Use of Pass/Fail Grading to Increase First Year Retention

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Abstract - Like many colleges of engineering we have been concerned about the retention of our first year students. At CSU we recently implemented an experimental project that allowed first semester engineering students the option to take all of the courses using grading that was based on satisfactory or unsatisfactory (S/U) being the only options. This was optional and during the first year of the project we had approximately one third of the students choose this option. In the second year we had approximately 50% of the students choose this option. We completed a comparison between the project participants and the students who chose to not participate. A simple comparison of composite grade point averages (GPAs) for the two groups indicated that nonparticipants had higher GPAs at the end of the first semester than participants (using grades before the conversion to the S/U system.) This was consistent with a comparison of high school records; since the participants were selfselected, the data indicated slightly lower high school performances in terms of grades and standardized test scores for participants. The positive effect measured was in the retention data, where participants were retained both in the university and in the college at higher rates than the nonparticipants.

Index Terms - retention, grades, pass/fail

INTRODUCTION

The approach of assisting first year students' transition into higher education by having them take their classes as pass/fail instead of traditional grading has been implemented at several schools. Like many colleges of engineering we have been concerned about the retention of our first year students to the second year and progression to degree completion. At CSU we recently implemented an experimental project that allowed first semester engineering students the option to take all of the courses using grading that was based on satisfactory or unsatisfactory being the only options. This was an optional program and during the first year of the project we had approximately one third of the students choose to participate. In the second year the percentage of participants increased to almost 50% of the incoming class. This paper presents an analysis of retention and grade point average data for the first two years of the project. We currently have one more year for this experiment before the university will make a determination if the project can be adopted on a permanent basis.

PROJECT DESCRIPTION

The Pass-Fail (P-F) program at Colorado State University affords first semester freshmen in the College of Engineering the option of taking all first year courses with pass-fail outcomes in lieu of traditional grades. By university definition a grade of D or higher was equivalent to a satisfactory grade while an F results in a grade of unsatisfactory. To be eligible for the program, the student must be enrolled in seminar course ENGR 181A1 focused on successful learning strategies in his/her first semester and attend the University as a first-time freshman student. A major benefit to the students is a reduction in the academic risk associated with low grades. Students with only S/U grades do not have an 'official' grade point average and therefore cannot be placed on academic probation.

Because this was an experiment, a series of constraints were imposed in collaboration with university leadership with the intent of minimizing any potential harm to the students. First, faculty members were not informed of which students in their class chose the S/U grading. Since grades are intended to provide important feedback information from faculty to students, the project was designed to maintain this feedback. Several days after the semester ended, grades for the participants were changed to the S/U system by the registrar's office. This gave the students several days to check on their 'earned' grades before the conversion. Also, the Registrar's Office maintained the grades originally assigned by the faculty.

Second, students could choose to take either all or none of their courses using the S/U grading system. There was no option of mixing grading schemes by a student during the semester. It was considered important that students would treat all courses the same and not use different grading schemes based on their perception of the ease or value of the course.

Finally, one of the major elements of the project was allowing students the option to recover the original 'earned' grades. This could be done at any time if the student changed majors outside the college and needed traditional grades for transfer purposes. If the student stays in the college, the grade recovery is limited to the first 60 credit hours eared at CSU – approximately the halfway point of their degree program.

RESULTS

I. Description of Fall 2010 Cohort

In Fall 2010, the pass/fail program began with an inaugural group of 139 participants. The remainder of the freshmen cohort was comprised of 310 students who did not participate in the program. The percentage of females in the participant group is 23% compared to the overall population being at 18% female. The gender breakdown is one of many areas of potential interest that will be investigated in future efforts. We also compared student demographics across choice of major and ethnic/racial categories. There was very little difference between the group participants and nonparticipants along these measures. The one area where student demographics did show important differences was in the index (CCHE index) used to quantify student high school cumulative academic records. This index combines students' high school GPAs with standardized tests scores where a high index reflects higher values on these two metrics -see Table I for a portion of the table showing how the CCHE index is determined. Table II shows the differences for the first cohort.

 TABLE I

 REPRESENTATIVE PORTION OF CCHE INDEX DETERMINATION

		SAT	1200-	1240-	1280-	1310-	1350-
			1230	1270	1300	1340	1390
		ACT	27	28	29	30	31
%HS	HS						
Rank	GPA						
77-81	3.6		120	122	124	126	128
82-85	3.7		122	124	126	128	130
86-89	3.8		123	125	127	129	131
90-92	3.9		125	127	129	131	133

 TABLE II

 CENTER AND SPREAD OF CCHE INDEX, FALL 2010

	P-F Participants	Non-PF Students
Mean	122	124
Mode	125	127
Median	121	124
Std Deviation	7	9

II. Fall 2010 Cohort: Retention in the College of Engineering

Figure 1 compares longitudinal retention rates for both the P-F participants and nonparticipants through Spring 2011, Fall 2011, and Spring 2012 semesters. These statistics show students who declared College of Engineering majors in Fall 2010 and persisted in the college as engineering majors through Spring 2012. The retention rates of P-F participants and non P-F students steadily declined over the course of three semesters. Despite the similarities in downward trends, however, the P-F participants show higher retention rates than non P-F students for each semester. The differences appear to be small but in terms of retention numbers these values are considered to be very important, as it is very difficult to move retention by large numbers. These metrics will continue to be monitored for the traditional 6-year period for graduation rates. The encouraging part of these data is that most students leave within the first two years so it is encouraging to see increased retention rates through this critical period.



FIGURE 1 Engineering Retention Rates Fall 2010 Cohort

III. Fall 2010 Cohort: Retention in Colorado State University

Figure 2 compares longitudinal retention rates of P-F participants and non P-F students through Spring 2011, Fall 2011, and Spring 2012 semesters. These statistics show students who declared College of Engineering majors in Fall 2010 and persisted at the university through Spring 2012, whether they continued as Engineering majors or transferred to other majors at the university. The retention rates of P-F participants and non P-F students decreased at similar rates, with P-F participants experiencing slightly higher retention rates than the comparison group in subsequent semesters. The differences between these two groups are smaller than what exists for the students retained in engineering. Based on this data it appears that this project may play a role in

encouraging students to stay in engineering instead of changing majors within the university.



FIGURE 2 University Retention Rates Fall 2010 Cohort

In fall of 2011 the second cohort of students in the project were admitted into engineering. For this cohort, a larger percentage of students chose to participate, almost 50%. One reason for this growing population of participants may be timing issues. Permission to recruit for the first cohort was not received from the university until the fall 2010 semester and already started so students had little time to make the decision. For the fall 2011 cohort, the process of recruiting students into the project existed during the summer orientation programs. This occurred early enough that students could also discuss the decision with their parents.

IV. Description of Fall 2011 Cohort

In Fall 2011, the P-F program recruited a second cohort of 235 participants. The remainder of the freshmen class comprised 254 students who opted to receive traditional grades. With a total first-year cohort size of 489 students, nearly half of the first-year Engineering students in Fall 2011 chose to participate in the P-F program. Similar to first cohort, the female participant percentage was higher then the general female percentage: 22.4 participants to 18.6 for nonparticipants. Again, this issue will not be discussed in detail herein. The distribution comparison between the two groups along racial/ethnic identifiers and chosen majors was very similar for the two groups.

Table III illustrates the differences in high school records of the two groups. Similar to the first cohort, participant indices are lower than the nonparticipants. As this is a self-selection process, one may hypothesize that students with slightly lower high school performance records might choose the lower academic risk afforded by this project.

 TABLE III

 CENTER AND SPREAD OF CCHE INDEX, FALL 2011

	P-F Participants	Non-PF	
Mean	124	125	
Mode	125	133	
Median	123	124	
Std Deviation	8	9	

V. Fall 2011 Cohort: Retention in the College of Engineering and the University

Figure 3 compares Spring 2012 retention rates of P-F participants to non P-F students at two levels: first, the number of students who persisted as Engineering majors; and second, the number of students who persisted at the university, regardless of whether or not they remained in the College of Engineering. Although P-F participants and non P-F students were retained at similar levels, P-F participants persisted at slightly higher percentages. This trend is similar to the first cohort and will be monitored over the coming semesters to see if long-term trends remain similar.



FIGURE 3 RETENTION RATES FALL 2011 COHORT

The issue to be discussed next is a comparison of student performance using composite GPAs. The first author [1] has briefly discussed the limitations of using composite GPAs to characterize student performance but it does remain a commonly accepted metric and will be briefly mentioned next as it provides some interesting data to add to the retention discussion above.

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VI. Comparison of Grade Point Averages (GPA)

The distributions of GPA (available upon request) deviate from normal and are negatively skewed, where more frequent scores are clustered toward higher GPAs. To better contextualize the data, the following figures compare GPAs of participants and non-participants in the P-F program. Although P-F participants receive academic feedback (Satisfactory or Unsatisfactory), the university maintains official student grades in the event students must retrieve their full transcript. Figure 4 shows that the aggregated GPA average of Fall 2010 participants in the P-F program was lower than that of non P-F students. This figure represents all students from the freshmen Fall 2010 College of Engineering cohort who persisted at the university as College of Engineering majors or transferred to other programs. What is clear in this figure is that although the P-F participants started with lower semester GPAs, as they persist in their studies they have steadily improved and the gap between the two groups has decreased.

The trend shown by the P-F participants in increasing GPAs over this period is very encouraging. One of the main concerns expressed by university administrators was the potential for the participants to be lulled into poor academic performance. Despite these concerns, these students are improving as the stay at the university.



FIGURE 4

FALL 2010 COHORT: GPAS OF STUDENTS RETAINED AT CSU Since extremely high or low outliers can skew data, Table IV provides additional statistics about the center and spread of GPAs of students retained at CSU.

TABLE IV FALL 2010 COHORT: CENTRAL TENDENCY STATISTICS OF GPAS OF STUDENTS RETAINED AT COL

STUDENTS RETAINED AT CSU								
	FA10		SP11		FA11		SP12	
	P-F	NON	P-F	NON	P-F	NON	P-F	NON
Mode	3.00	4.00	1.00	4.00	4.00	4.00	0.00	4.00
Median	2.73	3.00	2.62	2.82	2.86	3.06	2.93	3.07
Std Dev	0.85	0.74	0.85	0.90	0.96	0.86	0.91	.087

Figure 5 and Table V show a similar trend but focuses on students who remained in the College of Engineering from Fall 2010 through Spring 2012. These results indicate slightly higher differences persisting through the period of this study. The statistical significance of these results has not yet been tested, but will be explored in future studies



FIGURE 5 FALL 2010 COHORT: GPAS OF STUDENTS RETAINED IN ENGINEERING

TABLE V
FALL 2010 COHORT: CENTRAL TENDENCY STATISTICS OF GPAS OF
STUDENTS RETAINED IN ENGINEERING

	FA10		SP11		FA11		SP12	
	P-F	NON	P-F	NON	P-F	NON	P-F	NON
Mode	3.00	4.00	1.00	4.00	0.00	4.00	0.00	4.00
Median	2.73	3.00	2.55	2.73	2.73	3.00	2.73	2.94
Std Dev	0.85	0.76	0.86	0.91	0.94	0.88	0.93	0.90

In Figure 6 and Table VI, central tendency statistics of GPAs from the Fall 2011 first-year cohort in the College of Engineering is compared between P-F participants and non P-F students. There are three levels to consider: (1) Fall 2011, at which point all students were enrolled as Engineering majors; (2) Spring 2012 students who persisted in the College of Engineering; and (3) Spring 2012 students who remained in Engineering or transferred to other programs at the university.



FIGURE 6 FALL 2011 COHORT: GPAS OF STUDENTS RETAINED IN ENGINEERING AND AT CSU

Similar to the Fall 2010 cohort, P-F participants from the Fall 2011 cohort similarly received a lower average GPA than non P-F students.

TABLE VI FALL 2011 COHORT: CENTRAL TENDENCY STATISTICS OF GPAS OF STUDENTS RETAINED IN ENGINEERING AND AT CSU

	FA11		RETAIN	SP12 IED in ENGR	SP12 RETAINED at CSU		
	P-F	NON	P-F	NON	P-F	NON	
Mode	4.00	4.00	3.00	4.00	3.00	4.00	
Median	2.79	2.95	2.63	2.78	2.64	2.83	
Std Dev	0.84	0.87	0.93	1.02	0.96	1.03	

Again, these metrics need to be monitored in coming semesters to see if they change. It is worth noting that for this cohort, the differences in GPAs in Figure 6 are smaller than what occurred for the 2010 cohort. It is still too early to know if this trend will continue and what might be the source of this trend.

SUMMARY AND CONCLUSIONS

This paper has provided an analysis of the performance of two entering classes of first year engineering students who were allowed to participate in an optional program where students could choose to take their entire academic load receiving S/U grading instead of traditional grades. This project was initiated with the purpose of providing students with a lower risk setting as they transition from high school into the rigors of an engineering undergraduate program. A goal of the project was to increase retention rates of students in engineering. To evaluate the project, herein we have analyzed two common metrics important to student performance: retention and grades.

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A simple comparison of composite grade point averages for the two groups in both cohorts indicate that the nonparticipants had higher GPAs at the end of the first semester than participants (using grades before the conversion to the s/u system.) This was consistent with a comparison of high school records; since the participants were self-selected, the data indicated slightly lower high school performances in terms of grades and standardized test scores for participants.

The more interesting findings of this study are related to student retention. These overall findings suggest that, on average, although P-F participants received lower grades, they also persisted at higher percentage rates than that of non-participants. The higher retention for students with lower grades brings up some interesting questions to be explored in the future:

- Are students being retained that might not be ready to be successful in engineering? This was a question on many people's minds as the project began. Although their grades are lower, the majority of the P-F participants are earning Satisfactory grades (a minimum of 2.0 is required maintain acceptable academic status.)
- Will the difference between the participants and nonparticipants diminish, increase, or stay the same long term? At present the trend is towards a reducing gap but this may level off. Logistic regression and/or survival analyses may be instrumental in determining whether retention rates differ substantively between participants and nonparticipants.
- Why are students retaining at a higher rate? It was hypothesized by one administrator that students might start forming their identities primarily as engineers and less importantly as A, or B, or C, etc., students by delaying the earning of traditional grades. By facilitating interviews and focus groups, the college will explore this research trajectory to understand why students self-select into the project and what factors contribute to persistence.

Based on these preliminary results, the university has given the college permission to continue the project for another year and is evaluating its potential for other colleges on campus.

References

[1] Stanton, K, and Siller, T, "A Pass/Fail Option for First-Semester Engineering Students: A Critical Review", *Frontiers in Education*, Session T2d, 2011.

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