Characteristics of Students Who Do Not Do Homework

Introduction

All freshman engineering students at the University of Tennessee take a common course, EF 151 Physics for Engineers I, which is a combination of physics and an introduction to engineering. The pass rate for this course in Fall 2011 was 82.8%. The pass rate for students who completed at least 80% of the homework was 96.9%. The pass rate for the 22.5% of the class who did less than 80% of the homework was 33.3%. We are interested in why 22.5% of the students do not complete at least 80% of the homework. The goal of identifying the characteristics of students who do not do homework is to enable appropriate intervention techniques to be developed. This paper presents a work in progress, describing the research process and giving preliminary results.

There is debate over the role of homework, its usefulness, and its role in learning [e.g Vatterott (2009) and a current NSF project reported by Kaw and Yalcin (2010) examining whether collecting homework improves exam performance]. This research does not address that issue, but rather assumes that homework will be assigned and be a part of the grade. For the Fall 2011 EF 151 class with 409 students, the correlation coefficient between the homework grade and final average was 0.91, whereas the correlation coefficient between the first exam grade and the final average was 0.69, indicating the importance of homework, at least in this course.

Homework is worth 21% of the grade in EF 151. Approximately 80% of the homework grade is based on completing online homework problems. A customized web-based homework system is used (Schleter and Bennett, 2006). This system provides individualized homework (Goulet, 2010); each student has different parameters. Some of the features of the online homework system are shown in Figure 1. The remaining 20% of the homework grade is based on portfolio checks. The intent of the EF 151 portfolio is to help students organize all of their materials for the class, and to encourage students to document all of their work in a clear and methodical manner. To this end all students are required to maintain a portfolio of all work in a 3-ring binder. Students are graded based on their overall portfolio, as well as on the format and clarity of individual random written homework problems.

Recently a bonus system (Schilling, 2010) was implemented in the homework system, whereby students receive a 10% bonus homework problems completed at 24 hours or more in advance of the due date. This bonus has resulted in over half of the homework is being completed in the bonus time (Bennett et al, 2012). The positive effects are that the bonus system encourages students to figure things out for themselves, and it discourages procrastination. Improved preparation for lecture and recitation, and reinforcement of learning are also benefits identified by some students in the mid-semester survey.

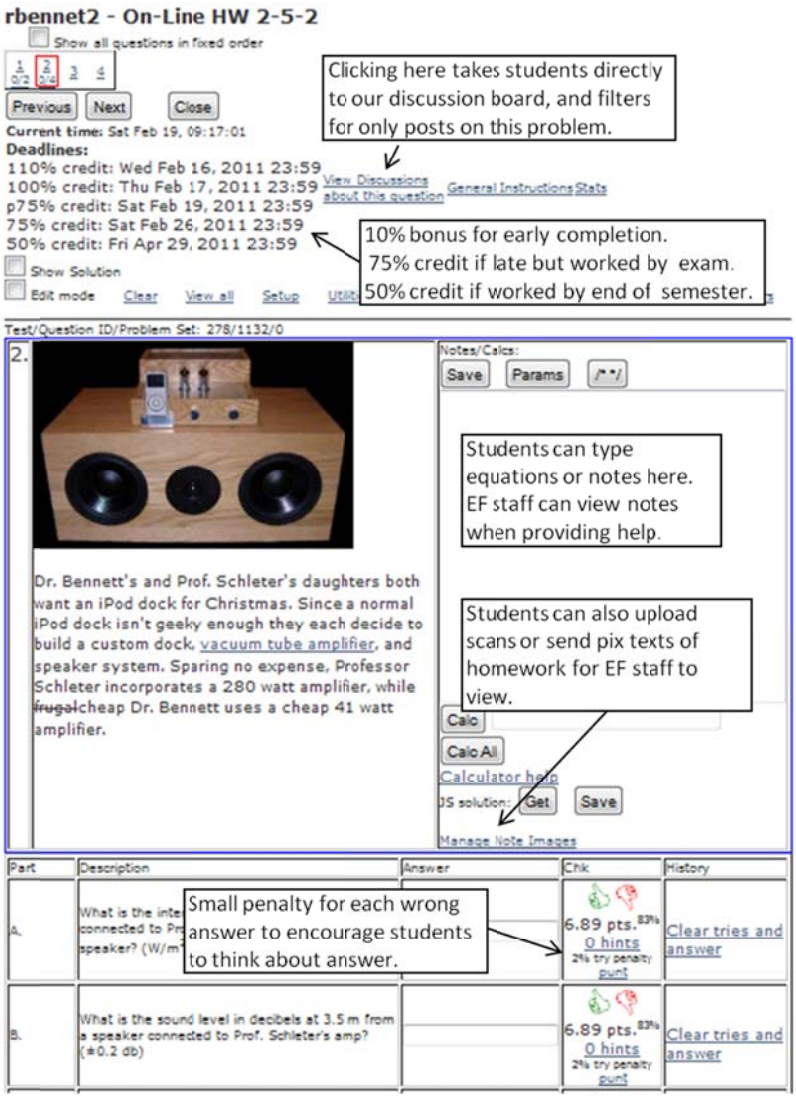

Figure 1. Online Homework System

Quantitative Analysis

Table 1 compares homework averages with other parameters. Comparisons are made in terms of correlation, and also averages of those students who had higher than an 80 homework average, and those students with lower than an 80 homework average. The medians of two groups are compared using the two-sided Wilcoxon rank sum test. There is a significant difference between the medians of all the parameters in Table 1, with $p<0.0001$ in all cases.

The Math ACT score is used as a measure of incoming preparation. The Math ACT score also factors in admission. To be admitted to the college of engineering, students need to have a Success Prediction Index (SPI) of 60, where the SPI is calculated as 10 times the high school GPA plus the Math ACT score. In addition, students must have a minimum Math ACT score of 25 to be admitted to the college of engineering. A Math ACT score of 28 is required to place into Calculus I, which is a co-requisite for EF 151. Some students with Math ACT scores below a 28

can place into Calculus I through Advanced Placement (AP) credit, dual enrollment credit, or passing a math placement test administered by the math department. It is interesting to note the Math ACT average for those students having less than an 80 homework average is only slightly above that required to be in Calculus I.

It has been hypothesized that students are better set up for success if they have more grit, more toughness, and more perseverance (Jaeger et al, 2010). The Fall 2011 students were given the grit survey (Duckworth and Quinn, 2009), with a small amount of extra credit being awarded for completing the survey. The mean overall grit score for the class was 3.54, which is essentially the same as the grit measured for 374 engineering freshman by Jaeger et al (2010) of 3.55. Although the correlation between the homework average and grit score is small, there was a statistically significant difference ($p<0.0001$) of the grit between the two groups. Those completing more of their homework did possess a higher grit.

The rest of the parameters are related to class performance. The homework average is compared to the overall class average. The exam average is the weighted average of four semester exams and the final exam. Each of the semester exams counts for 11% of the grade and the comprehensive final counts for 20% of the grade. As an improvement incentive, if a student scores higher on the final exam than a semester exam, the semester exam weighting is changed to 8% and the final exam weighting is increased by 3%. This applies to each semester exam, so the final exam can count as much as 32% of the grade if the final exam score is higher than all semester exams.

The format of EF 151 is large 50-minute lectures three days a week and smaller (24-28 students) 75-minute recitations two days a week. The lectures are team taught and use personal response systems (clickers) to increase course engagement. The recitations are led by trained graduate assistants and consist of collaborative problem solving, hands-on activities, demonstrations, and team projects. Students are assigned to teams of four for the recitations, and these teams sit around a table. Team assignments are made based on student performance, and new teams are formed every three weeks.

Lecture participation is measured by the percentage of clicker responses. In other words, students with greater than an 80 homework average answered on the average 86.2% of the clicker questions. Our grading of the clicker questions is 10 points for a correct answer, 7 points for an incorrect answer, and a student receives a 100 on their clicker grade if they obtain 75% of the possible points. The measure used here is not the actual clicker score, but simply the number of responses.

Recitation participation is a combination of an attendance grade taken at each recitation, and also completion of several extra credit surveys and extra credit activities. Students can earn approximately 10% extra credit by completing the surveys, attending three student society meetings (e.g. ASCE, ASME, IEEE, NSBE, SWE), and participating in two community service activities (e.g. Habitat for Humanity, Race for the Cure). Thus, the recitation participation can be as high as 110%, and should be an easy grade, as it just involves showing up.

Table 1 shows that students that are not doing their homework start with a lower Math ACT, have less grit, and are not fully participating in either the lecture or the recitation. This combination is leading to lack of success in the class.

Table 1. Comparison of Parameters to Homework Average

Parameter	Correlation	Average Value	
		< 80 HW Average	>80 HW Average
Math ACT	0.275	28.5	30.1
Total Grit	0.060	3.47	3.57
Average	0.907	53.6	87.6
Exam Average	0.807	51.4	82.4
Lecture Participation	0.680	53.9	86.2
Recitation Participation	0.749	84.7	105.4

Students fill out a background form at the beginning of the semester. As part of the background form, we ask students what their last high school math class was, and the quality of the class. We also ask students about whether they had high school physics, and the quality of the class if they did have physics. These results are summarized in Table 2. For those students having below an 80 homework average, less had high school calculus, and the quality of math instruction was lower. In terms of physics, a higher percentage of students having below an 80 homework average did not have any high school physics, and a lower percentage had AP physics, although some of the students did have AP physics. Students having below an 80 homework average rated the quality of the high school physics instruction lower, although the p-value was 0.054, or right at the typical significance cutoff of 0.05.

Table 2. Math and Physics Background of Students

Parameter	< 80 Average	>80 Average	Significance
HS Math Class Had Calculus	62%	79%	
Quality of Math Class	All: 3.82 Calc: 3.88	All: 4.19 Calc: 4.29	All: p=0.0050 Calc: p=0.0156
HS Physics	AP: 13% None: 29% Other: 58%	AP: 22% None: 19% Other: 59%	
Quality of Physics Class	3.38	3.71	p=0.0541

Qualitative Analysis

Students who were completing less than 80% of their homework in Fall 2012 were invited to participate in a 30-45 minute interview in order for us to better determine why these students were not doing homework. Approximately 100 students were invited to the interview, with 20 agreeing to participate. Instructors for the course were not involved in the interviews, and the interviews were conducted in a neutral location, away from the engineering campus. Initially the

students were asked some demographic questions. The following questions were then used to guide the interview.

- Why did you enroll in this course?
- How do you feel the class is going for you?
- What do you like about the course content? Why?
- What do you dislike about the course content? Why?
- Questions about the homework bonus system
    - Do you know how the homework bonus works? Describe it.
    - Do you think the homework bonus increases your motivation to complete the homework? Why?
    - When do you normally begin to work on your homework once it has been assigned?
- Describe the typical environment in which you do your homework.
- How much time do you spend on a typical homework assignment?
- Describe how easy or difficult it is for you to complete the average homework assignment?
- If you had a difficult homework problem, will you give up completing the homework or spend some time trying to answer it?
- If you had a difficult homework problem, how much time would you spend trying to answer it before you go on the next problem?
- How helpful is the homework in helping you understand the course content?
- Is there anything about the classroom instruction that influences your ability to complete the homework?
- What goals do you have for this class?
- How is doing homework connected to reaching your goals?
- Sometimes, "things happen" in a semester that make it difficult to get tasks accomplished or to focus on studying. Would you say that you have experienced personal circumstances that have interfered with completing homework assignments this semester?
- What are some other types of circumstances that have made it difficult for you to complete your homework?
- When these circumstances happen, what support could we provide to help you in completing homework assignments?
- Do you have questions for us?

The interviews are in the process of being transcribed, after which a detailed content analysis will conducted. Based on a preliminary analysis, several reasons were identified for why students do not do homework, which are listed below:

- Time management
- Struggling with both this course and other courses
- Work
- Too many credit hours
- Transition problems. Of the four students whose parents did not go to college, two of them reported transition problems, while the other students may have time management problems.

- Family problem which takes time
- Other activities which take time, such as religious activities and band rehearsal
- Do not like physics
- Get frustrated because of their low scores on tests and homework
- EF151 homework is harder and more than other courses
- Easily distracted by others (e.g., some students cannot work because a roommate is watching TV)
- No physics class in the high school. 6 of 20 students had no physics class before EF 151
- Like/use early homework bonus, mostly, and then less during semester
- The process of completing complex HW frustrates them and they cannot get help immediately at a key point (relates to the question below)

Conclusions

Both quantitative and qualitative methods are used to study characteristics of students who do not do homework in a freshman engineering class. Preliminary results are given, and work is continuing to further analyze and drill down into the data. Students who do not do as much homework have not had as good of a high school background, both in terms of courses and quality of courses, have slightly less persistence as measured by a grit test, and are not participating as much in class. The goal of identifying the characteristics of students who do not do homework is to enable appropriate intervention techniques to be developed.

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