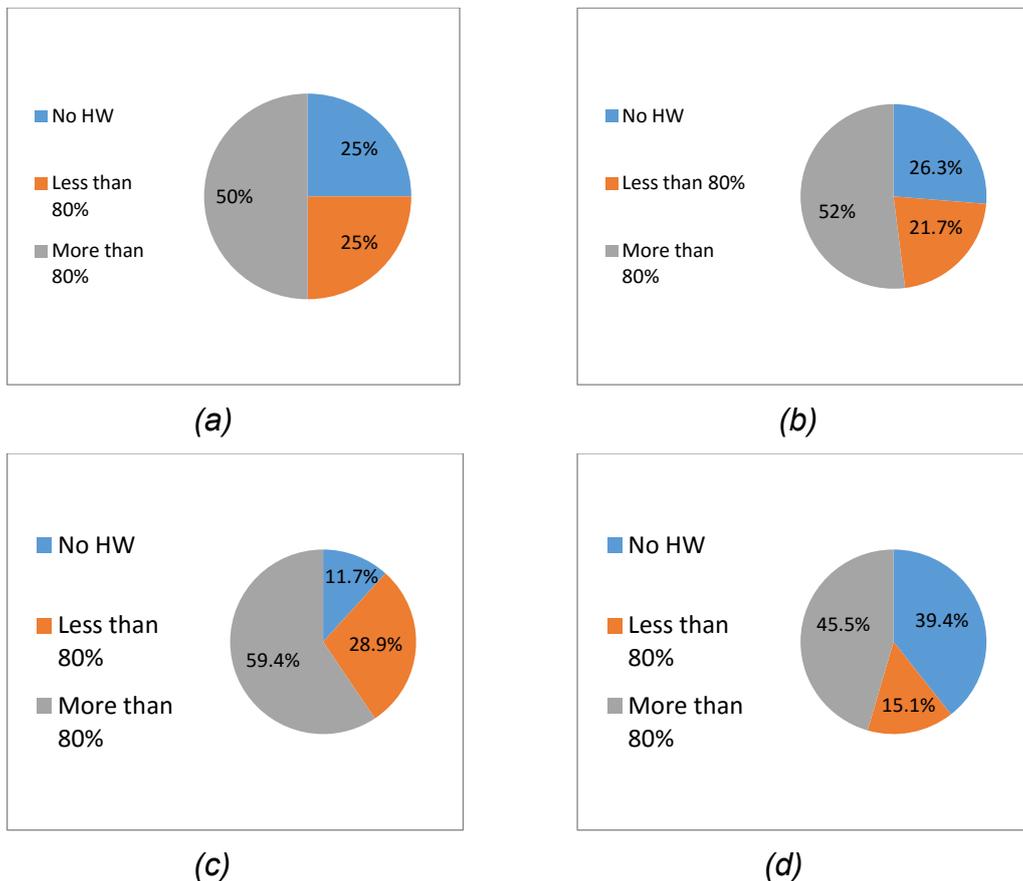


Fig.5. Percentage of Students who either handed-in over 80% of the homework assignments, handed-in homework assignments but fewer than 80%, or did not hand-in even a single homework assignment (a) for 1st year students, (b) for 2nd year students, (c) for 3rd year students, and (d) for 4th year students.

3 CONCLUSIONS

The first conclusion, valid for all four years, is that students who hand-in more homework assignments are more likely to pass the final exam, although the correlation between these two events decreases over the years. A second conclusion is that during the first three years there's a strong correlation between submitting HW assignments and attending the final exam. Those who fail to attend the final exam either drops out of college or takes the course again the following year. In the fourth year this trend changes and over 90% of the students in either group attend the final exam. When comparing 1st and 2nd year students (Figs.1 and 2) one can see that 1st year students who failed to submit HW assignments tend to give-up while 2nd year students are more committed and thus attend the final exams even if they failed to submit HW assignments.

As stated in the text, 38% of the 3rd year students who chose not to submit HW assignments did not attend the final exam – twice the percentage given for 2nd year students. In the 3rd year most students have a strong conviction that they are going to finish college and get a degree and they focus on improving averages as much as possible. From talks the author had with many of his students it seems that if they feel that their chances of succeeding in the final exam are not optimal (because they did not solve any HW assignments during the semester), they prefer not to take the exam and start over next year – this time, hopefully, with HW submissions. This can be a possible explanation to the increase in the number of 3rd year students who did not attend some of the final exam. Finally, most of the 4th year students got good grades regardless of whether they submitted HW assignments or not, this is due to the fact that the courses tested are non-obligatory courses selected by the students, and students select either courses that they find really interesting or courses in which they believe they can obtain good grades.

Returning to Fig.5, it is quite clear that 3rd year students submit more HW assignments and 4th year students submit fewer HW assignments, while at the same time most 4th year students attend the final exam whether they submitted HW assignments or not. After talking to several students the reason became clear: students in their final year spent time on their final project and many times already started working in the Hi-Tech industry so they have less time during the semester to prepare HW assignments. On the other hand they do not want to postpone the end of their studies, and they want to finish all their obligations within the standard 4 years, so they study well for the finals and the grades improve respectively.

4 SUMMARY

In this paper the author examined EE undergraduate students with respect to the academic year they are in, the willingness to submit HW during the semester, and the success in the final exams. The results shown above indicate a correlation between submitting HW assignments and passing the finals, however, the correlation and the measure of success changes from one year to another.

REFERENCES

- [1] Doolen T. L., Porter J. D. and Hoag J. (2003), "The Relationship between PDA Usage and Student Performance in an Introductory Engineering Course," *Journal of Engineering Education*, Volume 92, Issue 3, pp. 263–268.

- [2] Gati J., and Kartyas G. (2011), "Computer System Support for Higher Education Programs in Engineering," Emerging Trends in Engineering and Technology (ICETET), 4th International Conference on, pp. 61 – 65.
- [3] Hakala I., and Myllymaki M. (2011), "Blended learning in master studies in Mathematical Information Technology — Impacts on attendance and learning outcomes," IEEE Global Engineering Education Conference (EDUCON), pp. 404 – 411.
- [4] Gamulin J. and Gamulin O. (2012), "The application of web-based formative quizzes in laboratory teaching in higher education environment," MIPRO, Proceedings of the 35th International Convention, pp. 1383 – 1388.
- [5] Felder R. M., Felder G. N., and Dietz E. J. (1998), "A Longitudinal Study of Engineering Student Performance and Retention. V. Comparisons with Traditionally-Taught Students," Journal of Engineering Education, Volume 87, Issue 4, pp. 469–480.
- [6] Hunkeler D. and Sharp J. E. (1997), "Assigning Functional Groups: The Influence of Group Size, Academic Record, Practical Experience, and Learning Style," Journal of Engineering Education, Volume 86, Issue 4, pp. 321–332.
- [7] Feisel L. D. and Rosa A. J. (2005), "The Role of the Laboratory in Undergraduate Engineering Education," Journal of Engineering Education, Volume 94, Issue 1, pp. 121–130.
- [8] Prados J. W., Peterson G. D., and Lattuca L. R. (2005), "Quality Assurance of Engineering Education through Accreditation: The Impact of Engineering Criteria 2000 and Its Global Influence," Journal of Engineering Education, Volume 94, Issue 1, pp. 165–184.
- [9] Main J. B., Ohland M. W., and Mumford K. (2012), "Understanding Migration Patterns of Engineering Undergraduates: The Impact of Course Grades on Student Major Choice," 2012 Frontiers in Education Conference Proceedings, pp. 539-541.
- [10] Santos A., Gomes A., and Mendes A. (2013), "A taxonomy of exercises to support individual learning paths in initial programming learning," 2013 Frontiers in Education Conference Proceedings, pp. 87-93.
- [11] Gur E. (2015), Proceedings of the 43rd Annual Conference of the European Society for Engineering Education- SEFI2015, chapter 2, pp. 1-8, paper 51010.
- [12] Trussell H. J. and Dietz E. J. (2003), "A Study of the Effect of Graded Homework in a Preparatory Math Course for Electrical Engineers," Journal of Engineering Education, Volume 92, Issue 2, pp. 141–146.
- [13] Geide-Stevenson D. (2009), Journal of Economics and Economic Education Research, Volume 10, Number 3, pp. 3-14.
- [14] Bloom, B. S. (Ed.) (1956), Taxonomy of Educational Objectives Book 1: Cognitive Domain.