Noncognitive Ability, College Learning, and Student Retention

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Abstract

Recent decades have seen a steady increase in college enrollment rates, which has not been accompanied by a corresponding increase in graduation rates. If this discrepancy is at least partly due to insufficient "effort" exerted by students, policies that aim at rewarding effort explicitly may succeed at increasing graduation rates. This paper uses a unique and rich administrative data set to analyze the impact of the introduction of a new grading policy on performance and retention rates at Benedict College, a Historically Black College in Columbia, South Carolina. According to the new grading policy, grades for freshman and sophomore courses are determined in part by performance on tests and in part by measures of "effort" such as attendance and class participation. The policy was intended to inspire a sense of discipline in students' attitudes towards academic work, in the hope of improving learning and graduation rates. However, the data show that the introduction of the new grading policy was actually followed by an increase in dropout rates, disproportionately due to students with pre-college GPAs *above* the mean. This paper describes a simple theoretical model that illustrates how this observed change can be a result of the interaction between the increased disutility caused by the larger effort required by the new policy, and the uncertainty that relates effort to knowledge grades, an uncertainty that only disappears after the final grades are assigned. Overall, student SAT composite scores, ACT composite scores and high school GPAs are not great predictors of survival after the policy change.

Keywords: Grade Expectations, College Dropouts, Effort

*Preliminary and Incomplete

1 Introduction

Students are attending college at historically high rates. Among twenty-three year old individuals in 1970, twenty-three percent of high school graduates had completed a B.A. degree, while approximately fifty-one percent had enrolled in college. By 1999, only twenty-four percent of the same age cohort had earned a B.A .degree, while sixty-seven percent had attended college at some point.[1] In response to the lack of growth in graduation rates, many colleges and universities implemented programs that focus on increasing the retention rates of their students. Although there is a large literature addressing why students fail to continue to a degree, little is known about the effectiveness of policies that attempt to increase retention rates.

I evaluate the effectiveness of the Success Equals Effort policy at Benedict College, a Historically Black College in Columbia, SC. This policy incentivizes effort for the explicit purposes of increasing retention rates and improving student performance. The model developed is framed as a principal/agent problem. The students want to maximize the expected utility from class work, while the goal of the professor/administrator, hereafter called the professor, is to assign grades that maximize student learning. In maximizing utility, students balance the expected grades they receive from effort with the cost of that effort. By incentivizing effort, professors increase the returns to student effort and decrease the uncertainty of those returns. Since this policy induces more effort, students learn more and their grades are higher.

For some students, although they might have higher grades, the effort cost is too high; their net reward for effort is not enough for them to continue in college, so they drop out. Depending on their reasons, they may have been harmed by the policy. For

[1] See Turner (2004).

other students, these higher grades are a sufficient reward for the extra effort; these students continue in college and benefit from the policy.

Implemented in 2004 at Benedict College, the Success Equals Effort (SE^2) policy incentivized effort by requiring professors to grade for effort. These effort grades were made a large part of the final grade for freshman and sophomore level classes. Since the policy has only been in effect for four semesters, the causal effect on retention is difficult to determine. Additionally, only one cohort of students has attended the college all four semesters of the policy. These facts aside, the data suggest that after four semesters under the policy, retention rates are lower for those students in the entering cohort of Fall 2004. Even after controlling for income, demographic measures and pre-college ability measures, this cohort of students has left Benedict College at a higher rate than previous cohorts. This result seems counterintuitive, especially since student grades have improved. This paper models and explains this increase in dropout rates; in addition, a welfare improving change in the SE^2 policy is suggested.

The remainder of this paper is structured as follows. Section II reviews the relevant literature. The next section exposits the model. Section IV describes the Benedict College policy. Section V presents the data, the estimation procedure and the results. Section VI concludes.

2 Literature Review

Incentivizing effort to improve learning and retention implies the belief that three things are true. First, that effort has a positive return to learning. Second, the amount of effort that some students exert is low due to uncertainty of the benefits received from this effort. Third, increasing student learning increases retention rates.

With regard to the first belief, Romer (1993) shows that attendance is positively correlated with performance. Kremer et al. (2005) show that there is improvement in the performance of students when they are offered incentives (scholarships) to attend school. Romer's results imply that the extra attendance is correlated with improved performance. Kremer's findings can be interpreted as a positive causal relationship between effort and learning due to exogenous variation.

Papers such as Schuman et al. (1985) and Rau and Durand (2000) that estimate the returns to effort are plagued with problems quantifying the effort a student makes. Swinton (2006b) addresses this problem by using rich, unique administrative data from Benedict College that provide several advantages over earlier data used in studies of student effort. In contrast to measures typically found in survey data, the measure of effort utilized by Swinton is defined by the instructor, is course-specific, and spans the duration of each course. Using these improved measures, Swinton shows that there is a strong positive correlation between effort and learning.[2] Rau and Durand (2000) and Swinton (2006b) show that effort and learning have a positive relationship.

With regard to some students exerting low effort, one needs to look no further than the investment literature. It has been established that when uncertainty is involved, agents tend to under invest. If students consistently under invest in effort for their ability levels due to uncertainty about the final grade, then it is possible to implement a policy that increases the amount of effort that a student gives. This suggests that incentivizing effort will be beneficial.

Finally, with regard to retention rates, there seems to be no main theory in the economics literature. However, in the sociology literature, two main theories of student

[2] See Swinton (2006b) for a discussion of the literature that measures the return to student effort.

retention are discussed, the student integration model and the student attrition model.[3] The student integration model follows from Spady (1970) and Tinto (1975). According to Tinto, two major forces determine whether a student decides to stay in school, the student's academic integration and his social integration. A student is less likely to drop out if his motivation and academic ability match the school's academic programs (academic) and if the student is involved in the activities at the school (social). The student attrition model proposed by Bean (1980) focuses on the student's desire to remain in school, which is influenced by external forces such as family, friends and background. Caberera et al. (1993) show that when the two models are merged into one integrated model, a more comprehensive understanding of the complex interplay among individual, environmental and institutional factors is achieved.

DesJardins et al. (1999) use an event history model to look at a student's decision to drop out. Their sample consisted of 4,100 students who entered the University of Minnesota with fewer than 39 transfer credits in the fall term of 1986. By using a discrete time hazard model, the authors were able to look for time-varying coefficients. They found that characteristics do have different effects, depending on the length of time that the students is enrolled.[4]

To my knowledge, no paper that has dealt with student retention examines the effect that a policy change has on dropout rates.[5] This paper fills this gap by focusing on a policy that incentivizes effort. Starting with the assumption that effort improves learning, and that effort is low for the given ability level due to uncertainty, this paper develops a model that allows the incentivization of effort to have positive and negative effects on retention. The implications of this model are used to interpret the outcomes,

[3]For a more complete discussion, see Caberera et al. (1993).

[4]See Rawlson (2006) for a detailed discussion of the ways in which financial aid affects retention.

[5]Bucks (2004) looks at the change in admission policy in Texas and finds that retention rates improve.

such as final grades and a student's decision to continue or drop out of school.[6] Using an estimation procedure similar to DesJardins et al. (1999) and Rawlson (2006), the SE^2 policy is used to determine the effect that incentivizing effort has on retention.

This effect is important to many policy makers. By focusing on the institutional factors that the university controls, such as grading, this paper asks whether a specific policy change can affect student outcomes.

3 Model

Caberera et al. (1993) show the importance of individual, environmental and institutional factors in a student's decision to continue in school. A professor/student relationship embodies a principal/agent problem. If the professor believes that a student is sub-optimally exerting effort ex-post, the professor can increase the effort expended by making effort a more important part of the grade. The next section explains the model in terms of the student's effort choice (agent) for a given policy choice by the professor (principal).

3.1 Student Grade Expectations

A student in this model maximizes utility $U(e)$, by choosing his effort level e, for a given ability level a. Utility is a function of his effort e, knowledge $k(a, e, v)$, and cost of effort $c_j(e)$. The effort and knowledge combine to determine the grade outcome. For a student to continue to the next semester, $U \geq \underline{U}$. The student does not know about the value of the shock, v, which is unknown at the time the student chooses effort. This leads to the student choosing e to maximize the expected utility, $E(U)$

[6] See Swinton (2006a) for general outcomes under the policy.

$$
\begin{aligned}
max_e E(U(G, c_j)) &= E(G) - c_j > \underline{\text{U}} \\
&= \alpha e + (1-\alpha) * E(k(e, a, v)) - c_j(e)
\end{aligned} \tag{1}
$$

where $E(G) = \alpha e + (1-\alpha) * E(k(e, a))$, $c_j = c_j(e)$, α is the weight given to effort, (policy choice of the professors) $\alpha \sim [0, 1]$, $\underline{U}$ is the minimum utility a student needs to remain in school, $k(e, a, v)$ is the concave function in e that determines the expected knowledge, $c_j(e)$ is a convex effort cost function for the jth type of student, and $\frac{\partial c'_j(e)}{\partial e} < \frac{\partial c_j(e)}{\partial e}$, $\forall$ $j' < j$ $k(e, a, v)$ is nondecreasing in e and a. Therefore, the greater the effort put in and the higher the student's ability, the higher the grade expectation of the student. The effect that effort has on knowledge is uncertain at the time effort is chosen, since the student does not know the value of the shock, v. This is analogous to a student choosing the effort level at the beginning of the semester, and receiving the grade outcome at the end of the semester. Based on the realization of the utility, U, a student will then continue or drop out of school. Ideally, each student would be able to set his choice of effort and ability, α.

Such a policy would be impossible to implement. The professor must therefore control α. By increasing α, the professor makes effort more important, and reduces the effect that uncertainty associated with the student utility outcome has, by giving less weight to the uncertain knowledge. The j types of students allow for heterogeneity in the effect of effort. The first order conditions are:

$$
\frac{\partial U(E(G), c_j)}{\partial e} = \alpha + (1-\alpha)\frac{\partial E(k(e, a, v))}{\partial e} - \frac{\partial c_j(e)}{\partial e} = 0 \text{ for } j = 1, 2, 3.... \tag{2}
$$

Students of lower jth types prefer higher values of α than do other students since their cost increases at a slower rate the more effort given, all else being equal. Such students can be thought of as students who are more self-motivated. Students of higher types can be thought of as students who need to be pushed hard to succeed. Higher values of α hurt these students more by forcing them to put forth extra effort.

3.2 Grade Realizations and Outcomes

Given the effort level a student chooses, the resulting expected marginal benefit to effort in the knowledge function can differ from the actual outcome depending on the value of the shock, v. The student always optimizes by setting the expected marginal benefit of effort = marginal cost of effort. Ex-post, the realization of the marginal benefit of effort can be less than, equal to, or greater than, the marginal cost of effort. These realizations are affected if the professor changes the value of α. For ease of exposition, I give a lower value of α pre-policy than post-policy. This illustrates a policy change that reduces uncertainty and incentivizes effort more.

Equation 3 shows the case in which the expected marginal return equals actual marginal return.

$$\alpha + (1-\alpha)\frac{\partial k(e,a,v)}{\partial e} = \frac{\partial c_j(e)}{\partial e} \text{ for } j = 1, 2, 3.... \tag{3}$$

This is the first-best outcome. In this case, the student does what is optimal ex-ante. If the student does not earn enough utility to remain in school, i.e. $U < \underline{U}$, then the school should not attempt to intervene. This case becomes more likely as α increases since there is less uncertainty. Students post-policy are more likely to choose the correct effort level than students pre-policy.

Equation 4 shows the case when marginal costs are larger than marginal benefits.

$$\alpha + (1-\alpha)\frac{\partial k(e,a,v)}{\partial e} < \frac{\partial c(e)}{\partial e} \text{ for } j = 1, 2, 3.... \tag{4}$$

Ex-post, the effort level chosen by the student is high. For the effort level chosen, the student expected higher marginal returns. To increase the ex-post returns, the student would have been better off if he chose a lower amount of effort. This case should occur less often as α increases. A higher α post-policy will make the student worse off, since more weight is put on effort. As long as $U > \underline{U}$, a student will continue in school, but his U is lower post-policy than pre-policy.

Equation 5 shows the case when marginal benefits are larger than marginal costs.

$$\alpha + (1-\alpha)\frac{\partial k(e,a,v)}{\partial e} > \frac{\partial c(e)}{\partial e} \text{ for } j = 1, 2, 3.... \tag{5}$$

This case should occur less often as α increases. The student chooses the effort level that is too low ex-post as the student expected to have lower marginal returns. To decrease the ex-post returns, the student would have been better off choosing a greater amount of effort. This group of students will have higher utility post-policy because more effort is induced. This case is ideal for a policy that makes effort a more important component of the student's grade.

It is most interesting to look at the effects that these cases have on the marginal students. These are the students who (a) would have continued before the policy change, but who now drop out, and (b) would have dropped out before the policy change, but who now continue. These two cases are illustrated in Figures A.1 and A.2, which can be found in the Appendix. Figure A.1 shows the case in which a student would have continued, but drops out after the policy change, while figure A.2 focuses on the student who would have dropped out, but continues after the policy change.

Figure A.1 is the case in which effort is too high for a student of high jth type ex-post. This student prefers to give less effort since, costs to effort increase faster than those of lower jth type. U represents the realization of utility, $E(U)$Pre represents expected utility pre-policy, and $E(U)$Post represents utility post-policy. $\underline{U}$ represents the student's reservation utility. $E^{*}pre$ is the effort level chosen pre-policy, while $E^{*}post$ is the effort level chosen post-policy. Since the student chooses to give too much effort, the student is on the decreasing range of U. Since the student increases the amount of effort given (due to the policy change), the student has lower utility post-policy than pre-policy. The decrease in U is enough for the student to drop out post-policy, whereas the student would have continued pre-policy.

Figure A.2 is the case in which effort is too low ex-post for a student of low jth type. This student prefers to give more effort, since costs to effort increase more slowly than those of higher jth type. U represents the realization of utility, $E(U)$Pre represents expected utility pre-policy, and $E(U)$Post represents utility post-policy. $\underline{U}$ represents the student's reservation utility. $E^{*}pre$ is the effort level chosen pre-policy, while $E^{*}post$ is the effort level chosen post-policy. Since the student chooses to give too little effort, the student is on the increasing range of U. Since the student increases the amount of effort given due to the policy change, the student has higher utility post-policy than pre-policy. The increase in U is enough for the student to continue with school post-policy, whereas the student would have dropped out pre-policy.

4 The Success Equals Effort (SE^2) Policy

The SE^2 policy was implemented to increase the success of Benedict College's students by placing greater importance on effort. The policy emerged from dissatisfaction with learning outcomes due, in part, to a lack of preparedness of students for the rigors of college. The unique aspect of this policy is that, for freshman and sophomore level courses, effort is an explicit part of a student's grade.[7] The aim of the policy is to increase learning, retention, graduation rates and the value of a degree from Benedict College by incentivizing effort. Although the policy was implemented in the spring semester of 2002, it was not strictly enforced until the fall semester of 2004.[8] The SE^2 policy requires that a professor report two grades to the registrar for all students taking freshman and sophomore level courses: an effort and a content learning (knowledge) grade. The administration weighs the two grades differently for freshman and sophomore courses. Table 1 gives the possible outcomes for freshman level courses, and Table 2 gives the possible outcomes for sophomore level courses.[9]

Wetzel (1999), Singell (2004) and Rawlson (2006), among other researchers dealing with retention, find that student performance is important in determining whether students remain in school or leave. The SE^2 policy's goal is to improve student performance by increasing study skills and the preparedness of the students. This change should lead

[7] According to Benedict College, no other college or university has such a policy.

[8] The administration checked the grades that professors were assigning, and noticed that the policy was not being followed uniformly. The policy initially did not require professors to submit both an effort and a knowledge grade. As a result, two professors were eventually dismissed for insubordination. It seems plausible to assume that beginning in the Fall of 2004, the SE^2 policy was strictly enforced.

[9] Roughly speaking, knowledge and effort grades are weighted .4 and .6 for freshman courses and by .6 and .4 in sophomore courses.

Table 1: Freshman Level Grade Matrix

		Knowledge Grade				
		A	B	C	D	F
	A	A	A	B	C	C
Effort	B	B	B	B	C	D
Grade	C	B	C	C	C	D
	D	C	C	D	D	F
	F	C	D	D	F	F

Table 2: Sophomore Level Grade Matrix

		Knowledge Grade				
		A	B	C	D	F
	A	A	B	B	C	D
Effort	B	A	B	C	C	D
Grade	C	B	B	C	D	D
	D	B	C	C	D	F
	F	C	C	D	D	F

to higher cumulative grade point averages, assuming professors do not grade on a curve. These higher grades can be accompanied by additional effort costs for students enrolled in Benedict College, if the policy causes them to give more effort. The SE^2 policy reduces some of the uncertainty that students experience when forming grade expectations by putting more weight on their effort grade relative to their uncertain knowledge grade. By reducing uncertainty, each student should be more likely to put forth his optimal level of effort. However, the model that was previously presented shows that, depending on how costly the effort is to the student, the policy change can have an adverse effect on some students' decision to continue.

5 Estimation and Results

The SE^2 policy has been in existence in its current form for only four semesters. Therefore, its effect on retention rates beyond the first four semesters is unknown. In addition, the effect that the policy has on graduation rates cannot be determined until the policy has been in effect at least eight semesters. Given these data constraints, I estimate the effect that the SE^2 policy has on students' matriculation through the first four semesters using a Cox-proportional hazard model[10].

5.1 Data

Transcript data merged with Free Application for Federal Student Aid (FAFSA) and Benedict College application data was utilized in this specification. The data set includes information on the SAT composite score, ACT composite score, high school grade point average, age upon entry, sex, parental taxable income (PTI), and expected family contribution to the student's education (EFC).[11] The primary sample includes all students who entered Benedict College as full-time students in a fall semester (taking at least 12 credit hours.) The fall semester is their first semester in college. The entry years used are the fall semesters from 1999 to 2004.[12] The SE^2 policy started in its current form in Fall of 2004. However, students who entered in the Fall of 2004 did not know the policy was in effect until they matriculated. The Fall 1999, Fall 2000, Fall 2001, Fall 2002, and Fall 2003 cohorts entered before the SE^2 policy was in effect. Pre-policy students number 2925 students. The Fall 2004 cohort is the first set of students to enter under the SE^2 policy. That cohort includes 629 students. These two groups

[10] As more data becomes available, the analysis will augmented.

[11] Age is calculated using year of birth only.

[12] The SE^2 policy was in effect in Fall 2002. However, it changed to an enforceable format in Fall 2004. I have done the analysis excluding Fall 2002 and Fall 2003 cohorts, and the results are similar.

comprise the primary sample.

Table 3 and Table 4 show the demographic variables of the students pre- and post-policy. The mean SAT composite score for the pre-policy group is 786, while it is 771 for those in the post-policy group. There is no statistical difference between these two means. These scores are below the national average for all students from the years 1998 to 2003, which ranges from 1016 to 1026. They are also below the mean for blacks who took the SAT in 2003, which is 857. The mean ACT composite score for the pre-policy group is 14.89, while it is 15.47 for those in the post-policy group. The ACT composite score for the post-policy group is statistically significantly larger at the 99% confidence level than that for the pre-policy group. The Benedict College students are below the national mean ACT in 2003 of 20.6, and also below the national mean for black students of 16.9. The mean high school GPA for the students from the pre-policy group is 2.29, while it is 2.38 for those in the post-policy group. The mean high school GPA is significantly higher for the post-policy group. The mean nominal parental taxable income (PTI) for those in pre-policy group is $27,003, while it is $30,415 for those in the post-policy group. The latter's mean PTI is significantly larger than the mean PTI of the pre-policy group. Post-policy students have statistically higher ACT score, high school GPAs, and parental taxable incomes in nominal terms.[13] The mean age upon entry of pre-policy students is 19.17, while it is 18.78 for the post-policy group. 47 % were females pre-policy, while 50 % were post-policy. Students post-policy would seem to be the better prepared students due to their higher high school GPAs and ACT scores.

[13] There are 317 students in the sample who took both the SAT and the ACT. These students have statistically higher high school GPAs and parental taxable incomes than those who only took one or neither test.

Table 3: Summary Statistics for Students who Entered Pre-policy

Variable	Number of Obs.	Mean (Std. Dev.)	Min	Max
SAT Composite	1159	786.32 (176.19)	400	1470
ACT Composite	751	14.89 (2.56)	7	27
H.S. GPA	2616	2.29 (.62)	.3	5.17
Sex	2925	.47 (.50)	0	1
Age	2925	19.17 (2.46)	15	51
Parental Taxable Income (PTI)	2317	27,002.95 (24,819.61)	-14,916	218,675
Expected Family Contribution (EFC)	2317	2,417.50 (6,342.75)	0	78,367

Table 4: Summary Statistics for Students who Entered Post-policy

Variable	Number of Obs.	Mean (Std. Dev.)	Min	Max
SAT Composite	269	770.74 (162.59)	430	1400
ACT Composite	217	15.47 (2.76)	5	27
H.S. GPA	607	2.38 (.62)	.65	4.06
Sex	629	.50 (.50)	0	1
Age	629	18.78 (1.72)	17	38
Parental Taxable Income (PTI)	506	30,415.58 (25,103.45)	0	152,584
Expected Family Contribution (EFC)	506	2,975.93 (6,359.41)	0	37,622

The data set is arranged not by calendar time but by "semester time." All students who are in the sample are followed for four consecutive semesters excluding, summer terms. Although the students entered Benedict College at different calendar times, in "semester time" all students enter the first semester simultaneously and potentially stay for the second, third, and fourth semesters. If a student drops out for any semester, I assume that student will not return.[14] Although students drop out of school for many reasons, there is no way to determine the exact reason the student drops out of Benedict. A student could be taking a year break, giving up on school altogether, or transferring to another school. I treat all dropouts as equally harmful from Benedict College's perspective regardless of the student's reason.

Table 5: Converting Calendar Time to Semester Time for The Primary Sample

	Semester of Entry					
	Fall 1999	Fall 2000	Fall 2001	Fall 2002	Fall 2003	Fall 2004
1st Semester	Fall 1999	Fall 2000	Fall 2001	Fall 2002	Fall 2003	Fall 2004
2nd Semester	Sp. 2000	Sp. 2001	Sp. 2002	Sp. 2003	Sp. 2004	Sp. 2005
3rd Semester	Fall 2000	Fall 2001	Fall 2002	Fall 2003	Fall 2004	Fall 2005
4th Semester	Sp. 2001	Sp. 2002	Sp. 2003	Sp. 2004	Sp. 2005	Sp. 2006

Table 5 shows which semesters correspond to the first, second, third and fourth semester for each cohort. Table 6 shows the number of students who enter with each cohort and how far they matriculate. The Fall 2004 cohort has a larger percentage of students who drop out in the first four semesters than all other cohorts in the sample except for the Fall 1999 cohort. To show that the effect that is estimated is the effect of the policy as opposed to just the Fall 2004, Spring 2005, Fall 2005, and Spring 2006

[14]In my empirical model, reentry is not allowed.

Table 6: Shows the number of students in each cohort and the number that remain after each semester

	Semester of Entry											
	Fall 1999	Drop Outs	Fall 2000	Drop Outs	Fall 2001	Drop Outs	Fall 2002	Drop Outs	Fall 2003	Drop Outs	Fall 2004	Drop Outs
1st Semester	575	96	632	98	560	71	574	69	584	92	629	120
2nd Semester	479	164	534	156	489	125	505	149	492	120	509	155
3rd Semester	315	47	378	43	364	59	356	61	372	57	354	52
4th Semester	268		335		305		295		315		302	

semester effect, the matriculation of students in their fifth, sixth, seventh and eighth semester is shown in Tables 7 and 8. All students in the Upperclassmen sample must be full-time students in their fifth semester. Retention rates do not appear lower in the Fall 2004 for the Fall 2002 cohort, as is the case for the Fall 2004 cohort.

Table 7: Converting Calendar Time to Semester Time for the Upperclassmen Sample

	Semester of Entry			
	Fall 1999	Fall 2000	Fall 2001	Fall 2002
5th Semester	Fall 2001	Fall 2002	Fall 2003	Fall 2004
6th Semester	Sp. 2002	Sp. 2003	Sp. 2004	Sp. 2005
7th Semester	Fall 2002	Fall 2003	Fall 2004	Fall 2005
8th Semester	Sp. 2003	Sp. 2004	Sp. 2005	Sp. 2006

5.2 Comparisons of Groups

This section compares outcomes by pre- and post-policy, where pre-policy students are from the Fall 1999, Fall 2000, Fall 2001, Fall 2002 and Fall 2003 cohorts and post-policy students are from the Fall 2004 cohort. Students' cumulative GPA increases as the semester number goes from 1 to 4. This occurs because the students who continue tend

Table 8: Shows the number of students in each cohort and the number that remains after each semester

	Semester of Entry							
	Fall 1999	Drop Outs	Fall 2000	Drop Outs	Fall 2001	Drop Outs	Fall 2002	Drop Outs
5th Semester	193	19	281	22	241	14	244	16
6th Semester	174	44	259	34	227	26	228	22
7th Semester	130	3	225	13	201	18	206	19
8th Semester	127		212		183		187	

to have higher GPAs. Across all four semesters, those from the post-policy era have statistically higher cumulative GPAs. This pattern does not hold true when looking at the semester GPA. Semester GPA decreases in the 2nd and 3rd semester but increases in 4th semester for the pre-policy group, while it increases in the 2nd semester, but decreases in the 3rd and 4th semester for the post-policy group.

I now look at how the students who continue and those who drop out differ pre- and post-policy. The cumulative GPA for a student who continues increases for all semesters post-policy and just for the first two semesters for the pre-policy group, with post-policy students having a statistically higher cumulative GPA. Semester GPA decreases in the 2nd, 3rd and 4th semester for both pre-policy and post-policy groups. The post-policy semester GPAs are significantly larger than the pre-policy semester GPAs. The cumulative GPA for students who do not continue after the 1st semester is not statistically different pre- and post-policy. However, the cumulative GPA for those who do not continue after the 2nd and 3rd semester is significantly larger for the post-policy group than for the pre-policy group. The same pattern holds true for the semester GPAs. Student performance increases for students under the SE^2 policy, as measured by the cumulative and semester GPAs, except for students who do not continue after the 1st semester.

There is no statistically significant difference in the mean SAT scores of students who continue for the 1st, 2nd and 3rd semester pre- and post-policy. In addition, there is no significant difference between the mean SAT score of students who drop out after the 1st or 2nd semester pre- and post-policy. However, looking at drop outs after the 3rd semester, with 99% confidence, those pre-policy who continue have significantly smaller SAT scores than those post-policy. Upon entry into Benedict College, the high school GPA and ACT scores of the students in the post-policy group were significantly larger than those of the pre-policy sample. The same pattern is true when looking at students who continue and who drop out.

The last comparison is between students who continue and those who do not. There is no statistically significant difference between the mean SAT scores of students who drop out and those who continue post-policy. Pre-policy, the only statistically significant differences occur after the first semester, where those who continue have a higher mean SAT. The only statistically significant difference (at the 95% confidence level) in the mean ACT score for students post-policy occurs after the 3rd semester; students who continue have higher ACT scores. The only statistically significant difference in mean ACT scores occurs after the second semester; those who continue have lower ACT scores (at the 90% confidence level). Pre-policy the mean high school GPA is always significantly higher for students who continue than for students who drop out. However, post-policy, the only statistically significant difference in high school GPA occurs after the first semester; those who continue have higher GPAs than those who drop out. These results seem to indicate that pretreatment variables are not going to be strong predictors of student retention under the policy. This can be expected since the post-policy group is rewarded for soft skills or non-cognitive abilities at a greater rate than the pre-policy group.

5.3 Reduced Form Results

The estimation procedure employed to find the effect that the SE^2 policy has on retention is a Cox proportional hazard model. The Cox proportional hazard model fits the data better than probits. It allows for estimation of the effect that the policy has on the the student's continuation in school from their 1st semester to the 4th. Failure occurs when a student drops out or fails to attend the next consecutive semester of school. The hazard rate in this model gives the instantaneous probability of failing conditional on the student having survived to that point in time.[15] The advantages of the Cox proportional hazard model are that sample size is much larger and it uses more information than an estimation of the individual probits on each semester.[16]

$$h(t|V_i) = h_0(t)exp(V_i\beta_V) \quad (6)$$

Equation 6 gives the hazard rate of the ith individual, where β_V are the regression coefficients that are estimated, V_i will contain different variables depending on the estimation, and $h_0(t)$ is the baseline hazard and is not given any particular parameterizations. The equation has no constant since the intercept is a part of $h_0(t)$. The standard errors are adjusted for clustering on the student. Table 9 gives the variables and expected affect they will have on the student's hazard rate. A negative coefficient means that a student with a higher value of the variable would be expected to survive longer in school. It is expected that as ability measures such as SAT, ACT, and high

[15]Since the model is not continuous, the Breslow approximation is used for ties.
[16]Probit estimation are done and the results are similar. These results are available upon request.

school GPA decrease, the probability of failure in the next semester will decrease. Depending on which type of student is in the largest supply, the effect of incentivizing effort is indeterminate as shown, in the model section.

Table 9: Expected Signs of Coefficients

SAT_i	-
ACT_i	-
High School GPA_i	-
Age_i	No Effect
Female_i	No Effect
POL (Policy Dummy)	?
$POL1$ (Policy Dummy for 1st semester)	?
$POL2$ (Policy Dummy for 2nd semester)	?
$POL3$ (Policy Dummy for 3rd semester)	?
$G_{(i,t)}$	-
$S_{(i,t)}$	-

i indicates the ith student and t indicates semester number 1, 2, 3 or 4. $G_{i,t}$ is the cumulative GPA of the ith student for the tth semester. $S_{i,t}$ indicates the semester GPA of the ith student for the tth semester. POL shows whether the student is subject to the SE^2 policy. $POL1$, $POL2$ and $POL3$ are semester policy dummies. $POL1 = 1$ if the term is FALL 2004, it equals 0 otherwise; $POL2$ =1 if the term is Spring 2005, it equals 0 otherwise. $POL3$=1 if the term is Fall 2005, it equals 0 otherwise.

There is a chance that there is something outside of the model influencing the drop-out rate. Therefore, the first estimation finds the effect that being a student post-policy has on the primary sample, and the upperclassmen sample. This will allow for comparisons of the subset of students affected by the policy with the subset of students that should not be affected by the policy.

$$h(t|POL, X_i) = h_0(t)exp(POL\beta_{POL} + X_i\beta_X)$$

$$\text{where} X_i = \left\{ \begin{array}{l} \text{Age} \\ \text{Female} \\ \text{High School GPA} \\ \text{SAT score} \\ \text{ACT score} \\ \text{High School GPA Flag} \\ \text{SAT flag} \\ \text{ACT flag} \\ \text{SAT and ACT flag} \end{array} \right\}$$

X_i gives the pretreatment or demographic variables of the students before entry. SAT flag is 1 if SAT is missing, it is 0 otherwise. ACT flag is 1 if ACT is missing, 0 otherwise. SAT and ACT flag are 1 if SAT and ACT are missing, zero otherwise. High School GPA flag is 1 if high school GPA is missing, zero otherwise. Sex equals 1 if the student is female, zero if male. Age is the estimated age upon entry.

Table 10 shows that the SE^2 policy appears to increase the rate at which students are leaving Benedict College, since the coefficient on the POL is positive and significant. However, POL is negative and insignificant for the upperclassmen sample. This result shows that the effect that is being picked up by POL is an effect that is unique to students entering post-policy as opposed to a college-wide downturn in the period subject to the policy

These results may be missing an effect, since they treat all semesters under the policy as identical. To see if the policy has different effects depending on the semester, the

Table 10: Cox Hazard Model using Pretreatment Variables and Policy Variable for the the Primary Sample (1) and Upperclassmen Sample(2)

	(1) (Std. Err.)	(2) (Std. Err.)
POL	.1878***	-.0463
	(.0533)	(.1296)
Age	-.0004	.0081
	(.0079)	(.0213)
Female	-.2920***	.0957
	(.0444)	(.1254)
High School GPA	-.1896***	-.4126
	(.0403)	(.1160)
SAT Composite Score	-.0007***	-.0001
	(.0002)	(.0006)
ACT Composite Score	.0358**	.0752*
	(.0174)	(.0400)
High School GPA Flag	.0671	-1.1985***
	(.1109)	(.3949)
SAT Flag	-.4492**	-.1616
	(.1798)	(.4754)
ACT Flag	.5638*	.9937
	(.2843)	(.6737)
SAT and ACT Flag	.1380	.5292*
	(.1082)	(.2161)
No. of Students	3354	959
No. of Failures	1734	250
No. of Observations	10521	3318

*** 99% confidence level, ** 95% confidence level and *90%confidence level.

following equation is estimated:

$$h(t|POL1, POL2, POL3, X_i) =$$

$$h_0(t)exp(POL1\beta_{POL1} + POL2\beta_{POL2} + POL3\beta_{POL3} + X_i\beta_X),$$

where X_i, $POL1$, $POL2$, and $POL3$ are the same as defined above.

Table 11: Cox Hazard Model using Pretreatment Variables and Policy Variables for the Primary (1) and Upperclassmen (2) Samples

	(1) (Std. Err.)	(2) (Std. Err.)
$POL1$	.2637***	.1907
	(.0765)	(.1984)
$POL2$	.1383*	-.4602**
	(.0752)	(.2208)
$POL3$	.0948	.5151*
	(.1429)	(.2761)
Age	-.0005	.0069
	(.0079)	(.0213)
Female	-.2915***	.0957
	(.0444)	(.1252)
High School GPA	-.1899***	-.4148
	(.0402)	(.1159)
SAT Composite Score	-.0007***	-.0001
	(.0002)	(.0006)
ACT Composite Score	.0361**	.0754*
	(.0174)	(.0400)
High School GPA Flag	.0682	-1.1933***
	(.1109)	(.3947)
SAT Flag	-.4537**	-.1614
	(.1796)	(.4736)
ACT Flag	.5663**	.9963
	(.2840)	(.6735)
SAT and ACT Flag	.1392	.5298*
	(.1293)	(.2936)
No. of Students	3554	959
No. of Failures	1734	250
No. of Observations	10521	3318

*** 99% confidence level, ** 95% confidence level and *90%confidence level.

Table 11 shows a positive and significant coefficient found for the variable representing the first and second semester. The policy variable for the third semester is positive but is not significant. The joint test, with the null hypothesis that the coefficients on $POL1$, $POL2$ and $POL3$ are equal to zero, is rejected with 99% confidence.

The policy increases the hazard of dropping out after the first and second semester. The coefficient for the first semester under the policy for the upperclassmen sample is positive but insignificant. The coefficient for the second semester is negative and significant, while the coefficient for the third semester is positive and significant. The joint hypothesis test that the coefficients on $POL1$, $POL2$ and $POL3$ are equal to zero is rejected with 95% confidence. These results strengthen the belief that the policy variables are estimating the true effect of the policy rather than an unobserved school-wide trend.

The next estimation ran was

$$h(t|X_i) = h_0(t)exp(X_i\beta_X) \text{ for } POL = 0 \text{ (1) and for } POL = 1 \text{ (2)}$$

where X_i and POL are the same as defined above.

This estimation determines whether the pretreatment variables have the same or similar effect pre-policy and post-policy. Table 12 shows that for the pre-policy period, pretreatment variables were more effective at predicting the survival of students. In the pre-policy semesters, the higher the high school GPA and SAT scores, the less likely the student is to fail before reaching the fourth semester. The only common finding is that a female student's chances of continuing at Benedict College is greater than that of a male student. Therefore, the students who are graded under the SE^2 policy seem to make their decision to leave school differently from the students under the policy. This occurs because the SE^2 policy increases the importance of non-cognitive skills in

Table 12: Cox Hazard Model using Pretreatment Variables for Pre-Policy(1) and Post-Policy(2) Periods using Primary Sample

	(1) (Std. Err.)	(2) (Std. Err.)
Age	-.0009	-.0152
	(.0082)	(.0254)
Female	-.2797***	-.3225***
	(.0506)	(.0926)
High School GPA	-.2182***	-.1250
	(.0465)	(.0808)
SAT Composite Score	-.0010***	.0003
	(.0002)	(.0005)
ACT Composite Score	.0491**	-.0105
	(.0196)	(.0350)
High School GPA Flag	.0846	-.5065
	(.1216)	(.3676)
SAT Flag	-.6084***	.3000***
	(.2061)	(.3842)
ACT Flag	.7513**	-.0916
	(.3173)	(.5724)
SAT and ACT Flag	.1323	.1581
	(.1283)	(.2042)
No. of Students	2925	1001
No. of Failures	1350	384
No. of Observations	8040	2481

*** 99% confidence level, ** 95% confidence level and *90%confidence level.

grading which are not measured by SAT scores, high school GPAs, and ACT scores.

Thus far, only pretreatment variables have been used to predict the hazard rate of students. However, in the retention literature, it is almost universally agreed that student performance is one of the main factors that influences a student's decision to continue in school. Therefore, the following equations are estimated using cumulative grade point average and semester grade point average:

$$h(t|POL_i, X_i, G_{i,t}) = h_0(t)exp(POL\beta_{POL} + X_i\beta_X + G_{i,t}\beta_{G_{i,t}})$$

$$h(t|POL_i, X_i, S_{i,t}) = h_0(t)exp(POL\beta_{POL} + X_i\beta_X + S_{i,t}\beta_{S_{i,t}}),$$

where X_i and POL are the same as defined above. $G_{i,t}$ represents the cumulative GPA and $S_{i,t}$ represents the semester GPA.

Table 13 shows that controlling for both cumulative and semester GPA increases the magnitude of the policy variable for the primary sample. The variable is still positive and significant for those affected by the policy. This means that after controlling for in-school performance, the post-policy students are still likely to leave Benedict at a higher rate. As found before, those in the upperclassmen sample seem to have no significant response to the policy being implemented, as is to be expected.

Table 13: Cox Hazard Model using Pretreatment Variables, Cumulative GPA(A), Semester GPA(B), and Policy Variable for the Primary (1) and Upperclassmen (2) Samples

	(1A) (Std. Err.)	(2A) (Std. Err.)	(1B) (Std. Err.)	(2B) (Std. Err.)
POL	.2822***	-.0548	.3015***	-.1880
	(.0493)	(.1228)	(.0487)	(.1212)
Cumulative GPA	-.7537***	-1.4837***		
	(.0227)	(.1294)		
Semester GPA			-.6285***	-.7690***
			(.0183)	(.0558)
Age	.0172**	.0420**	.0095	.0348*
	(.0081)	(.0207)	(.0079)	(.0192)
Female	-.1187***	.2922**	-.1408***	.2196*
	(.0420)	(.1190)	(.0407)	(.1157)
High School GPA	.1197***	.0746	.0740*	-.0984
	(.0393)	(.1204)	(.0464)	(.1155)
SAT Composite Score	.0005***	.0019***	.0004*	.0011*
	(.0002)	(.0006)	(.0002)	(.0006)
ACT Composite Score	.0454**	.1045**	.0319**	.0777*
	(.0153)	(.0431)	(.0151)	(.0438)
High School GPA Flag	.6118***	.4534	.5470***	-.2562
	(.1033)	(.3745)	(.0985)	(.3487)
SAT Flag	.4372**	1.019**	.2623	.4903
	(.1782)	(.5120)	(.1753)	(.4956)
ACT Flag	.6856***	1.3350*	.4575*	.8865
	(.2522)	(.7236)	(.2493)	(.2734)
SAT and ACT Flag	-.0374	.5673**	.0220	.6378**
	(.1029)	(.2881)	(.1000)	(.2734)
No. of Students	3554	959	3554	959
No. of Failures	1734	250	1734	250
No. of Observations	10521	3318	10521	3318

*** 99% confidence level, ** 95% confidence level and *90%confidence level.

The estimation allowing for different effects of the policy in each semester is estimated next. The following equations are estimated:

$$h(t|POL1, POL2, POL3, X_i, G_{i,t}) =$$
$$h_0(t)exp(POL1\beta_{POL1} + POL2\beta_{POL2} + POL3\beta_{POL3} + X_i\beta_X + G_{i,t}\beta_{G_{i,t}})$$

$$h(t|POL1, POL2, POL3, X_i, S_{i,t}) =$$
$$h_0(t)exp(POL1\beta_{POL1} + POL2\beta_{POL2} + POL3\beta_{POL3} + X_i\beta_X + S_{i,t}\beta_{S_{i,t}})$$

,

Table 14: Cox Hazard Model using Pretreatment Variables, Cumulative GPA(A), Semester GPA(B), and Policy Variables for the Primary Sample (1) and Upperclassmen Sample(2)

	(1A) (Std. Err.)	(2A) (Std. Err.)	(1B) (Std. Err.)	(2B) (Std. Err.)
*POL*1	.3421***	.2366	.3364***	.0654
	(.0667)	(.1925)	(.0667)	(.1917)
*POL*2	.2500***	-.5046**	.2897***	-.6196***
	(.0730)	(.2060)	(.0737)	(.2141)
*POL*3	.1814	.4887*	.2142	.4156
	(.1351)	(.2661)	(.1305)	(.2645)
Cumulative GPA	-.7534***	-1.4908***		
	(.0227)	(.1298)		
Semester GPA			-.6282***	-.7688***
			(.0184)	(.0553)
Age	.0172**	.0410*	.0095	.0335*
	(.0081)	(.0206)	(.0079)	(.0192)
Female	-.1279***	.2888**	-.1405***	.2125*
	(.0420)	(.1187)	(.0407)	(.1156)
High School GPA	.1196**	.0759	.0737**	-.1030
	(.0393)	(.1207)	(.0377)	(.1154)
SAT Composite Score	.0005***	.0019***	.0003*	.0011*
	(.0002)	(.0006)	(.0002)	(.0006)
ACT Composite Score	.0458***	.1038**	.0320**	.0777*
	(.0153)	(.0434)	(.0151)	(.0442)
High School GPA Flag	.6139***	.4786	.5472***	-.2482
	(.1034)	(.3769)	(.0986)	(.3485)
SAT Flag	.4335**	1.020**	.2596	.4840
	(.1781)	(.5102)	(.1752)	(.4927)
ACT Flag	.6900***	1.3290*	.4586*	.8759
	(.2519)	(.7268)	(.2488)	(.7250)
SAT and ACT Flag	-.0364	.5620*	.0231	.6390**
	(.1028)	(.2885)	(.0999)	(.2740)
No. of Students	3554	959	3554	959
No. of Failures	1734	250	1734	250
No. of Observations	10521	3318	10521	3318

*** 99% confidence level, ** 95% confidence level and *90%confidence level.

Table 14 shows that, as was the case for the full policy variable when looking at the semester policy variables the magnitude of the estimates increases compared to Table11. The same holds true that, controlling for in-school performance, the post-policy students still leave school at a higher rate than the pre-policy students. Looking at the upperclassmen sample, the effect picked up does not match that of the main sample. This leads to the conclusion that the policy does lead to students leaving school at a higher rate.

5.4 Counterfactuals with Probits

As shown in the model section, it is to be expected that the extra effort required now could cause certain types of students to leave school. From Benedict's perspective to compare students pre- and post-policy, they can use the pretreatment variables of high school GPA, SAT scores, and ACT scores. The previous sections shows that changes in policy alter the importance of these variables in determining whether a student does, or does not, continue. Therefore, upon entry, it is interesting to see how these variables predict a students probability of surviving to the fourth semester pre- and post-policy. The following regression is estimated:

$$Cont_{i,t} = \Phi(constant + X_i \beta_{X_i})$$

for $POL = 1$ and for $POL = 0$ each semester 1, 2, 3, and 4.

where students are included if they have a high school GPA and either a SAT score or an ACT score or both.[17] These probits allows for the calculation of the predicted

[17] See Betts and Morrell (1999) and Cohn et al. (2004) for a discussion of the use of pretreatment variables to predict college performance.

probabilities $P1_i$, $P2_i$, and $P3_i$, which are the probabilities of surviving to the second, third and fourth semester, respectively[18]. The predicted probabilities of survival to the next semester have been estimated for all students in the sample, both as if they were subject to the SE^2 policy, and as if they were not subject to the SE^{2}policy. To obtain the predicted conditional probability of surviving to the fourth semester, $P4_i = P1_i * P2_i * P3_i$. This gives the probability of surviving to the fourth semester, conditional on surviving to the third semester, conditional on surviving to the fourth semester.

With the conditional probabilities of all students being subject to the policy and no students being subject to the policy in hand, mean testing is done on the probabilities to determine whether different types of student prefers post-policy to pre-policy based on having a greater probability of surviving to the fourth semester. To do this, students are separated into quartiles of high school GPA, SAT composite score, and ACT composite score. The cutoff points for each quartile are shown in Table 15.

Table 15: Gives the range of Pretreatment Variable in Each Quartile

	SAT Scores	ACT Scores	High School GPA
0-24.99 (Q1)	400-670	5-13	.3-1.85
25-49.99 (Q2)	680-760	14-15	1.86-2.25
50-74.99 (Q3)	770-860	16	2.26-2.72
75-100 (Q4)	870-1470	17-27	2.73-5.17

[18]Logits results are available upon request. Although the results could be shown with hazard functions, the probabilities provided by probits are easier to understand.

The mean tests are done on quartiles of high school GPA and SAT score combinations and high school GPA and ACT score combinations. In the table that follows, the probabilities and whether there is a statistically difference are both indicated.

Table 16: Mean Conditional Probabilities of Surviving to the Fourth Semester for post-policy (A) and pre-policy (B).

Bold indicates that probability is statistically larger

		SAT SCORE							
		Q1		Q2		Q3		Q4	
		A	B	A	B	A	B	A	B
HSGPA	Q1	.39	**.47**	.40	**.49**	.37	**.46**	.36	**.46**
	Q2	.45	**.55**	.44	**.54**	.44	**.54**	.40	**.51**
	Q3	.49	**.60**	.47	**.59**	.47	**.58**	.44	**.56**
	Q4	.56	**.67**	.54	**.66**	.54	**.66**	.52	**.66**
		ACT SCORE							
		Q1		Q2		Q3		Q4	
		A	B	A	B	A	B	A	B
HSGPA	Q1	.43	**.47**	.44	**.48**	.46	**.50**	.44	**.47**
	Q2	.49	**.54**	.49	**.53**	.49	**.52**	.47	**.51**
	Q3	.52	**.58**	.54	**.59**	.51	**.56**	.52	**.57**
	Q4	.57	**.65**	.59	**.66**	.58	**.65**	.58	**.66**

Table 16 shows that the SE^2 policy affects students differently. The probability of survival using the ACT, SAT and high school GPA is always statistically larger pre-policy to post-policy. If Benedict College's goal was to create a grading system that rewarded non-cognitive skills, this policy is successful. Even when comparing across sex, the predicted probability of continuing using ACT, SAT and high school GPA is always statistically larger pre-policy than post-policy.

6 Conclusion

The SE^2 policy was implemented to increase retention rates and graduation rates at Benedict College. I have found that in the short term, the policy leads to lower retention rates for the Fall 2004 cohort through the first four semesters as compared to the retention rate for the pre-policy cohorts. This occurs because the SE^2 policy increases the importance of non-cognitive skills in grading. This policy helps those students with unmeasured non-cognitive skills, while potentially harming some of the students with higher measured cognitive skills. The Fall 2004 cohort is the best prepared entry class in the data set, and this helps explain why the policy leads to their leaving at a higher rate. Since students who drop out have higher GPAs, it might be the case that the policy enhances the possibility that such students are able to transfer to another school. This, however, cannot be tested, since I have no data on any student's reason for leaving this school.

The counterfactuals predict that all students have a higher probability of continuing without the policy in effect. Since the SE^2 policy seems to help students with unmeasurable non-cognitive skills and missing skill information, the policy has some merit. However, Benedict might be interested in implementing the policy in a fashion that it not hurt those students who do not benefit from the incentivizing effort. This would occur if the policy were framed such that each student's grade is defined as :

$$\text{Grade} = \begin{cases} K & \text{if } K > E \text{ \& SAT, ACT, HS GPA is above a threshold} \\ \text{SE}^2 \text{ policy} & \text{SAT, ACT, HS GPA is below a threshold.} \end{cases} \tag{7}$$

If the policy is fashioned in this manner, students with certain characteristics could chose not to be graded under the current SE^2 policy. This would allow students who do not need to give any extra effort a chance to avoid the extra cost of giving it. This framework still requires that students who benefit from the incentivizing of effort a greater probability of success at Benedict College.

.1 Figure

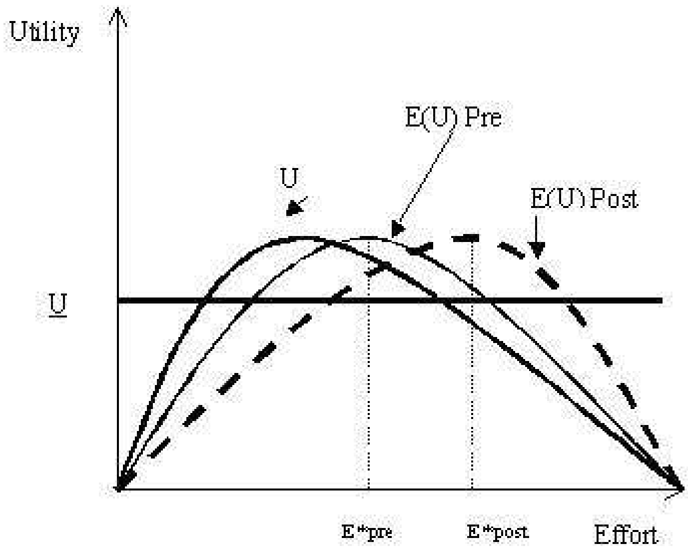

Figure 1: Student who is Hurt by Incentivized Effort

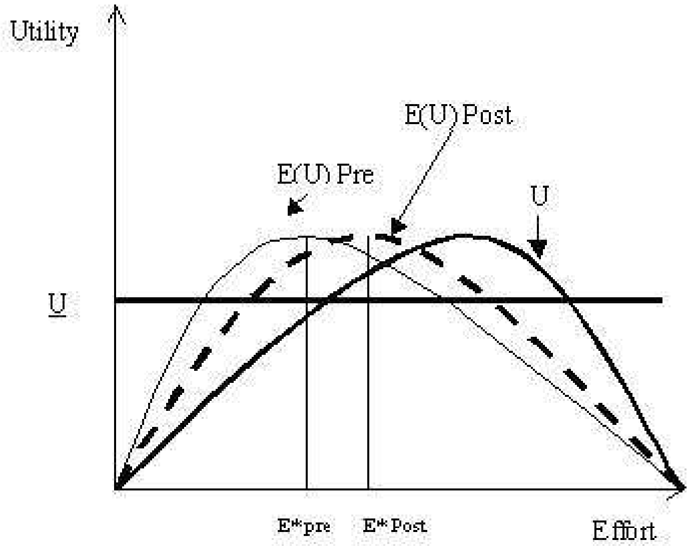

Figure 2: Student who is Helped by Incentivized Effort

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