AC 2010-912: USING PERFORMANCE BONUSES TO DECREASE PROCRASTINATION

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Using Performance Bonuses to Decrease Procrastination

Abstract

A common problem amongst college students is procrastination. Students tend to wait until the last minute to work on projects, especially if the project is longer than a day or two in duration. By procrastinating, students often end up rushing at the end to complete the project, resulting in the student not obtaining the optimal educational benefit from the assignment. This syndrome also leads to long lines outside of the office door on the day or two before an assignment is due, as the students are frantically trying to complete an assignment and have questions that they cannot answer. Those who are able to work effectively under pressure complete the assignment, while those who do not either turn in substandard work or submit late assignments. The late assignments receive reduced credit and impact the delivery of the next assignment. These late assignments also defer grades being returned to other students, as it is difficult for fair and equitable grading to be ensured unless the majority of assignments are graded at the same time.

In the construction industry, it is common for contractors to be assigned a performance bonus. Contracts that are finished early receive an incentive, typically in the form of an extra payment, while jobs which are finished late are penalized. In academics, it is common for a penalty to be assessed on late assignments. However, grading has not provided an incentive for students to finish their assignments early. This article analyzes the results of applying such an incentive system to engineering assignments. Through a small study, it will analyze whether performance bonuses reduce tardiness in assignment submissions as well as whether a performance bonus improves student learning through better achievement of course outcomes.

Introduction

One of the most common problems faced by students is procrastination. It is estimated that 95% of all college students procrastinate at some point in their academic career, and 25% of students are chronic procrastinators[1]. This is especially prevalent on long assignments. If an assignment is not due immediately at the next class session, students wait until either the weekend before or the night before the assignment is due to start work. This can be very problematic, as by procrastinating, any problems they encounter may result in either an incomplete or late submission.

Procrastination also has additional effects on college students. College students who procrastinate tend to have ``unhealthy sleep, diet, and exercise patterns''[2]. Research indicates that procrastination can be related to the self paced nature of assignments as well as low self esteem[3]. Procrastination is also linked with decreased student achievement [4,5,6] and cramming.

Procrastination can be especially difficult for students who are new to the college environment. In addition to adjusting to college life, bad habits may be magnified. This can lead to poor performance, academic probation, and ultimately withdraw from school. It is cited in multiple

sources that procrastination is a significant factor in low student retention, in both traditional courses and web courses.[7]

Traditional methods to overcome procrastination have involved the identification of student procrastinators and counseling intervention. This, in many ways, involves the student recognizing that they have a problem and attempting to overcome the issue.

But, procrastination does not only affect the student. Procrastination affects the instructor's behavior as well. It can be difficult to maintain consistent grading if assignments are submitted late, as late submissions may vary in their grading versus the initial, on time submissions. This may manifest itself in less thorough grading or easier grading. Procrastination also impacts the ability of a faculty member to provide fair and timely support to all students. Students who procrastinate tend to come in later during office hours, require more extensive support and be less confident in their understanding of the material. It is very possible that a few procrastinators may prevent other non-procrastinating students from receiving timely assistance.

Traditional techniques for combating procrastination have tended to be punitive. Faculty members either assign explicit deadlines for assignments, after which they will not be accepted. Short of forbidding late submissions, faculty members attempt to combat procrastination by assigning significant late penalties, such as the commonly used one letter grade per day late.

Aside from these approaches, very few professors actively try to discourage procrastination. In fact, some professors encourage procrastination by extending due dates or changing assignments after they have been made.

Other attempts at reducing procrastination have been targeted at increasing student interest in the assignments. These methods include splitting up larger assignments and establishing periodic deadlines, allowing students to more effectively schedule their time.[8] Within the Software Engineering area, competitive games[9] as well as collaborative development[10] have been tried. These mechanisms, however, may not work appropriately in all circumstances.

A different approach to combating procrastination would be an incentive based approach. This is a commonly used approach in engineering field. Civil Engineering contractors often receive large incentives for completing highway projects ahead of schedule, and many Department of Defense contracts also include rewards for exceptional performance.

Academic uses of such incentives have been rare. Students in the College of Pharmacy at the University of Houston received performance incentives on future examinations and remediation processes, and in doing so, achieved a 185% increase in passing rates on the Milemarker I exam and a 590% improvement on the Milemarker II exam.[11] Beyond this case, the only analysis of incentives in education has revolved around incentives for educators to improve student performance.

The Incentive Program

The goal of this incentive program was simple: to attempt reduce the percentage of students submitting late assignments in order to improve their individual performance. The goal of the incentive program was to provide the students with a small initiative to complete their work in a timely fashion yet not provide a significant enough incentive that grade inflation or artificial grade alteration would occur. As had previously been in place, a penalty was retained for late submissions as well.

The program itself was described to the students as follows in the course syllabus.

> *"In order to encourage timely completion of assignments, an early submission bonus will be available for all lab assignments. Lab assignments submitted 48 hours or more in advance of the due date may receive a 10% early submission bonus. Lab assignments submitted 24 hours or more in advance of the due date may receive a 5% bonus."*

Students were informed of this policy during the first class session, but not routinely reminded of it during the quarter (unless specifically questioned).

This policy was applied to all courses taught by the professor starting with the fall quarter of 2009 regardless of student grade or course content. It was the professor's view that this policy would be experimentally adopted for at least one quarter, and any required changes would be made at the quarter break for future classes.

The effectiveness of approach was to be measured in several ways. First, from a quantitative standpoint, was there a reduction in assignments submitted late by students, and were students submitting assignments early? Other aspects of success would be viewed from a qualitative standpoint. Were students asking better questions and were those questions being asked sooner? Did the quality of students work improve because they started sooner and did not procrastinate?

Quantitative Data

This section includes data collected from three different courses taught during the fall of 2009 in which performance incentives were used to attempt to decrease student procrastination. In all cases, while the student populations are different, based on different academic ranking, the lab structure and format for the courses was similar.

Each course represented a core course within a Software or Computer Engineering program. As such, students were given independent lab assignments to complete. These assignments were started during a lab session, but often involved significant work outside of lab to complete them. In most cases, the assignment was made one week and was due the following week of the quarter. In all cases, there was at least a weekend without classes between the assignments being made and being due.

Assignments were submitted electronically to the professor using a content management system. Assignments were graded using detailed rubrics and returned to student electronically as well.[12]

Freshman

The freshman class was the first area to be analyzed. In order for a student to be successful, it is vital that good study habits develop quickly. Otherwise, students may face significant struggles. Historical data also reflected that freshman classes also had the most problems with late submissions.

The first analysis involved a comparison of late versus early submissions at the freshman level. In previous years, the instructor had taught courses at the freshman level twice. Class A and Class C were the same course material from two different years. Both courses were taught during the fall quarter. Class B, while not an identical class, served the same constituency. It also contained many of the same students as Class A, and was of similar material, only differing significantly in that it was taught during the winter quarter. Thus, while not an exact match, it is an appropriate comparison with Class A.

	Freshman Class A			Freshman Class B			Freshman Course C with Performance Incentive				
Assignment	Submissions	Late	Percent Late	Submissions	Late	Percent Late	Late	Early	Total	Percent Late	Percent Early
1	20	0	*0.0%*	21	0	*0.0%*	1	7	20	*5.0%*	*35.0%*
2	20	4	*20.0%*	20	5	*25.0%*	2	10	20	*10.0%*	*50.0%*
3	20	2	*10.0%*	20	2	*10.0%*	0	11	20	*0.0%*	*55.0%*
4	20	3	*15.0%*	20	3	*15.0%*	1	9	19	*5.3%*	*47.4%*
5	20	7	*35.0%*	20	5	*25.0%*	4	3	19	*21.1%*	*15.8%*
6	20	6	*30.0%*	21	5	*23.8%*	0	4	18	*0.0%*	*22.2%*
7	20	6	*30.0%*	20	5	*25.0%*	2	2	18	*11.1%*	*11.1%*
8	17	3	*17.6%*	20	5	*25.0%*	0	6	18	*0.0%*	*33.3%*
9	17	6	*35.3%*	20	5	*25.0%*	1	0	18	*5.6%*	*0.0%*
10	17	7	*41.2%*								
Average			*23.4%*			*19.3%*				*6.4%*	*30.0%*
Median			*25.0%*			*25.0%*				*5.3%*	*33.3%*
Stdev			*13.0%*			*9.1%*				*6.9%*	*19.0%*

Figure 1 Freshman Performance with and Without the Performance Incentive

In both of the freshman courses, previous data indicated approximately 20% of assignments would be submitted late. This varied from week to week, tending to get worse as the quarter progressed.

Course C, however, used student incentives to try and prevent student procrastination. The results were markedly different. Overall, approximately 5% of assignments were submitted late or never submitted. Furthermore, approximately 33% percent of students routinely submitted their assignments early. This indicated that either these students were encouraged by the incentive to work ahead on their assignments or already had good study habits.

	Sophomore Class A			Sophomore Class B with Performance Incentive				
Assignment	Submissions	Late	Percent Late	Late	Early	Total	Percent Late	Percent Early
1	16	1	*6.3%*	0	7	18	*0.0%*	*38.9%*
2	16	1	*6.3%*	3	9	18	*16.7%*	*50.0%*
3	16	1	*6.3%*	2	10	18	*11.1%*	*55.6%*
4	16	3	*18.8%*	3	10	18	*16.7%*	*55.6%*
5	16	3	*18.8%*	0	0	18	*0.0%*	*0.0%*
6	16	7	*43.8%*	0	1	16	*0.0%*	*6.3%*
7	16	4	*25.0%*	0	8	16	*0.0%*	*50.0%*
8	16	3	*18.8%*	0	6	16	*0.0%*	*37.5%*
9				1	12	16	*6.3%*	*75.0%*
Average			*18.0%*				*5.6%*	*41.0%*
Median			*18.8%*				*0.0%*	*50.0%*
Stdev			*12.7%*				*7.4%*	*24.1%*

Figure 2 Sophomore class performance with and without performance incentive.

Sophomore

The sophomore comparison involved a fall required course taught to Software Engineering Students. While these students are no longer freshman, many of them are still developing study habits, and returning after the summer break can be difficult.

In the baseline class, approximately 18% of assignments were submitted late. As was noticed with the freshman, this varied with the week, but tended to increase later on in the quarter.

This changed, however, with the introduction of the incentive plan. Overall, only 5% of assignments were submitted late. Furthermore, unlike the previous year, the number of submissions which were late actually decreased as the quarter progressed. A significant percentage of students also submitted their assignments early, with approximately half of the students routinely submitting their assignments early.

	Junior Class A				
Average				*10.6%*	*46.6%*
Median				*5.6%*	*50.0%*
Stdev				*12.3%*	*18.8%*
Assignment	late	early	total	Percent Late	Percent Early
1	0	16	20	*0.0%*	*80.0%*
2	7	7	20	*35.0%*	*35.0%*
3	3	4	18	*16.7%*	*22.2%*
4	1	10	18	*5.6%*	*55.6%*
5	2	9	18	*11.1%*	*50.0%*
6	1	9	18	*5.6%*	*50.0%*
7	0	6	18	*0.0%*	*33.3%*

Figure 3 Junior course performance incentive data.

Junior

For the junior data set, there was not a comparable comparison set of historical data, as the instructor had not previously taught juniors. Thus, it is not possible to determine if there was a reduction in late submissions. However, it is possible to assess the data relative to student submissions. As was noticed with the sophomore class data, nearly half of the students routinely submitted assignments early. Furthermore, the percentage of late submissions was very similar to that measured for the sophomore class. The data does suffer from one outlier data point, specifically assignment 2, as a significant number of students experienced problems completing the assignment due to an anomaly in a pre-requisite course.

Qualitative Observations

While the quantitative data indicates that this mechanism may have helped in reducing procrastination, there are other qualitative measures that indicate it was successful as well. These measures include student questions and office visits as well as student comments.

Since implementing this incentive program, the nature of student behavior has changed. In previous years there would be an onslaught of students visiting the office the day before the assignment was due followed by an onslaught of e-mails the night before the assignment was due. This fall, however, was significantly different. In many cases, students began to work on the assignment when it was given. Students sometimes continued working on the project immediately after the lab period was completed, either visiting the office or e-mailing if they had an issue. Additionally, the questions that were being asked were of a higher level. The questions were not basic issues of understanding brought on by a panic, but rather were questions related to how the assignment could be completed in a more optimal manner. Students also worked over the weekend, as evidenced by the date and time stamps on e-mails, some of which arrived at 22:00 and 23:00 on Friday and Saturday evenings.

Because students were working at a more measured pace, office visits were also more spread out. Students came into the office the day after the assignment was made, and very rarely were students coming in the day the assignment were due. This helped tremendously in allowing adequate time to answer student's questions.

From the professor's standpoint, it was also significantly easier to return assignments in a timely fashion, as the majority of assignments came in on time. This led to the material being returned to the students sooner than in previous years. In one particular case, an assignment which was due at 23:00 the previous evening was returned by 12:00 the next day. This immediate feedback was appreciated by students, and reflected in higher instructor evaluations at the end of the quarter.

Student comments on course evaluations also seemed to reflect positively towards this program. Specific comments to the question "What did the professor do well?" included:

- "Nice to have the chance to earn extra credit on labs"
- "Bonus points for turning things in early."
- "Willing to help at nearly any time"
- "Grading was fair and useful"
- "Helped students out when they were behind."

Comments were also favorable on ``minute'' papers throughout the quarter as well. Additionally, on several occasions near the end of formal lab sessions, students were overheard discussing whether they wanted to try and complete the assignment when it was due or try and complete it earlier for bonus.

The Grade Aspect

One question which might be asked in regards to an incentive program deals with the impact upon students grades and achievement. Did the students learn better because they were not procrastinating, and was the learning measurable in terms of better performance against class outcomes?

Unfortunately, given the small sample set, variability in student populations, and improvements in teaching effectiveness and other changes in the course, it is impossible to determine if this incentive program promoted better achievement. While the freshman course served the same population, significant changes in course outcomes had occurred, a new sequence of material was used, and the course had an additional lecture hour added to the delivery. The junior course did not have baseline data to compare against, and the sophomore course did not indicate a significant change in overall grades. Qualitatively, it appeared that many of the student

questions asked indicated a better understanding of the concepts, but there was no mechanism in place to effectively measure if this was true.

One concern that might arise is the aspect of grade inflation. With students receiving a 5 or 10% bonus for early submissions, would this bonus artificially inflate their grade? To answer this question, the Excel spreadsheet used for calculating grades was adjusted to exclude performance bonuses for early submission of assignments. In all but one case, there was no net change in the overall letter grade. The placement of students within a letter grade changed, but the overall grade did not. This can be attributed to multiple factors. First, multiple dimensions were used for grading. Overall, lab assignments and homework only accounted for 20-30% (depending on course) of the student's grade. The remainder of the grade was determined based on tests and quizzes, which did not have a performance bonus. Thus, even if the student submitted all assignments early and received the maximum incentive possible, the net increase in their overall grade would only be 2-3%. If a student was at the upper end of a given letter grade, then a change might occur. However, outside of this condition, a grade change would not be possible.

Other Aspects

While the program appears to have been successful based upon this limited study, there are other aspects which need to be considered. These include student work quality and the impact on other courses.

In terms of student work quality, there were several occasions where students submitted work early but it was not of appropriate quality. The question this brings up is did the performance incentive bias the student into submitting substandard work. It is very possible that for certain students this incentive program may have simply shifted the students rushing forward in time. Instead of rushing for the due date, they were rushing for the performance bonus. Luckily, overall there were few cases of this occurring, and it may be possible to tune the incentive to avoid this problem.

A second aspect which cannot be assessed as easily is the impact this incentive may have had upon other classes. If this incentive merely caused students spend more time studying rather than procrastinating, then it can be viewed as effective. However, if this performance incentive increased rushing in other classes then it cannot be considered as effective.

Summary

This article has presented an incentive program targeted at reducing student procrastination on course assignments. From a preliminary assessment, it appears that it has been successful at reducing this problem. More student work was submitted on time, and the overall student reception was positive. Furthermore, the program did not appear to cause artificial grade inflation.

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