
AC 2012-3721: A SUCCESS ENHANCEMENT PROGRAM AFTER THE FIRST TEST IN FRESHMAN ENGINEERING

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A Success Enhancement Program after the First Test in Freshman Engineering

Introduction

All first-year engineering students at the University of Tennessee take a common sequence of two-4 hour Physics for Engineers classes. The classes cover typical introduction to engineering topics, as well as basic physics concepts. The classes are divided into modules, with each module lasting approximately three weeks. There is a 50-minute test at the end of each module, which is worth 11% of the student's grade.

The first module in the first course has lectures on the following topics:

- Units, Significant Figures, Estimates
- Vectors, Components
- Vector Addition, Unit Vectors
- Position, Velocity, Acceleration (2 lectures)
- Constant Acceleration
- Motion in 2 Dimensions

Some students have had an AP Physics class in high school, and for them most of this material is a review. Other students have not had any high school physics, and for them almost all of the material is new. The test on this module is often the first major test that students will have in college, usually occurring before their first math or chemistry test. For some of the students it will be the lowest test score they have earned in their life.

In order to help students in the adjustment to college, a success enhancement program (SEP) is offered after the first test. Students are able to earn back a portion of the points they missed on the first test based on completing certain tasks. For higher scoring students, 40% of the missed points can be earned by reworking the problems that were missed, indicating why the points were missed (e.g. math error, did not understand the problem, careless mistake, ran out of time), and what actions will be taken to avoid the same mistake on future tests. A variety of approaches have been tried with lower scoring students. These have included attending extra help sessions, meeting with an advisor or instructor, developing a study schedule, and working extra math problems. Recently, the requirement for lower scoring students has been to retake the test, with 75% of the difference between the two scores being an adjustment to the original score. The SEP program is only available for the first test. This paper describes the program in detail, examines the participation in this optional program, and examines the effect of the program on the overall course grade.

The SEP program has some similarities to the Grade Recovery Program described by Hensel¹. In the Grade Recovery Program, students who had a D or F midterm grade in Calculus 1 were allowed to replace one of the first two test grades with their grade on the final exam (maximum replacement score of 70) if they fulfilled a contract for the second half of the semester where

they attended all classes, completed all homework, and attended one extra hour of study session each week. The SEP program seeks to intervene earlier in the semester, and is available to all students.

Another early intervention technique in a calculus course is described by Koch². Students who performed poorly on the first exam in Calculus I were given the option of switching into a half-term, 2-credit hour intensive pre-calculus course, before retaking Calculus I the following term. The goal of the SEP program is to retain the students in the course, and for them to make the necessary corrections to be successful.

Lavelle³ describes an intervention program after the first Calculus exam in which students meet with an academic advisor, develop an action plan, and then have a follow-up meeting with the advisor. When the SEP program was first started, there was a component in which students would have to meet with an advisor. However, lack of resources caused this part of the program to cease in 2008.

Fall, 2010 Success Enhancement Program

Requirements

The requirements for the Fall, 2010 success enhancement program (SEP) are shown in Table 1. These requirements had remained relatively unchanged since the Success Enhancement Program was first started in Fall, 2002. There are increasing requirements to earn back up to 40% of the missed points as the performance on the first test drops. The requirements have to be completed by the second test, which is three weeks after the first test.

TABLE 1. SEP Requirements for Fall 2010

Test 1 score	Test Rework	Math Practice HW	Study Plan	Instructor Mtg
80-100	Required	Optional	Optional	Optional
70-79	Required	Required	Recommended	Optional
60-69	Required	Required	Required	Optional
0-59	Required	Required	Required	Required

Example: a student with a score of 62 on Test 1 is required to complete the Test Rework, Math Practice HW, and Study Plan to receive $(100-62)*0.4 = 15.2$ points.

The Test Rework requires the student to rework, on a blank paper, every problem on which they lost points. They must write why they lost the points (examples might be math error, careless mistake, did not understand concept, wrong assumption, ran out of time, etc.) and what actions they can take to avoid these problems in the future. For problems in which they earned less than 2/3 of the possible points, they must completely rework the problem in the homework format of Given, Required, Solution.

The Math Practice homework is a 25 problem online homework in basic algebra, trigonometry, and geometry. The Study Plan requires students to write out a study plan for improving their performance in the course. The study plan must include a weekly time schedule and things that they are going to do to improve their performance in the course. Examples include regularly

attend Supplemental Instruction sessions, read the textbook sections before coming to class, look at the homeworks as soon as they are assigned and bring questions to recitation and/or help sessions, join with other students to form a study group, or seek math help in areas that you are weak in through online tutorials or through the Math Tutorial Center.

The Instructor Meeting requires the students to meet with one of the course instructors for about 15 minutes. The student must have their test 1 rework and study plan completed and with them at the meeting. During this meeting the faculty and student discuss what the student can do to improve their performance on tests, suggestions for improving their study habits, and suggestions for obtaining additional help.

Results

The results are given in Table 2 in terms of final course grade broken down by different categories. The category is based on their first test score, and whether they completed the SEP or not. For comparison, the homework average is also given. The course is graded as A, B, C, and NC (no credit).

TABLE 2. Results of Fall, 2010 SEP Program

Category	No.	Avg.	HW Avg.	Course Grade								
				A	A-	B+	B	B-	C+	C	NC	W
Class	450	78.1	85.7	110	41	49	69	34	37	26	74	10
>80 SEP	133	87.4	96.2	50	16	21	19	14	7	3	3	0
>80 No SEP	133	84.2	88.0	50	16	15	18	6	8	5	15	0
70-79 SEP	82	79.9	88.6	8	7	8	22	6	10	11	10	0
70-79 No SEP	5	72.8	70.2	0	0	0	1	2	0	0	2	0
60-69 SEP	43	70.0	81.1	2	2	5	5	5	6	4	12	2
60-69 No SEP	5	32.6	34.7	0	0	0	0	0	1	0	2	2
0-59 SEP	37	55.4	68.3	0	0	0	4	1	5	3	24	0
0-59 No SEP	12	13.6	23.1	0	0	0	0	0	0	0	6	6
Total SEP	295	78.8	88.4	60	25	34	50	26	28	21	49	2
Total No SEP	155	76.7	80.6	50	16	15	19	8	9	5	25	8

The students who completed the SEP program clearly performed better in the course than those who did not. It is not clear whether that is due to participation in the SEP program, or whether completion of the SEP program is an indicator of whether a student is engaged in the course or not. For the 17 students who scored below a 70 on the first test and did not participate in the SEP program, only one student (6%) passed the class. For the 80 students who scored below a 70 on the first test and did participate in the SEP program, 42 students (52%) passed the class.

Fall, 2011 Success Enhancement Program

Requirements

Our impression was that the SEP program was not being as effective as we had hoped, and in particular, the meeting with instructor was not very productive. Students would wait until the day or two before the deadline to contact the instructors, and often the meeting would have to be postponed due to scheduling difficulties. Most of the students we met with seemed to have little interest in the meeting, and were only there to meet the requirement. Only 35% of the students we met with ended up passing the course. Therefore, in Fall, 2011, the SEP requirements were changed. The program was reduced to two categories. Students who score a 70 or above need to complete the test rework, as described above. Students who score below a 70 are given the opportunity to take the test again. The retake test is not the same test, but it covers the same material. Students are given 75 minutes for the test retake, instead of the normal 50 minutes. The student is given 75% of the difference between their two scores as an adjustment to your original score. For example, if the original score was 50, and the second score is an 80, then the adjustment would be $0.75 \times (80 - 50) = 22.5$ pts. If a student does worse on the retake test, then their original score remains unchanged. No other major changes were made to the course, with the same instructors teaching the course in Fall 2010 and Fall 2011.

Results

The results are given in Table 3 in terms of final course grade broken down by different categories.

TABLE 3. Results of Fall, 2011 SEP Program

Category	No.	Avg.	HW Avg.	Course Grade								
				A	A-	B+	B	B-	C+	C	NC	W
Class	412	80.1	87.6	120	42	55	45	31	20	28	67	4
>70 SEP	127	84.7	95.2	38	21	15	19	16	4	4	8	2
>70 No SEP	197	84.8	89.8	81	19	33	18	4	12	10	20	0
0-69 SEP	64	72.1	83.5	1	2	7	8	10	2	12	22	0
0-69 No SEP	24	38.6	40.8	0	0	0	0	1	2	2	17	2
Total SEP	191	80.5	91.3	39	23	22	27	26	6	16	30	2
Total No SEP	221	79.8	84.5	81	19	33	18	5	14	12	37	2

For comparison, the performance on the first test in Fall 2010 and Fall 2011 was about the same. Both tests had medians of 84. The average was slightly higher in Fall 2011, 81.3, versus the average in Fall 2010, 80.7. The median score on the retake was 77, compared to a median of 63.5 on the first test for those students who took the retake. The averages were 76.8 and 59.6 respectively. Three students who took the retake scored below their first test score, so did not receive any adjustment. We are unable to identify how much having an extra 25 minutes for the retake contributed to the improved performance.

Similar results are seen to Fall 2010, where students who completed the SEP program performed better than those who did not. The participation was less in Fall 2011, with 46% participating in Fall 2011 compared to 66% in Fall 2010. We are not sure of the reason for this.

Comparison of Fall 2010 and Fall 2011 SEP programs

The two SEP programs were quite different, and we were interested in how they compared. We focused on students who scored below a 70, which was the range with the most difference in program requirements. In terms of participation, 82% of the students who scored below a 70 participated in the SEP program in Fall 2010, while only 73% participated in Fall 2011. We are not sure if this drop reflects a difference in attitude of the students, or is reflecting something about the new program. However, 18 of the 80 students who participated in the Fall 2010 SEP program completed less than 25% of the requirements. If these students are not considered as full participants, then only 65% fully participated in the program in Fall 2010, or slightly less than in Fall 2011. We conclude that the form of the SEP program did not have a significant impact on the number of participants.

The average adjustment was examined for those students who scored below a 70 on their first test, with the results given in Table 4. Fall 2010 students who completed greater than 25% of the SEP requirements are examined separately, as well as Fall 2011 students who had a non-zero adjustment.

TABLE 4. Adjustments for Students who Scored Below 70

Category	Avg. Adj.	Median Adj.
Fall 2010, All	12.8	13.6
Fall 2010, > 25% participation	15.8	14.2
Fall 2011, All	13.1	12
Fall 2011, > 0 adj.	13.8	12

The Fall 2010 SEP program resulted in a slightly higher adjustment. Using the U-test⁴, there was a statistically significant difference in the medians at the 5% level ($p=0.0018$). However, the absolute difference in medians of 1.6 points was small enough that the adjustment of 75% of the difference in test scores is reasonably consistent with adjustments in previous years.

Finally, the effect on the final grade was examined. As stated previously, for the 80 Fall 2010 students who scored below a 70 on the first test and did participate in the SEP program, 42 students (52%) passed the class. For the 64 Fall 2011 students who scored below a 70 on the first test and did participate in the SEP program, 42 students (66%) passed the class. The Fall 2011 program was a bit more successful. Based on these data, we conclude there is a slight advantage to having students retake Test 1 versus the Fall 2010 requirements.

Students Who Did Not Participate in the SEP Program

We were interested in the 24 students who scored below a 70 on the first test and did not participate in the SEP program. It appeared that for most of these students the SEP intervention

was too late. For example, 3 of the 24 students did not even take the first test, and 3 others scored below a 25 on the first test. Of these 24 students, only 12 took the final test in the course.

Figure 1 shows the percent of students who did any of the homework (HW) and the homework average (Avg) of those students who did the homework, both for these 24 students (< 70) and for the entire class (class). Due to an early homework completion bonus, the homework average can be greater than 100. The drop in average for Homework 4 reflects two problems which were difficult for the entire class. Modifications are planned for the recitation to address this. We don't have an explanation for the rebound for homework 5 of the number of students who did the homework out of the group of 24 students being examined.

There are noticeable differences in this group from the first homework in terms of homework average. In terms of homework completion, there is a noticeable difference starting with the fourth homework, which was due 8 days after the first day of class. Even though this group of 24 students was only 6% of the class, they accounted for 60% of the homework that was not completed in the first module. Of the 17 students in this group who did not pass the class, 14 earned less than 50% on the fourth homework. This suggests that it is possible to identify many of the students who are not going to be engaged in the class by the end of the first week of classes. It also suggests the need for very early interventions, even before the first test.

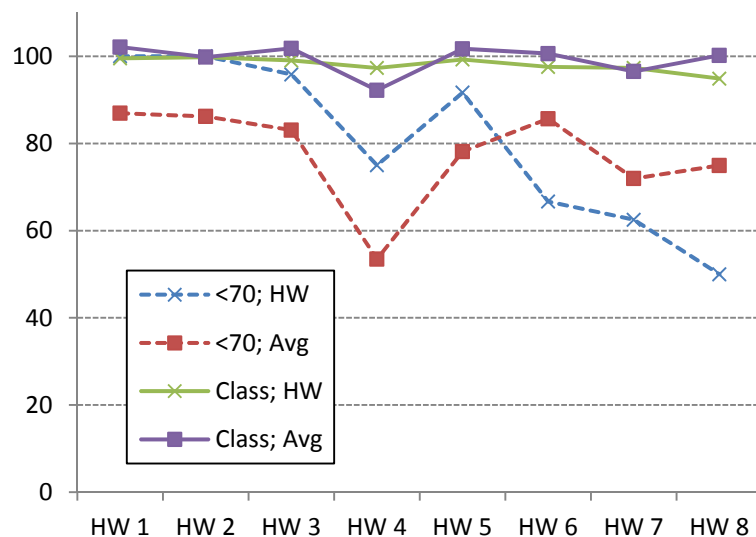


FIGURE 1. Percent Working Homework (HW) and Homework Average (Avg)

It has been hypothesized that students are better set up for success if they have more grit, more toughness, and more perseverance⁵. The Fall 2011 students were given the grit survey⁶, with a small amount of extra credit being awarded for completing the survey. The number of students that took the grit survey was 375, with the mean overall grit score for the class being 3.54. This is essentially the same as the grit measured for 374 engineering freshman by Jaeger⁵ of 3.55. The grit score for the group of 24 students who scored less than 70 and did not participate in the SEP is shown in Table 5. Although there is a small difference in the average between those who

passed the class and those who did not, it does not appear significant enough to be able to predict success.

TABLE 5. Summary of Grit Scores

Category	# of Data Points	Average Grit Score
Class	375	3.54
< 70, Did not participate in SEP	20	3.51
Passed the class	4	3.62
Did not pass the class	19	3.48

Conclusions

There appears to be little difference in the impact of two different Success Enhancement Programs (SEP). Having students retake the test seems to have a slightly greater impact, and we plan to continue this method. The retake also reduces the administrative burden, allowing instructors for focus on more productive things.

It is hard to gauge the impact of the SEP program due to having no good means of establishing a control group. The overall effect on the class may be marginal, but based on anecdotal evidence the program does keep a few students engaged in the course who otherwise may have given up. There are always a few students who come to see us after the first test in a panic. We are often able to relieve the panic by explaining the SEP program and their ability to regain many of the missed points. We also have a policy that if a student does better on the final than on an test, the test weighting is dropped from 11% to 8%, with the final counting an additional 3%. We do try to emphasize to students that the SEP is only for the first test, and unless some change is made, the student will not be successful in the class. We don't want to be giving students false hope, or the SEP program to become a crutch that students count on.

The data from non-SEP participants indicates the SEP program is too late for effective intervention for some students. It appears that it is possible to identify some of the non-engaged students after the first week of class. We are in the process of developing earlier intervention plans than the SEP program. Initial plans are to send personalized e-mails to students that are dropping off in their homework participation and performance. We have also never proactively encouraged students to participate in the SEP program, relying on the student to take the initiative to participate. As students have to sign up for a time slot for the retake, we can identify who has not signed up, and will contact those students. It is clear that intervention as early as possible is needed.

References

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