Identifying At-Risk Students: How Use of Optional Study Materials and Collection of Graded Work Correlate with Academic Performance

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Abstract

We report on a study designed to identify students at risk by monitoring certain academic behaviors. Two different approaches were implemented. The first one involves monitoring student access of optional homework problems. While this approach was successful in the early identification of students at-risk, optional homework (as opposed to mandatory one) degrades attainment of learning objectives. The second approach relies upon "counting" of uncollected work. Since no grades were posted, the only way for the students to keep track of their performance was to collect their work. Failure to collect graded work, we argue, is indicative of weak motivation, poor class attendance and poor attendance of office hours. In a class of 114 students, 29 students failed to collect at least one major graded work. Twenty-one of them had below-average class ranking and all students with final grades of F and D+ were part of the underperforming group of 21 students. We also studied the motivating impact of rank-performance plots. The impact of these plots was assessed using an anonymous survey. Total of 89 students participated and 78 of them state they have used the plots to determine their ranking. Total of 36 students (47% of 78) report increased efforts; for students ranking in the bottom 1/3 of the class this percentage was close to 60%. The disadvantage of using rank-performance plots as a motivation tool is an increased anxiety.

Introduction

Having high cognitive abilities does not guarantee success in college. Approximately one student in every five students with GPA of A/A+, and SAT of 1300+ will fail to complete college in six years[1]. Similar statistics can be found elsewhere[2] and have been attributed to poor non-cognitive skills. As depicted in Figure 1, Conley[3] identifies four major categories of skills that a person must possess to be successful in college. The academic behaviors and the contextual skills are called "non-cognitive" because these attributes cannot be measured using IQ tests and standard academic tests. To better understand the academic performance of students, assessment of non-cognitive attributes is needed. Unfortunately, such assessment is not a simple task; there are many non-cognitive attributes and their interactions are complex[4].

This paper is concerned mostly with motivation and self-discipline and their correlation to certain academic behaviors and academic performance. Similarly to other "non-cognitive" factors, internal motivation and self-discipline are difficult to measure. Ideally, the assessment should be direct and the tools we use should not change the behavior of our subjects. Two such assessment tools are discussed in this paper.

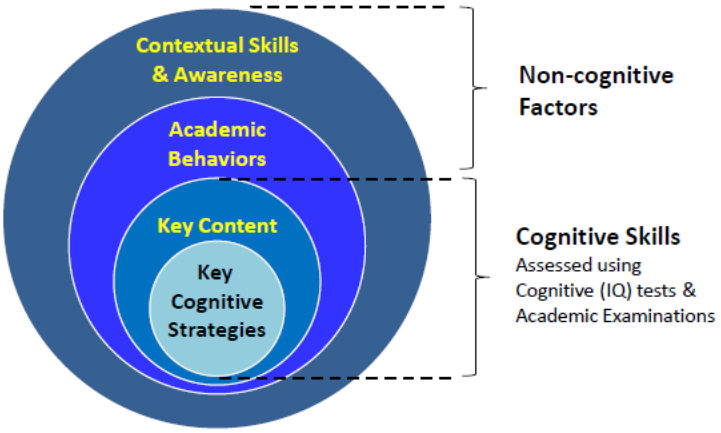

Figure 1: Facets of College Readiness (after Conley[3])

Course Description

The study was implemented in a 10-week introductory Semiconductor Device Electronics Class (EE 306). This course is mandatory for all students pursuing a bachelor degree in electrical engineering and computer engineering at Cal Poly, SLO. In the curriculum of these two programs, EE306 is typically taken in the Fall quarter of the junior year.

The course is structured with three fifty-minute lectures each week. The total enrollment is usually 150-160 students. Four to five individual sections of are offered, with individual enrollments of 30-40 students. Two and often three different instructors teach the individual sections. Reported here results are for three (out of five) sections. These three sections were taught by the same instructor and had combined enrollment of 114 students. Students were expected to attend all face-to-face lecture classes, but no attendance was taken or enforced. All in-class lectures were video captured[5]. Access to the recorded videos was provided using PolyLearn. PolyLearn is a Moodle-based Learning Management System used at CalPoly, SLO.

The course grading was based upon each student's performance on one midterm, three quizzes and a comprehensive final exam.

Use of Optional Resources and Academic Performance

Improved understanding of students learning habits can be obtained by monitoring the use of important but optional resources[5]. After each lecture, a homework assignment was up-loaded to PolyLearn. The homework was optional and solutions were not collected for grading. The cumulative number of times students accessed the assignments folder was used as indicator of motivation and study habits. The expectation was that motivated students will regularly check the assignments folder. Therefore, high level of access to the assignments folder would suggest good study skills. Conversely, low level of access would generally imply poor study skills; low total access results when a person downloads many assignments at once (when "cramming" for an exam, for example).

The 6-week cumulative access of each student was rank-ordered. The same was done for the exam performance and quiz performance. Table 1, Table 2 and Table 3 show the pair results. As seen in Table 1 and Table 2, the student population is classified into nine different categories depending upon their level of access to homework materials and class performance. Should performance and access were perfectly correlated, the entries on the main diagonal would have been 38 each (1/3 of the class enrollment) with all the other entries being zero. This is not the case – which was expected. It is notable however that the entries on the main diagonal have the largest value, suggesting some degree of positive correlation between "access counts" and academic performance. More importantly, the lower diagonal entry of Table 3 correctly identifies the two students who will eventually fail the course as well as two of the three students who will receive D+ as a final grade. The other three students will eventually receive below-average course grades of C, C+ and C- . It is notable, that these at-risk individuals were identified prior to administering the last quiz and the final exam.

Table 3 also indentifies four students with unusual access-performance characteristics. The two individuals with heavy access but poor (initial) performance would eventually "recover" and achieve course grades of C and B. The course grades of the other two students were B+ and A- . The class average was B-.

Table 1

		Class Rank based upon Mid Term Exam		
		Top 1/3	Mid 1/3	Bottom 1/3
Rank: Access to HW Assignments	Top 1/3	**20**	9	9
	Mid 1/3	9	**17**	12
	Bottom 1/3	9	12	**17**

Table 2

		Class Rank based upon Quizzes		
		Top 1/3	Mid 1/3	Bottom 1/3
Rank: Access to HW Assignments	Top 1/3	**21**	10	7
	Mid 1/3	12	**14**	13
	Bottom 1/3	5	14	**18**

Table 3

		Class Rank based upon Mid Term & Quizzes	
		Top 1/3	Bottom 1/3
Rank: Access to HW Assignments	Top 1/3	**14**	2
	Bottom 1/3	2	**7**

The above-described approach was reasonably successful in identifying students at risk of failing the class. However, I would not recommend this strategy, because it weakens the attainment of the leaning objectives. An alternative approach for determining the internal motivation of students and some motivation-related academic behaviors is described next.

Performance Awareness and Academic Performance

I intentionally did not post grades. Hence, to keep track of performance the students had to collect their graded work. Under these conditions, I argue, uncollected work is indicative of deficiencies in motivation, poor class attendance and poor attendance of office hours.
I also allowed students to collect the graded work of their friends, so uncollected work might also imply inadequate social interaction with fellow students.

Total of 29 students, approximately 25% of the class, have failed to collect at least one major graded work – quiz or a mid-term paper. Not surprisingly, most of those students had relatively poor performance. Twenty-one of them had below-average class ranking and all five students with final grades of F and D+ were part of the underperforming group of 21 students.

The Impact of "Forced" Performance Awareness

It is my impression that students with poor academic performance also have a poor understanding of their class standing. This issue, I argue, can be resolved by use of rank-performance plots. These are plots where raw performance is rank-ordered. One such plot is shown in Figure 2. Using this plot a student (who knows his mid-term score) could determine his class ranking.

For a large class and a well-designed exam, the rank-performance plot will have three regions – two steep ones at the beginning and the end and a shallow region in the middle. Scores falling within the steep regions indicate "outlier" performance – either exceptionally good or exceptionally poor performance.

A rank-performance plot can also be used as a motivation tool. This is especially true when the professor grades on a curve. According to the achievement goal theory, the use of rank-performance plots falls into the "performance goals" category [6, 7].

The rank-performance plots were provided in week #7 and the impact was assessed in week #10. An anonymous survey was used for the assessment. The survey was administered on the last day of classes. Only those students present on that day took part of the survey; total of 89 students (78% of 114 students) participated. The survey questions are listed on the next page.

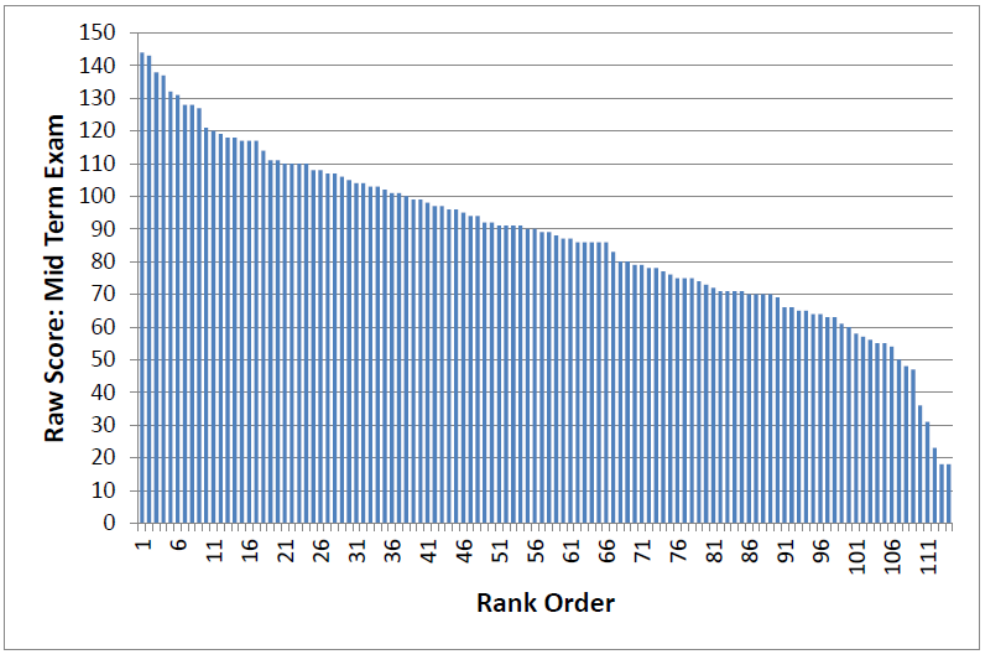

Figure 2: The plot shows exam scores ordered by rank. Each bar corresponds to the performance of a unique student in a class with enrollment of 114 students.

Please, share your opinion on Rank-Performance Plots

Q1: **Do you like knowing your (relative) class standing?**
☐ YES ☐ NO If "no", skip questions 2,3 & 4.

Q2: **Did you use the provided Rank-Performance plots to determine your class standing?**
☐ YES ☐ NO If "no", skip questions 3 and 4.

Q3: **What is your current class ranking?** (Please, be honest!)
☐ Top 1/3 ☐ Bottom 1/3 ☐ Mid 1/3

Q4: **What was the Impact of the provided Rank-Performance Plots on you?** (Check all that apply)
☐ No impact ☐ Made me anxious
☐ Increased my confidence ☐ Decreased my confidence
☐ Made me work harder ☐ Made me work less
Write your own:

Q5: **Why not?**

It is notable, that 82 students answered positively to Question #1 and 78 of them (88% of all responding students) used the plots to determine their class ranking. The impact of the provided plots upon the study efforts of students is summarized in Table 4. As seen, total of 37 students (approx. 47%) report increased efforts while only 7 (approx. 9%) report decrease in effort. It is notable that the "bottom 1/3" category is under-represented in the survey. This would suggest that (on average) more under-performing students were not present in class or answered

negatively to Question #1.The psychological impact of using rank-performance plots is summarized in Table 5. It is interesting, that nearly all students who report increased efforts also report change in their confidence level and/or increased anxiety. Unfortunately, a significant number of students, having middle and low ranking, report heightened anxiety without the sought-after benefit of increased effort. While rank-performance plots are seen as a power motivation tool, I would only use them in the second half of the course.

Table 4

		Efforts	
Rank (self-reported)	# of Students	Increased	Decreased
Top 1/3	31	13 (42%)	6
Mid 1/3	32	15 (47%)	1
Bottom 1/3	15	9 (60%)	0

Table 5

		Confidence		Increased Anxiety
Rank (self-reported)	# of Students	Increased	Decreased	
Top 1/3	31	23	1	6 (19.3%)
Mid 1/3	32	7	6	21 (65.6%)
Bottom 1/3	15	1	7	12 (80%)

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