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The effect of effort grading on learning☆

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ABSTRACT

In the fall of 2004, Benedict College – a Historically Black College in Columbia, SC – began enforcing a new grading policy called Success Equals Effort (SE^2). Under this policy, students taking freshman and sophomore level courses were assigned grades that explicitly rewarded not only content learning ("knowledge" grade) but also measures of effort ("effort" grade). This paper examines the effects of effort grading using two stage least squares and fixed effect estimates. I find evidence of a strong positive correlation between "effort" grades and "knowledge" grades. Under some restrictions this relationship can be interpreted as "effort" producing "knowledge".

1. Introduction

According to "High School Academic Curriculum and the Persistence Path Through College" August 2001, only 61.2% of students with an SAT score from 400 to 790, 62.1% of black students, 56.9% of students with a parental education level of high school or less, and 56.1% of students attending a less selective private school will stay enrolled continuously in their first college or university.[2] Benedict College, an open admissions Historically Black College and University (HBCU), has a student population that fits squarely within the above cited statistics.

In the fall of 2004, Benedict College implemented the Success Equals Effort (SE^2) policy because of a 6-year graduation rate that was less than 30%. The SE^2 policy emerged from a dissatisfaction with learning outcomes due, in part, to a lack of preparedness by students for the rigors of college. The college employed this policy to increase learning, retention and graduation rates, and the value of a degree from Benedict College.

The unique aspect of this policy is that, for freshman and sophomore level courses, effort is a separate component part of a student's grade.[3] The SE^2 policy requires a professor to report two grades to the registrar for students taking freshman and sophomore level courses: effort and content learning (knowledge). The administration weights the two grades differently for freshman and sophomore courses. Tables 1 and 2 present the final grade outcomes for freshman and sophomore courses, respectively. Roughly speaking, knowledge and effort grades are weighted 40% and 60%, respectively, for freshman courses and 60% and 40% in sophomore courses.[4]

For the SE^2 policy to increase learning, retention and graduation rates, as well as the value of the degree the students receive, the following assumptions must hold.

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[2] See Carroll and Horn (2001).

[3] Benedict College has indicated that no other college or university in the United States has such a policy.

[4] There is some concern that this policy lowers the grading standard. I tested whether this policy affected the grading standard using a procedure similar to Betts and Grogger (2003) and found that it did not.

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Table 1
Freshman level grade matrix.

		Knowledge grade				
		A	B	C	D	F
Effort grade	A	A	A	B	C	C
	B	B	B	B	C	D
	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
Effort grade	A	A	B	B	C	D
	B	A	B	C	C	D
	C	B	B	C	D	D
	D	B	C	C	D	F
	F	C	C	D	D	F

Assumption 1. There is a positive externality between the effort grade and the knowledge grade (i.e., effort affects knowledge positively).

Assumption 2. Effort today has permanent effects on a student's ability to earn higher grades tomorrow.

Assumption 3. There is no principal-agent problem between administrators and professors.

Assumption 4. All students have complete information (i.e., the professor defines effort and this definition is known to the student).

Conventional wisdom suggests that the more effort a student puts forth, the better grade the student will earn. However, researchers find mixed results when examining this relationship. This finding may be due to the less than ideal manner in which effort has been measured in the literature. Moreover, existing estimates regarding the link between effort and grades are biased because the estimates ignore the stochastic nature of effort. Using data from the Success Equals Effort (SE^2) policy at Benedict College, this paper extends the literature in two ways: first, by offering an alternative and arguably superior way of measuring effort – using the professor's perception over the course of the term as opposed to a snapshot survey. Second, the empirical methodology accounts for the endogeneity of effort. The findings show that more effort leads to more student learning.

2. Literature review

Many investigators have studied how effort affects grades in college. The convention in the literature is to utilize student surveys determine a student's study habits. An early example is a paper by Schuman, Walsh, Olson, and Etheridge (1985) that studies the relationship between college grades and self-reported amounts of effort. In this study, effort was defined as the quantity of time spent studying or in other course preparatory work, as distinct from the quality of the work (as measured by aptitude measures). The authors found no significant increase in the relationship between time studied and GPA. An organic chemistry lab was also studied. For this specific class, there was even less evidence that the amount of time spent studying affected achievement as measured by grades. The paper concluded that study time and grades may have a substantial relationship, but the measures of effort in an individual study day may not capture the variation that occurs from day to day.

Hill (1991) found in a study at a small state school with open admissions similar results as Schuman et al. In a study of a sociology class, Hill found that study time during the week was not related to any measure of college grades, while study time on the weekend was significantly and positively correlated with all measures of college grades. Hill then conducted a random sample where he again found that the average number of hours studied during the week was not significantly related to GPA.

These surprising findings that study time was not strongly related to grades could be the result of a number of factors omitted in their analysis. Their effort measures ignored the stochastic nature of student studying by relying on either estimates of study habits in the previous semester or surveys about how much studying was done the previous day. Additionally, the student effort was not course specific and it was not known how much effort a student put into a particular course. Lastly, their estimations did not control for endogeneity of effort with the learning outcome, which biased the results.

Following Schuman et al.'s (1985) surprising result of a marginally significant relationship between the amount of time spent studying and GPA, Michaels and Miethe (1989) attempted to correct Schuman et al.'s model. Michaels and Miethe found that study time did have an impact on grades, whereas class attendance did not. Running a regression on separate categories of students, they found that students who study throughout the week derived more benefits than crammers. In contrast to Schuman et al., they found that an increase in academic effort was rewarded with higher grades. Rau and Durand (2000) also tested the effects of effort on college grades. They found that students who studied daily and have better study habits performed better on tests, even if they had lower standardized test scores. They concluded that effort made a difference at Illinois State University. Schuman (2001) replied to Rau and Durand (2000) that the difference in results were due mainly to the fact that Rau and Durand used somewhat different measures of effort.

Although Michaels and Miethe and Rau and Durand found that student effort was important to student performance, they failed to address the same factors that were ignored by Schuman et al. and Hill. Therefore, their results are questionable.

This paper addresses the important factors omitted in the previous research: stochastic nature of effort, class specific effort, and endogeneity. The measure of effort provided from the SE^2 policy is superior because it measures how well a student put forth the effort that a teacher defined as necessary for each course. This paper looks at effort in each class and the learning outcome in that particular class. Therefore, it is the perceived effort of the student

Table 3
Summary statistics of those affected by the SE^2 policy.

Variable	% with Missing Obs.	Mean	(Std. dev.)	Min	Max
SAT Verbal	64%	390.85	(93.51)	200	780
SAT Math	64%	394.05	(98.04)	200	800
ACTCOMP	73%	15.15	(2.67)	5	28
H.S. GPA	31%	2.39	(0.62)	0.5	5.05
H.S Rank	31%	148.73	(109.49)	1	711
H.S. Size	31%	228.26	(130.09)	5	1247

3778 Unique students used in the estimations.

from the professor's perspective in a particular class. This measure includes class attendance, which Romer (1993), Dobkins, Gil, and Marion (2010) and others, find is related to performance. This effort measure is also better in that it measures consistent effort across a semester; it is not just a snapshot provided by a student survey. Additionally, better model specification is used to control for any potential correlation between the effort measure and the grade measure. This paper adds to this literature by showing that effort is important in improving learning even when controlling for the aforementioned factors.

3. Data

Benedict College is an open admission HBCU; at least 97% of its students are black.[5] In Fall 2004, there were 2433 students who took 9954 SE^2 classes; in Spring 2005, there were 2330 students who took 9612 SE^2 classes; in Fall 2005, there were 2340 who took 9268 SE^2 classes; and in Spring 2006 there were 2153 students who took 8386 SE^2 classes.

The demographic data, which comes from Benedict College, is limited to students who enrolled at Benedict College from Fall 1999 to Fall 2005. There were 3778 unique students in the data set. The data set included information on math and verbal SAT scores, ACT composite score, high school rank, and high school grade point average. There were many students with missing SAT, ACT, high school grade point averages, and high school rank because Benedict College does not require this information for admission.

This data was then matched with the students' transcript data. The transcript data had 37,250 observations that included effort and knowledge grades, identified the professor, and the credit hours of each course taken. The effort grade and knowledge grade, as defined by the professor, were measured differently for each class. The effort grade contained components such as class attendance, turning assignments in on time, and class participation. The knowledge grade contained outcomes such as homework, test, and research papers. The average knowledge grade was 2.31 with a standard deviation of 1.36 and the average effort grade was 2.67 with a standard deviation of 1.33.

Table 3 provides summary statistics for students enrolled in the school year Fall 2004-Spring 2005 and Fall 2005 who were affected by the SE^2 policy. The mean SAT score for a student attending Benedict College was 785. The mean ACT score of 15 was approximately equivalent to a score on the SAT of 750.[6] These scores were below the national average of all students from the years 1998 to 2003, whose SAT scores ranged from 1016 to 1026, and were also below the mean for blacks for the year 2003, whose average score was 857. The mean high school grade point average for those Benedict students with reported SAT scores was 2.39 which was below the 2.95 mean gpa of black SAT takers for 2003.[7]

4. Testing the effects of grading for effort

For the SE^2 policy to increase learning, retention and graduation rates, and the market value of a Benedict college degree, the assumptions from the introduction must hold. To better think about these assumptions, a student's and professor/administrator's choice is discussed. A student's grade is a signal to future employers about the students' ability, therefore, students want to maximize the grade that they receive in a class. The goal of the professor/administrator, hereafter called the professor, is to assign grades that maximize the informational learning of the students. Students generally want to put in the least amount of effort to earn a given grade—the measure of the knowledge that the student has mastered in the class.[8] The professor wants to maximize the signal that the grade gives to future employers, i.e. to have the student earn the highest grade, but does not want to lower the amount of knowledge that the students are required to learn.

Given this conflict, how do professors motivate students to put forth more effort? The following examples illustrate some choices a professor can make. Suppose a professor decides to maximize student's grades by giving all students the best possible grade. If the professor does this, students have no incentive to put forth effort. Even worse, the signal, which is just the grade, does not tell future employers anything about the students' ability.

If a professor decides instead to maximize the effort given, the professor gives all the credit to effort as opposed to knowledge. This maximizes the effort expended by the students, however, the signal only tells employers how the student is at giving effort and not what the student knows.

If a professor instead decides to give credit only for knowledge as opposed to effort, this may cause students below a certain ability level to give no effort. This policy signals to future employers which students have low or high ability. However, the policy will not induce all students to give effort.[9] Therefore, the problem is how do you induce all students to give effort without lowering the amount of knowledge gained by the students or weakening or minimizing the signal that is sent to future employers.

5 See Swinton (2007) for detailed description of the policy and data.

6 This information comes from the ACT concordance study of 103,525 students taking both the ACT and SAT I between October 1994 and December 1996.

7 "College-Bound Seniors: A Profile of SAT Program Test Takers, 2003", The College Board.

8 This assumes that a student's outside option is not better than attending school.

9 See Betts and Grogger (2003).

Assume a student's ability, which is known by the student, is the main factor in determining the grade a student will receive. The student with a certain ability level is guaranteed a minimum grade. This minimum grade is increasing in the ability of the student. Each professor determines how much knowledge to teach in each class. The more knowledge that is taught, the more difficult it becomes to receive any given passing grade in a class. It is easier to earn a higher grade for a given ability level with a lower amount of knowledge taught.

To test the effects of effort, it is assumed that the amount of learning a student does in a particular class is affected by his academic ability, the amount of effort he exerts, and the difficulty of the course. This allows learning to be represented by the following production function:

$$L_{it} = f(E_{it}, A_i, D_t) \qquad (1)$$

where L_{it} is the content learning for the ith student in the tth class, E_{it} is effort given by the ith student in the tth class, A_i is the academic ability of the ith student, and D_t is the difficulty of the tth class.

However, there are not exact measures for L_{it}, E_{it}, A_i, and D_t. To proxy for content learning, L_{it}, the knowledge grade K'_{it} will be used. The knowledge grade is a good proxy for content learning, L_{it}, since students should be graded such that the more a student learns, the higher a student's knowledge grade is.

Using the effort grade E'_{it} as a proxy for student's effort, E_{it}, is the best alternative available. If a student reports his own effort, there has to be concern over the accuracy and effectiveness of the effort the student records. Here, the effort grade is cumulative and measured by the professor of each class. Effort measured by survey is likely to be misreported and not course specific. K'_{it} and E'_{it} are converted from letter grades to the 4 point scale where A = 4, B = 3, C = 2, D = 1, and F = 0.

The measures used for ability, A_i, are high school GPA, SAT Math and SAT Verbal scores, and high school rank. These variables are the best proxies for academic ability available for students at the time they enter college. In addition, the number of years of college experience at Benedict College is included in the model. This allows for the student's ability to vary from the pre-college measures.

D_t is measured as the share of students in a particular class that receive A's, B's, Cs, D's, and F's for their knowledge grade. Additionally, the amount of Years at Benedict College is used instead of a student's classification to attempt to pick up any benefits the more experienced students may obtain. Although the policy only affects freshman and sophomore level classes, over 80% of students take at least one SE[2] class.

Two alternative estimation procedures are discussed: two stage least squares and individual fixed effects. The ideal situation is for the effort grade to be given by an independent observer and not the professor. This would eliminate the possible professor and ability correlations. Using ordinary least squares ignores the fact that the same professor gives the effort and knowledge grades and the unobserved ability of the student can affect both. If the instruments are valid and the knowledge grade is linearly affected by the effort grade then two stage least squares and individual fixed effects models will fix the correlation problems. If however, the knowledge production function is not linearly, then the estimations cannot be interpreted as causal. Nevertheless, a positive correlation is important because it shows that there is a positive relationship between effort and learning.

4.1. Two stage least squares

Using the same production function with proxies substituted in gives the following

$$K'_{it} = f(E'_{it}, A'_{it}, D'_{it}) + u_{it} \qquad (2)$$

variables:

K'_{it} = knowledge grade, E'_{it} = effort grade, i = ith student, t = tth class

$$D'_{it} = \begin{pmatrix} \text{Share of A's in class } (s_a) \\ \text{Share of B's in class } (s_b) \\ \text{Share of D's in class } (s_c) \\ \text{Share of F's in class } (s_f) \end{pmatrix}$$

$$A'_{it} = \begin{pmatrix} \text{High School GPA (HSGPA)} \\ \text{High School Rank (HSRANK)} \\ \text{SAT Verbal (SATV)} \\ \text{SAT Math (SATM)} \\ \text{ACT (ACTCOMP)} \\ \text{2 Years at Benedict College } (Y_2) \\ \text{3 Years at Benedict College } (Y_3) \\ \text{4 Years at Benedict College } (Y_4) \\ \text{5 Years at Benedict College } (Y_5) \\ \text{6 Years at Benedict College } (Y_6) \\ \text{7 Years at Benedict College } (Y_7) \end{pmatrix}$$

If the production function is assumed to be linear, then this estimation can be run using ordinary least squares. However, the error u_{it}, might be correlated with the E', where the error is defined

$$u_{it} = a_i + p_t + \varepsilon^k_{it}, \qquad (3)$$

where a_i = unobserved student ability, P_t = unobserved professor effect, and ε^k_{it} is the unobserved random factors that determine K'_{it}.

Given that the effort grade and knowledge grade for a particular class are earned by the same student, the grades may be affected by the same unobserved student ability. In addition, the grades are given by the same professor, so they are subject to unobserved professor bias. To correct the endogeneity problem, a production function for effort must be defined.

$$E'_{it} = g(A'_i, D'_{it}, E^o_{i,term}, C^n_{it}, C^e_i, R^A_i, R^F_i) + u^e_{it} \qquad (4)$$

where A'_i and D'_{it} are the same as defined before. $E^o_{i,term}$ is the average past or future effort depending on the term for the ith student, C^n_{it} is the number of credit hours of the tth class the ith student is taking, C^e_i is the number of credit hours the ith student is taking in which effort is given an explicit grade, R^A_i is the relative difficulty of the class as compared with others the student is taking in terms of earning an "A" for effort, and R^F_i is the relative difficulty of the class as compared with others the student is taking in terms of earning an "F" for effort. This production function is also assumed to be linear. The estimation is run as two stage least squares. A valid instrument in this case is a variable that is correlated with effort grade, and only affects the knowledge grade through the effort grade. $E^{o}_{i,term}$, C^{n}_{i}, C^{e}_{i}, R^{A}_{i}, and R^{F}_{i} will be the instruments.

An instrument is the "average other effort" grades, $E^{o}_{i,term}$, of the student from a previous term if the term is a Spring term or a future term if term is a Fall term. The past or future effort grades shows how willing a student is to give effort and how well the student can give effort as defined by his professor. This variable, the average past or future effort grades, only affects the knowledge grade in a given class through the effort grade for that class. This is true for two reasons. First, the student learns that effort does lead to a higher knowledge grade. Second, the student learns how to give effort more efficiently, thus reducing the cost of effective effort. For fall semesters, I use the average of future effort grades in spring semesters, and for spring semesters, I use the average of past effort grades from the fall semesters. Another way to think about this instrument is that past or future effort grades give the best approximation of the students' willingness to put forth effort.

The second instrument is the number of credit hours for a particular class, C^{n}_{it}. The more credit hours a course is, the more difficult it becomes to put effort into any single class. With the cost of effort rising with the number of credit hours for a class, this variable should be negatively correlated with the effort grades. The knowledge grade is not affected by the credit hours. It is affected through the effect of credit hours on the effort grade.

The number of effort credit hours C^{e}_{i} is an instrument. Effort credit hours are defined as credit hours in which an explicit effort grade is given, i.e. freshman and sophomore level courses. In these classes, the effort grade roughly counts for either 60% or 40% of the grade. Effort is more important in these classes. The benefits from effort rise with the number of effort credit hours a student has. The more effort credit hours the student has, the better the policy is understood and internalized by the students. There is a direct effect of the number of effort credit hours on the effort grade. As argued above, the knowledge grade is affected through the effect of the number of effort credit hours on the effort grade.

R^{A}_{i} and R^{F}_{i} are also instruments. R^{A}_{i} shows the class a student takes that has the most "A"s and the least "A"s for effort of all the classes the student takes. R^{F}_{i} shows which class that a student takes that has the most "F"s and the least "F"s for effort of all the classes that the student takes. If a class a student takes is the easiest to earn an "A" of the classes the student takes, then the student's effort choice should be different than in other classes. It is unclear whether a student should put more or less effort into the easiest class. The same idea goes for classes when thinking about classes in terms of "F"s. These facts about each class should affect the effort given, but the effect on the knowledge grade should only be through the effort expended.

In summary, the "second stage" of the two stage least squares estimation is represented by the regression

$$K'_{it} = \alpha * \hat{E}_{it} + \beta * A'_{i} + \gamma * D'_{t} + u_{it} \quad (5)$$

Table 4
Fixed effect estimates for school years 2004–2005 and 2005–2006.

	Coeff.Std. dev.	Coeff.Std. dev.	Coeff.Std. dev.
All courses			
Effort grade	0.6526**	0.4341**	0.4322**
	(0.0041)	(0.0048)	(0.0048)
Spring term			−0.0693**
			(0.0101)
Fixed effects	NO	YES	YES
Obs.	37250	37250	37250
Adj. R-squared	0.41	0.60	0.60
Freshman courses only			
Effort grade	0.6089**	0.4012**	0.3993**
	(0.0056)	(0.0068)	(0.0068)
Spring term			−0.0887**
			(0.0146)
Fixed effects	NO	YES	YES
Obs.	21123	21123	21123
Adj. R-squared	0.36	0.57	0.57
Sophomore courses only			
Effort grade	0.7084**	0.4663**	0.4649**
	(0.0058)	(0.0074)	(0.0074)
Spring term			−0.0388**
			(0.0153)
Fixed effects	NO	YES	YES
Obs.	16127	16127	16127
Adj. R-squared	0.48	0.64	0.64

** 99% Confidence.

and the first stage by

$$\widehat{E}_{it} = \theta * E^{o}_{i,term} + \rho_1 * C^{n}_{it} + \rho_2 * C^{e}_{i} + \tau_1 * R^{A}_{i} + \tau_2 R^{F}_{i} + \kappa * A'_{i} + \eta * D'_{t} + u^{e}_{it} \quad (6)$$

The coefficient of interest is α. It shows how much an increase in the effort grade changes the knowledge grade. This variable will show whether effort leads to more learning.

4.2. Individual fixed effects

The ability measures, difficulty measures, and the instruments do not control fully for all unobserved student ability or professor bias. Therefore, I estimate a fixed effects model with fixed effects for professors and students. This procedure controls for the possible correlation between the effort grade and the error term. The estimation equation is

$$K'_{it} = \alpha' * E'_{it} + FE_{i} + FE_{p} + u_{it}, \quad (7)$$

where FE_i are the individual fixed effects and FE_p are the professor fixed effects. Individual characteristics cannot be used in this model because the characteristics are not time varying.

5. Results

5.1. Results from individual fixed effects

Table 4 gives the results of the estimations using individual fixed effects. All the estimated coefficients on the effort grade are 99% significant and strictly positive. This shows that an increase in the effort grade does lead to an increase in the knowledge grade.

Table 5
Significance level of instruments.

	99%	95%	Not significant
Average other effort	59	0	0
Number of credit hours for particular class	12	2	45
Number of effort credit hours	46	6	7
Easiest class to get an "A"	57	0	2
Hardest class to get an "A"	58	1	0
Easiest class to get an "F"	46	5	8
Hardest class to get an "F"	46	4	9

Table 4 shows the results using the school years 2004–2005 and 2005–2006. Using fixed effects lowers the estimated coefficient compared to ordinary least squares as expected by eliminating positive feedback from professor and student bias. However, all estimates still remain significantly greater than zero. Adding in the fixed effects improves the amount of variation explained for all specifications. The effect of an increase in the knowledge grade due to the effort grade is not significantly different for sophomore level courses and freshman level courses once fixed effects are added. These estimated results show that there is a positive effect on the knowledge grade due to effort grading. This result is in line with the findings of Michaels and Miethe (1989) and Rau and Durand (2000), and contradicts Schuman et al. (1985) and Hill (1991).

5.2. First stage and instruments

These results come from the two stage least squares estimates. From the first stage, the mean value of the R-squared is 0.2883, with a standard deviation of 0.0315. The minimum R-squared is 0.2, while the maximum R-squared is 0.39. The instruments fit the regression nicely. Table 5 gives the level of significance for each instrument in the regressions. This is a summary of the information from all the first stage regressions.

As expected, the "average other effort" grade is the best predictor of the effort grade for a given class. The difficulty of earning "A"s and "F"s as an effort grade preforms well. The number of credit hours for a particular class is related strongly to the number of effort credit hours. This explains why the number of credit hours for the particular class is usually not significant. Overall, the instruments perform well. The Sargan statistics show that the test for identification restrictions supports the null hypothesis that the instruments are uncorrelated with the error term, and that they are correctly excluded from the estimated equation for all estimations. With regard to the exogeneity of the effort grade in the production function, the Wu–Hausman F statistics only rarely rejects the null hypothesis that the effort grade is exogenous across all specifications at the 90% confidence interval. Nonetheless, to be more robust, two stage least squares estimates are reported.

Table 6
Coefficients on effort grade for 2SLS.

	Fall semesters only Effort coeff. (std. dev.)	Spring semesters only Effort coeff. (std. dev.)
All courses	0.4542** (0.0141)	0.6112** (0.0135)
Number of Obs.	15911	15206
Freshman level courses	0.3561** (0.0180)	0.5504** (0.0179)
Number of Obs.	9149	8106
Sophomore level courses	0.6202** (0.0224)	0.7160** (0.0209)
Number of Obs.	6762	7100

** 99% Significance level.

5.3. Two stage least squares

The results are obtained from all the second stage regressions. The coefficient on the effort grade is always positive and significant at the 99% confidence level. The mean increase in the knowledge grade due to an increase in the effort grade by a letter grade is 0.5111, with standard deviation of 0.1260. The maximum increase in the knowledge grade is estimated at 0.8116 (std. dev. 0.1002) for seniors in their spring semester. The minimum increase in the knowledge grade is estimated at 0.2769 (std. dev. 0.0316) for those with a high school GPA in the 0–24.99th quartile in the fall semesters. These results are encouraging for the policy. Earning a higher effort grade leads to a higher knowledge grade.

Table 6 shows the effects of effort grading on learning for the main sample using all class observations. The variables used are as follows: dependant variable: knowledge grade; independent variables: effort grade, share of A's in class, share of B's in class, share of D's in class, share of F's in class, High School GPA, High School Rank, SAT Verbal, SAT Math, ACT, and Years at Benedict (2–7); and Instruments: average other effort, number of credit hours for the particular class, number of effort credit hours, easiest class to get an "A", hardest class to get an "A", easiest class to get an "F", and hardest class to get an "F". The number of observations for the two stage least squares is smaller because of the "average other effort" instrument. To remain in the sample, a student has to be enrolled in both the Spring and Fall semester of a school year. This lowers the total number of grade observations from 37,250 to 31,117 and students in the sample from 3778 to 2492.

Table 6 shows that the effects of effort on learning are greatest across specifications for the Spring semester sample. The effects of effort grading on learning are greater for Sophomore level courses in each sample. This occurs even though the effort grade gets less weight in sophomore level courses than in freshman level courses. These results are similar to what is found when using individual fixed effects. The Spring semester estimates are larger due to the fact that the Spring semester uses the "average other effort" instrument that is backward looking. By being backward looking, this leads to some positive feedback.

The previous regression are run using only the forward looking "average other effort" instrument and only the backward looking "average other effort" instrument. Table 7 includes both results for ease of comparison. When looking at the results in Table 7 all Spring semester results

Table 7
Coefficients on effort grade using 2SLS.

	Fall semesters Effort coeff. (std. dev.)	Only spring semesters only Effort coeff. (std. dev.)
Using forward looking effort instrument		
All courses	0.4542**	0.5994**
	(0.0141)	(0.0200)
Number of Obs.	15911	6752
Freshman level courses	0.3561**	0.5413**
	(0.0180)	(0.0276)
Number of Obs.	9149	3595
Sophomore level courses	0.6202**	0.6601**
	(0.0224)	(0.0209)
Number of Obs.	6762	3157
Using backward looking effort instrument		
All courses	0.5053**	0.6112**
	(0.0220)	(0.0135)
Number of Obs.	5483	15206
Freshman level courses	0.3563**	0.5504**
	(0.0312)	(0.0179)
Number of Obs.	2191	8106
Sophomore level courses	0.7228**	0.7160**
	(0.0302)	(0.0209)
Number of Obs.	3292	7100

** 99% Significance level.

are smaller as expected and all Fall semester results are larger as expected.

The results from the individual fixed effects models are smaller for a few reasons. First, to be included in the two stage least squares estimation a student must attend school two concurrent semesters. Therefore, the two stage least squares estimates includes students who continue, while the individual fixed effects models includes all students. This would mean that if a student does not continue after a given semester, they would show up in the individual fixed effects estimation, but not in the two stage least squares estimation. This biases the individual fixed effects model downward.

Secondly, using a backward looking instrument estimation biases the results in a positive fashion. Two stage least squares has larger Spring semester estimates because of this. Although this is a problem, using both forward and backward looking "average other effort" instruments allows the sample sizes to be about the same size for the Fall and Spring semesters. Getting rid of the bias is not worth the lost in sample size.

Lastly, although the instruments do perform well, the individual fixed effects eliminate the professor and student biases better than the instruments. The results do show that the relationship between the effort grade and the knowledge grade is positive and significant regardless of the estimation procedure used.

6. Conclusions

This paper finds that the effort grade affects the knowledge grade positively and significantly across all specifications. This is strong evidence that more student effort does lead to increase learning. These results should be viewed favorably by the administration at Benedict College and teachers in general. With a better measure for effort than previous research and a more appropriate estimation procedure, effort is shown to be important in improving the knowledge gained by students. These results are in line with the common but difficult to test belief that more effort leads to more learning.

Focusing a policy such as this on high achieving students would not be helpful given that they can choose the appropriate level of effort. However, by rewarding effort for certain students, it may help motivate them to become better students. At the present, it is not known if the program leads to increases in the 6-year graduation rates. However, if the program is successful at increasing graduation rates, then the policy should be of interest to any university looking for a way to increase learning and graduation rates.

Appendix A.

The appendix is available upon request. It only contains complete regression output tables.

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