

**Teacher Quality and Its Effects on Student Achievement in Pennsylvania
Public Schools**

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Abstract

This study analyzes the effects of teacher tenure and teacher salary on student achievement in Pennsylvania public schools during the 2017 to 2018 school year. Student achievement is measured by the percentage of high school seniors who plan to attend college and the percentage of students who perform proficient and above on the Pennsylvania Keystone standardized exam. Surprisingly, the results demonstrate a negative and significant relationship between teacher's salary and the percentage of students who plan to attend college. While teachers' tenure and the percentage of students who performed proficient or above on the Keystone Exam represent a positive and significant relationship. The results show that there is no correlation between teachers' tenure and the percentage of students who plan to attend college. Similarly, there is no correlation between teachers' salaries and the percentage of students who perform proficient or above on the Keystone Exam.

Introduction

Education is a fundamental right, granted and enforced by the United States Constitution (Fernandez, Rogerson, 1996). An individual's education determines many important aspects of their life. Quality education breeds skills and knowledge necessary to earn jobs in the labor market. Of course, there are unique examples of individuals who fail to attain an education, but still land well-paying jobs within the labor market. However, in most cases, attaining a quality education is crucial to earning a job that offers a substantial wage. Therefore, studying the quality of education throughout school districts is important to continuously improving student achievement. This study works to examine the quality of education of Pennsylvania public school districts. The quality of the education taught in public schools is often unmeasurable and subjective, but there have been many different studies conducted that determine the key variables that help define the quality of education. In this study the quality of education will be measured by student achievement. This study examines if teachers' salaries and length of teacher tenure affect student achievement. Student achievement is defined by post high school plans and state standardized test outcomes. However, it can be affected by many communities, demographic, and economic factors as well. The study found that average teachers' salaries have a negative effect on the percentage of students who plan to enroll in college. Also, the results show that the average length of teacher tenure positively affects the percentage of students who perform proficient and above on the Keystone Exam. However, when the average length of tenure reaches above 14.69 years of experience, Keystone Exam outcomes begin to fall.

Literature Review

In the study done by Dolton and Marcenaro-Gutierrez (2011), it is stated that the quality of an education system cannot exceed the quality of its teachers. This makes sense considering it is the teacher's job to ensure that students are learning and getting the necessary education. According to De Paola (2009), teachers with more experience tend to positively affect the students' accumulation of human capital, or education. Therefore, it is reasonable to assume that the better the teacher, the better the education. With that being said, the quality of education is directly dependent on the teacher. So, the quality of education directly affects student achievement and performance because the better the quality of education results in higher achievement and better test scores. However, it is important to note that there are many community, demographic, and economic factors that could affect the quality of education and student achievement. Lin (2010) shows that teacher quality, has a positive and significant effect on student achievement. This implies that better qualified teachers enhance students' learning and ultimately increases the performance and achievements of the students. Therefore, student achievement is a manifestation of education quality.

One measure of the quality of education is student achievement. Student achievement can be represented by standardized test outcomes and the proportion of public high school graduates enrolled in a 2- to 4- year university or post-high school education program. (Lin, 2010). According to the article, *What Test Scores Can and Cannot Tell Us About the Quality of Our Schools*, statewide standardized test scores are a good way to measure the knowledge of an individual student, but more recently standardized test scores have been used to measure the quality of education being taught at the school (Crone, 2004). There are more recent testing procedures that are designed to hold school districts accountable to teaching the statewide

curriculum (Crone, 2004). Standardized tests give a better outlook on students across all classrooms and schools, when compared to regular teacher-generated tests or course grades. This is because teachers can write their own test and teach the specific material that is on that test, so their students score well, and their teaching is reflected in a positive way (Crone, 2004).

As can be seen in the studies conducted by Dolton and Marcenaro-Gutierrez (2011) and Lin (2010), student achievement reflects the education quality of public schools. Therefore, when the quality of education at a school is high, students likely learn more. This leads students to developing a high quality of knowledge and skills. This high-quality education is then reflected by high scores and outcomes on standardized tests, which leads to achieving successes, like attending a 2- to 4- year college to earn a degree or accepting full-time job.

There are many aspects outside of the classroom that affect a student's education and achievement, like community demographics. For instance, school districts in urbanized areas tend to demonstrate higher levels of student achievement (Lin, 2010). This finding is very interesting when also considering that 32% of elementary and secondary school teachers worked in rural areas (Taylor, 2008). This statistic is important because it represents that most teachers are employed outside of rural communities, in more urban areas. This demonstrates that the school districts in urban areas require more teachers because they must educate more students due to the higher population in the school district. If a school district can afford to hire more teachers, this decreases the student to teacher ratio. When there are more teachers the class sizes are smaller.

In addition, urbanized school districts, specifically suburban school districts, can afford educational expenditures that rural schools are likely not able to afford. For instance, a wider array of courses, activities, and technologies that improve student performance and achievement

(Lin, Quayes, 2006). However, there is a lot of possible differentiation between suburban and city school districts, although they are both urbanized school districts. First, city schools are often granted money, just like suburban schools are, but this does not always mean more resources for the city school students (Hoxby, 1996). Lower income urban school districts, like city schools, often have high student enrollment and the dire need to spend grant money elsewhere. For instance, these school districts might need to buy school lunches for their students, provide transportation, or invest in school building improvements. Meanwhile, suburban school districts do not need to use their grant money for basic school necessities like that, because they are in higher income areas. Suburban schools could use grant money for expenditures for their students, such as technology and field trips. Therefore, although city and suburban schools are both urbanized, it is possible there is a lot of differentiation between the school environment and quality.

School districts are funded directly by local tax revenue (Lin & Quayes, 2006). Although tax revenue may be a bad proxy for student achievement because not all the community's tax revenue is spent on the public school district (Lin, 2010), it is still the main source of funding for public schools. Local taxes and average income level are demonstrated to have a positive impact on school performance (Lin, Quayes, 2006).

As such, median household income is a good reflection of the financial status of a community. It is possible that the communities that have higher median household incomes could potentially have higher tax revenue bases for their public schools. The financial status of a community is often a reflection of the community quality, which we see greatly impacts the quality of education taught at the community's public school. In Lin's study, median household income exerts a positive and significant effect on student achievement (Lin, 2010). While the

proportion of low-income families affects student achievement negatively and significantly (Lin, 2010). These results imply that the higher the household income the better the student's achievement. The reverse also holds (Lin, 2010). This finding can be appointed to the fact that families with a higher household income have the financial ability to support extracurricular activities and expenditures that benefit students learning. For instance, a child that has access to technologies, books, and tutoring outside of the classroom will continue to learn after school hours, which will result in better performance and achievements at school. However, a student that comes from a family that cannot financially support extra learning expenditures will not see these benefits.

Ethnicity could also influence school quality because it could indirectly affect student achievement. For example, different ethnic groups may also place differing levels of importance on education (Lin, 2010). In Lin's 2010 study, the results showed that Asian enrollments positively and significantly affect student achievement, but African American, Hispanic-American, and American Indian enrollments negatively and significantly affect student achievement. These results suggest that a higher proportion of Asian students enrolled in the school is associated with higher student achievement. Meanwhile, the results also imply that a higher proportion of African American and Hispanic students enrolled in the school is associated with low student achievement. Lin explains the two main reasons for these results. First, the average household income of Asian families is higher than that of the other two ethnic groups. Therefore, Asian families are capable of financially supporting their children's education. Second, the Asian culture places a higher value on education, therefore they likely spend more time helping their children with homework, studying, and supporting their future college

endeavors (Lin, 2010). In fact, the level of education completed by White or Asian families is greater than that of an African American or Hispanic American household (Lin, Quayes, 2006).

Furthermore, a student's access to educational expenditures at school, like student to teacher ratios and technology, is a direct reflection on the education quality at the school. The study done by Boozer, Krueger, et al. (1992) stated that wealth is the main determinant of the student-teacher ratio. African American students have lower family wealth than white students, and in some regions of the country African American students attend schools with worse student-teacher ratios than white schools (Boozer, Krueger, et al. 1992). In addition, African American and Hispanic American children are less likely to have access to computers in school and at home, than white or Asian children. This is because children from low-income families have less access to technology in their schools and especially at home (Boozer, Krueger, et al. 1992).

As stated above, the quality of education cannot exceed the quality of its teachers (Dolton and Marcenaro-Gutierrez, 2011). The study done by Lin analyzed the relationship between teachers' salaries and student achievement (Lin, 2010). Lin demonstrated that there is a positive and significant relationship between teachers' salaries and student achievement in Pennsylvania (Lin, 2010). These results, in conjunction to the statement above, imply that higher teacher salaries attract better qualified teachers who enhance student's learning and improve student's achievement. In addition, according to Figlio public schools can, in fact, attract better qualified teachers to their district by raising the teacher's salaries (Figlio, 2002). This is because where a teacher is paid in a country's income distribution will lead to attracting teachers of the appropriate quality (Dolton and Marcenaro-Gutierrez, 2011). This means that school districts that offer lower wages for their teacher candidates will attract lower quality teachers, while school districts offering higher wages will attract better quality teachers.

There are many factors that determine a teacher's salary. For example, a teacher's tenure and experience, research productivity, and subject knowledge, all make a teacher more valuable or worth a higher salary (De Paola, 2009). However, a teacher's knowledge and ability are not the sole determinant of their contract or salary. In fact, most public-school teachers belong to a teacher's union that defines the salary schedules, and the teacher contract rules. Therefore, the local teacher's union is what mostly determines the salary of a public-school teacher (Baron, 2018). In the later part of the twentieth century, public sector unionism became extremely popular because many states passed collective bargaining regulations for government workers, like teachers (Baron, 2018). In the United States, teachers' unions work to optimize the utility of their teachers by bargaining with local school boards for higher wages, benefits, job security, and better working conditions. Unions also bargain for contracts that are determined only on seniority, and education attainment (Baron, 2018). Unions' also increase the budget that school districts use to fund expenditures and extracurricular activities for students, while also reallocating these funds to promote more efficient spending (Baron, 2018). This directly affects education because educational expenditures are necessary for a high-quality education (Hoxby, 1996).

Therefore, the role of a union is important because they are the main determinant of teachers' salaries. As stated in previous paragraphs, both factors directly affect the quality of education. Teachers' salaries can attract better teachers, which in turn increases the quality of education. Educational expenditures, like student to teacher ratio and technology benefit students learning, performance, and achievement.

Data and Methodology

This study uses the data of each Pennsylvania public school district, to examine the relationship between teacher quality and student achievement. The research question this study works to answer is: Does teacher quality affect student achievement in Pennsylvania public schools? Teacher quality is represented by two proxies: average teacher salary and average length of tenure. Student achievement is represented by two proxies: Keystone standardized test performance and post-high school graduation plans. I hypothesize that school districts with higher average teachers' salaries and longer length of tenure is correlated with the school districts with higher student achievement, controlling for multiple community, demographic, and economic factors that could affect the quality of education.

The sample was collected from the Pennsylvania Department of Education, specifically from the 2017-2018 school year for Pennsylvania public schools only. All the data for the dependent variables are from the Pennsylvania Department of Education from the 2017-2018 school year. The data on teacher salaries and teacher tenure was found on the Open Pennsylvania Government website where it references school payroll. To test the relationship between teacher quality and student achievement, I use the data from this sample to run four separate regressions for each proxy of student achievement. The four separate regressions will be based on the dependent variables: Keystone standardized test outcomes and higher education enrollment plans and the relationships to teacher tenure and teacher salary. The first regression is, % Students attending college_i = $\beta_0 + \beta_1 \ln \text{salary}_i + \beta_2 \ln \text{medianhouseholdincome}_i + \beta_3 \text{asian}_i + \beta_4 \text{hispanic}_i + \beta_5 \text{black}_i + \beta_6 \text{parentshs}_i + \beta_7 \text{parentssomecollege}_i + \beta_8 \text{parentsba}_i + \beta_9 \text{city}_i + \beta_{10} \text{suburb}_i + \beta_{11} \text{town}_i + \beta_{12} \ln \text{expenditure}_i + \beta_{13} \text{chronicabsenteeism}_i + \beta_{14} \text{studentteacherratio}_i + \beta_{15} \text{studentteacherratiosquared}_i + \mu_i$. The second regression is, % Students attending college_i = β_0

$+ \beta_1 \text{tenure}_i + \beta_2 \text{tenuresquared}_i + \beta_3 \ln \text{medianhouseholdincome}_i + \beta_4 \text{asian}_i + \beta_5 \text{hispanic}_i + \beta_6 \text{black}_i$
 $+ \beta_7 \text{parentshs}_i + \beta_8 \text{parentssomecollege}_i + \beta_9 \text{parentsba}_i + \beta_{10} \text{city}_i + \beta_{11} \text{suburb}_i + \beta_{12} \text{town}_i +$
 $\beta_{13} \ln \text{expenditure}_i + \beta_{14} \text{chronicabsenteeism}_i + \beta_{15} \text{studentteacherratio}_i +$
 $\beta_{16} \text{studentteacherratiosquared}_i + \mu_i.$ The third regression is, % Students scored
 proficient/advanced on Keystone Exam $_i = \beta_0 + \beta_1 \ln \text{salary}_i + \beta_2 \ln \text{medianhouseholdincome}_i + \beta_3$
 $\text{asian}_i + \beta_4 \text{hispanic}_i + \beta_5 \text{black}_i + \beta_6 \text{parentshs}_i + \beta_7 \text{parentssomecollege}_i + \beta_8 \text{parentsba}_i + \beta_9 \text{city}_i +$
 $\beta_{10} \text{suburb}_i + \beta_{11} \text{town}_i + \beta_{12} \ln \text{expenditure}_i + \beta_{13} \text{chronicabsenteeism}_i + \beta_{14} \text{studentteacherratio}_i +$
 $\beta_{15} \text{studentteacherratiosquared}_i + \mu_i.$ The last regression is, % Students scored
 proficient/advanced on Keystone Exam $_i = \beta_0 + \beta_1 \text{tenure}_i + \beta_2 \text{tenuresquared}_i +$
 $\beta_3 \ln \text{medianhouseholdincome}_i + \beta_4 \text{asian}_i + \beta_5 \text{hispanic}_i + \beta_6 \text{black}_i + \beta_7 \text{parentshs}_i +$
 $\beta_8 \text{parentssomecollege}_i + \beta_9 \text{parentsba}_i + \beta_{10} \text{city}_i + \beta_{11} \text{suburb}_i + \beta_{12} \text{town}_i + \beta_{13} \ln \text{expenditure}_i +$
 $\beta_{14} \text{chronicabsenteeism}_i + \beta_{15} \text{studentteacherratio}_i + \beta_{16} \text{studentteacherratiosquared}_i + \mu_i.$

The Keystone Exam outcomes of the of Pennsylvania high school students are one of the
 dependent variables of this study. The Pennsylvania Keystone Exam is a statewide standardized
 test that every student must take during the spring of their junior year of high school. There are
 three different Keystone Examinations for this grade level: Algebra, Literature and Biology.
 Students can earn four possible outcomes: below basic, basic, proficient, and advanced. To best
 represent the overall Keystone outcomes of each school district, I find the percentage of students
 that earn proficient or advanced on each exam. Then, I average that value over the three exams
 for each school district.

Higher education enrollment plans are also a proxy for student achievement. For this
 study, I found the percentage of students planning to pursue a 2- to 4- year university program
 and the percentage of students pursuing a specialized associate degree granting institution. This

number represents the total percentage of high school students who plan to attend college. This self-reported data is the only measure available on immediate post high school plans of Pennsylvania high school students.

As mentioned above, teacher quality is proxied by two variables, average teachers' salaries, and average length of teacher's tenure. Both are reported by school district, to the Pennsylvania Department of Education. These proxies are not perfect representations of the quality of a teacher. For example, a teacher could be very experienced, in the top tenure percentile, but they could be seen as a poor teacher. There is reason to assume more tenured teachers are better, because they have more job experience, but the opposite could also be true. This could be because they are close to retirement and past their peak career point, while younger, but less-experienced, teachers are new and fresh and considered to be the better teachers at the school. To find if there is an optimal length of tenure of a school, I will add tenure squared into the equation. This optimal point would be where additional years of tenure increases student achievement to a point where any more years of tenure would decrease student achievement.

In addition, teacher's salaries could also be a problematic proxy for teachers' quality. Teachers' salaries are heavily based on local labor union contracts, which are normally non-negotiable. In Pennsylvania, The Pennsylvania State Education Association (PSEA) is the teacher's union that oversees all Pennsylvania public school teachers' contracts. A teacher's salaries increase with tenure and degree attainment, so a teacher with a master's degree makes more than a teacher with a bachelor's degree. However, this is all subject to the terms and conditions of the union contract, which is primarily dependent on the local tax base. Therefore, local tax bases are higher in areas that are wealthier, like suburban areas. So, school districts in

suburban areas can likely afford to pay their teachers more than school districts of small towns. If this is the case, teachers' salaries would not reflect the quality of the teacher but would directly reflect the financial ability of the district.

Another important point to highlight is that teachers must choose the school district in which they teach based on many personal factors, not just which districts offer higher pay scales. For example, some teachers may choose to travel farther from their home, to earn higher income. These kinds of factors are simply unmeasurable and unattainable; therefore, it is often hard to find perfect proxies for teacher quality. However, these proxies should still capture substantial aspects of teacher quality. For instance, school districts that can afford to pay their teachers higher wages will likely have more applicants than school districts that cannot offer the same wages. Therefore, these school districts will have more of a choice on who they can hire. This could mean that they will have the choice to hire the best teachers of the applicant pool, instead of simply whoever they can get to accept their offer, like less-wealthy schools. In this case, the better teachers will result in higher performing students at these school districts. Therefore, I predict that the schools that can offer their teachers higher salaries will also be the schools that have the students that perform in the proficient or advanced category of the Keystone Exams and have a high percentage of students planning to pursue higher education.

There are many other factors that could affect student achievement in Pennsylvania Public Schools. There are multiple community, demographic and economic factors that need to be controlled for to produce the most accurate results. The community characteristics of a school district can greatly affect student achievement because there are many aspects outside of the classroom that affect students. First, the study controls for whether a community is urban or rural, which is represented as a dummy variable in the data set. This data is from the

Pennsylvania Department of Education in the school Locale section, which was created based on the United States Census Bureau's urbanized data. Controlling for location is important because urbanized school districts are often much different than school districts located in rural areas, which would cause different effects on student achievement. For instance, wealthier school districts, like those located in suburban areas, often offer more educational benefits to their students, which would directly affect student achievement.

Next, the study controls for parental education attainment, which is described in the dataset as four different categories of the education attainment of the parents of the students. The categories are the percentage of parents with a high school education, percentage of parents with some college education, percentage of parents with a bachelor's degree and up, and the percentage of parents with no high school diploma. This data is from the National Center for Education Statistics. This is controlled for in the study because when a high percentage of the students' parents have a college degree, it is likely that many of the students 'will also want to pursue higher education. This demonstrates that there is a higher value on education within the families of the community, which would greatly affect a student's achievement. Parental educational attainment is especially important because it could affect the quality of education taught in the school district. If most of the parents have a bachelor's degree or higher that would lead to higher household incomes, which would lead to higher tax bases for the school district. When a school district attains more revenue in taxes, they can fund more educational benefits for students. This would affect student achievement, which is why this variable must be controlled for in this study.

Lastly, chronic absenteeism of a school district is another factor that must be controlled for. This data is from the Civil Rights Data Collection website for the school year of 2017-2018.

The variable is described as the average percentage of students that are absent 15 or more dates during the school year. This is an important variable to control for because it represents many different communal aspects, like their home life, parental value on education, and health factors. A student could be absent from school for many personal reasons that are not associated with the education they are being taught in the classroom. For instance, their parents could not be committed to making sure their children attend school or work hard outside of the classroom to complete assignments. It is also possible that they could struggle with health issues that cause them to be absent from school regularly. However chronic absenteeism could greatly affect a student's achievement due to the fact they are getting less of an education than others who are not chronically absent.

In this study, it is important to control for demographic factors of a school district, like the races or ethnicities of the students enrolled in the district. This data is from the Elementary/Secondary Information System on the National Center for Education Statistics. The percentages of White, Black, or African American, Hispanic, and Asian students enrolled in the school district, is used in the data. These percentages will be compared to the percentage of White students enrolled in the school. A student's ethnic group may affect their achievement in school. According to Lin's (2010) study, the Asian culture places a higher value on education, therefore they likely spend more time helping their children with homework, studying, and supporting their future college endeavors. Therefore, a school district that has a high percentage of Asian students enrolled could demonstrate higher levels of student achievement.

There are also numerous economic factors that need to be controlled for in this study. Specifically, the student teacher ratios, total spending, and median household incomes of each school district. Student to teacher ratios of a school district could greatly affect student

achievement because if teachers have smaller class sizes, it is likely they have more opportunity to spend instructing individual students one on one. Therefore, the quality of education in schools that have less students enrolled per teacher employed will demonstrate higher levels of student achievement. Therefore, the school districts that have lower student-teacher ratios will correlate with the districts that have better student achievement. The student-teacher ratio squared variable is included to possibly find the maximum class size of Pennsylvania public schools until student achievement begins to be negatively affected. Like mentioned above, it is suspected that lower the student teacher ratios will be associated with higher student achievement. Therefore, I want to see if there is a certain ratio where this is no longer true and student achievement begins to fall. Student-teacher ratio is controlled for because it could be reflecting the population of the area that the school district is located in. For example, a school district located in an area with very small population will likely have low student-teacher ratios, while the opposite is true for very populated areas. The data on student-teacher ratios was found on the Elementary/Secondary Information System on the National Center for Education Statistics.

In this study, the percentage of total spending per student is also a control variable. The percentage of total spending per student reflects a school districts economic status. Wealthier school districts are likely capable of affording more educational expenditures. Educational expenditures do not reflect the overall teacher's quality of a school; however, it could affect student achievement. Educational expenditures include technology, academic clubs, tutoring, extracurricular activities, field trips, and many more aspects that benefit the education taught at the school. Therefore, it is reasonable to assume that the more educational expenditures a school

has, the higher levels of student achievement. This data on educational expenditure spending was found on the Pennsylvania Department of Education website.

Lastly, median household income of the school district must be controlled for in this study. The data is from the American Community Survey- Education Tabulation on the National Center for Education Statistics website. The median household income reflects the financial status of families in the school district. This is important because it can greatly affect a student's achievement for two main reasons. One reason being that wealthier families can afford to financially support their children's education. For example, they could hire outside tutors or purchase technology that could benefit a student's achievement in school, for instance cause better Keystone Exam outcomes and increases in the percentage of students who plan to attend college. Also, a school district that has a higher median household income will receive higher amounts of tax revenues. Therefore, median household income can greatly affect student achievement.

Results

Table 1. OLS Regression Results

	Regression 1	Regression 2	Regression 3	Regression 4
	% Students attending college	% Students attending college	% Students scored proficient/advanced on Keystone Exam	% Students scored proficient/advanced on Keystone Exam
Constant	1.35*** (.179)	.808*** (.147)	-249.73*** (65.8)	-282.63*** (63.1)
ln(salary)	-.054*** (.01)		3.72 (4.58)	
Tenure		-.007 (.008)		12.19*** (3.9)
Tenure²		.0002 (.0003)		-.415*** (.135)
ln(median household income)	-.009 (.01)	-.008 (.0105)	19.8*** (4.45)	19.18*** (4.38)
Asian	-.00001*** (4.22)	-.00001*** (4.53)	.005** (.002)	.005** (.002)
Hispanic	-2.8*** (8.22)	-2.53*** (9.34)	-.001*** (.0003)	-.001*** (.0003)

Black	1.99** (.0005)	2.67** (1.2)	-.0008** (.0004)	-.0009** (.0004)
Parents High School Education Only	.0005* (.0002)	.0006** (.0003)	.443** (.218)	.419* (.222)
Parents Some College Education	.0002 (.0002)	.0004 (.0002)	.187 (.208)	.148 (.213)
Parents Bachelor's degree/ up	.0005* (.0003)	.0006* (.0003)	.368* (.195)	.352* (.198)
Location: City	-.003 (.005)	-.005 (3.4)	-3.47 (2.37)	-2.88 (2.37)
Location: Suburb	-.008*** (.002)	-.013*** (.003)	-3.8*** (1.29)	-3.44*** (1.26)
Location: Town	.004 (.004)	.007 (.004)	-4.3*** (1.6)	-4.51*** (1.58)
ln(expenditure spending % per pupil)	1.79 (.00001)	8.75 (.00001)	-.001 (.006)	-.005 (.006)
Chronic absenteeism %	-.042*** (.0157)	-.027*** (.017)	-28.81*** (.006)	-24.9*** (8.53)
Student-Teacher Ratio	-.088*** (.013)	-.088*** (.014)	5.55* (2.98)	5.5* (3.14)
Student-Teacher Ratio Squared	.002*** (.0004)	.002*** (.0004)	-.164 (.105)	-.157 (.111)
Number of Observations	495	495	495	495
R²	0.4887	0.4526	0.33	0.35
F-Stat	18.63***	15.42***	23.72***	23.49***

Note: Standard errors for independent variables are shown in parenthesis. Robust standard errors shown in brackets. The symbols *, **, *** correspond to a 10% , 5%, and 1% level of significance.

Four Ordinary Least Squares (OLS) regressions were used to estimate the impact of various factors on student achievement. Table 1 shows the results for all 495 public school districts in the state of Pennsylvania. Two separate measures of student achievement were used to define a student's success. These measures are the percentage of high school seniors that state they are planning to attend college and the percentage of students who scored proficient or above on the Pennsylvania standardized Keystone Exam. White's, and Breusch-Pagans test for heteroskedasticity was conducted and showed that heteroskedasticity was present in all the regressions. Therefore, the robust standard errors are used all four of the regressions.

Table 1. OLS Regression Results, depicts the results for tenure and tenure-squared in relation to the percentage of students attending college and the percentage of students who scored proficient or advanced on the Keystone Exam. Tenure and tenure-squared is one of the main variables of interest. Many would think the higher the number of years of experience a teacher has, the better the quality of the teacher. Tenure positively correlated and statistically significant at the one-percent level to the percentage of students who scored proficient or advanced on the Keystone Exam. However, based on coefficients student achievement increases until 14.8 years of average tenure, then student achievement begins to decrease. This makes sense because a newer teacher often is inexperienced in the classroom, which could result in lower student achievement. The contrary is true for older teachers, who have more experience in their teaching career, which would lead to higher student achievement. However, a newer teacher is likely aware of a newer teaching technique, while an older teacher could only teach in old-fashioned teaching techniques that are no longer efficient. Tenure and tenure-squared is not significant to the percentage of students who plan to pursue higher education. However, tenure and tenure-squared are statistically significant at the one-percent level to the percentage of students who perform in the proficient and advanced categories on the Keystone Exam. Therefore, this supports my hypothesis that longer tenure of a teacher is correlated with higher percentages of students who perform well on the Keystone Exam, but only up until about the average teachers 'sixteenth year of teaching. After that, the longer the length of their tenure begins to negatively affect student achievement.

The second main variable of interest is the natural log of the average teachers' salaries. The average teachers' salaries of a school district are statistically significant at the one-percent level to the percentage of students who attend college. Therefore, if average teachers' salaries

increase by one percent, it is associated with a .054 percentage point decrease of the percentage of high school seniors going to college. It is very surprising that it is negatively correlated to the percent of students who attend college. This results, in regression one, do not support my hypothesis that higher teacher salaries are correlated with the school districts that have high student achievement. This could be because of the many other aspects that affect a student's decision to attend college that are not related to their high school education. For example, the financial burden of attending college and the time commitment and forgone earnings by choosing to not enter the labor market. In addition, average teacher's salary is not statistically significant to the percentage of students who scored proficient or above on the Keystone Exam. This finding is surprising because it demonstrates that school districts that have higher paid teachers do not always have the better test scores or student achievement.

The median household income is not statistically significant to the percentage of students who choose to attend college. However, it is statistically significant to the percentage of students who score proficient and above on the Keystone Exam, at the one percent level. For instance, in regression 3, if the average median household income increases by one percent, its associated with a .198 percentage point increase in the percent of students who scores proficient or above on the Keystone Exam. This indicates that the wealthier the student's household, the more likely the student will score well on the Keystone Exam. This could be because the more financially stable a family is, the more financial support they can offer their student. For instance, these parents can provide educational expenditures for their students like extra tutoring or materials that enhance their learning and help them score better on exams.

Much like tenure and tenure-squared, Table 1 also depicts the results of student-teacher ratio and student-teacher ratio-squared in relation to the percentage of students attending college

and the percentage of students who scored proficient or advanced on the Keystone Exam. This parabolic relationship is important because it demonstrates the maximum size a class can be before it starts to decrease student achievement. A low student-teacher ratio is very important to the productivity of a class, meaning smaller class sizes and more individual instruction for students is expected to increase student achievement. The data shows that the maximum number of students per one teacher, or class size, is around 16 students. For instance, in regression 1 the optimal number is 16.17 students and in regression 2 it is 15.8 students. This means that a ration greater than 16.17 students in a classroom is associated with a negative effect on the percentage of students who plan to attend a higher education program.

The relationship in this regression shows a negative correlation between chronic absenteeism and the percentage of students attending college. This makes sense because the more absent a student is from high school, the less likely they are to attend college. In addition, chronic absenteeism is statistically significant and negatively correlated to the percentage of students who score proficient or above on Keystone Exams, at the one percent level. This also makes sense because the more a student is absent from school, the less instruction they will receive, and the worse they will score on the Keystone Exam. This directly reflects the overall quality of the school district because the more students that are chronically absent will decrease the overall percentage of students who score proficient and above on the Keystone Exam.

The percentage of spending per pupil of Pennsylvania School districts directly reflects the financial ability of a school because if a school has more money, they can purchase more resources for their students that could benefit their education. It is reasonable to assume that the more resources a school can afford, the higher their student's achievement would be. For instance, higher percentages of students planning to go to college and higher the percentage of

students who perform proficient or above on the Keystone Exam. However, the relationship cannot be supported because it was not statistically significant to the percentage of students who plan to attend college or the percentage of students who scored proficient or above on the keystone Exam.

The percentage of student enrollments that identify as Asian, Hispanic, or Black, relative to the enrollments of White, Pacific Islander, and American Indian enrollments, is represented in the regressions. The percentage of students who identify as Asian, Hispanic, or Black/ African American, relative to the enrollments of White, Pacific Islander, and American Indian, were all statistically significant to the percentage of students who plan to attend college and the percentage of students who score proficient or above on the Keystone Exam, relative to the drop group of White, Pacific Islander, and American Indian enrollments. The percentage of students who are Asian and Hispanic is negatively and significantly related to the percentage of students who plan to attend college, at the one percent level, relative to the enrollments of White, Pacific Islander, and American Indian students. Therefore, the higher the number of Asian and Hispanic enrollments at a school, the lower the percentage of students who plan to attend college. However, the percentage of Black student enrollments is positively and significantly related to the percentage of students who plan to attend college. Therefore, the higher the Black or African American enrollments, compared to that of White, Pacific Islander, and American Indian, the higher the percentage of students who plan to attend college. This relationship was not suspected. However, this finding could be appointed to the fact that investing in your education and pursuing higher education after high school is very expensive. The cost of attending any type of higher education degree program is not just costly because of the high monetary cost of tuition, however there are many opportunity costs. For example, forgone earnings are a huge opportunity

cost. Therefore, not only are students choosing to pay a very costly tuition bill, but they are also giving up their opportunity to earn money during those years. These results could represent that some ethnic groups support paying the cost of higher education, and choose to do so, while others do not.

For the relationship between the ethnic group variables and the percentage of students who score proficient or above on the Keystone Exams, all three of the ethnic groups demonstrate statistically significant correlations. Asian enrollment is the only ethnic group, relative to the drop group, that shows a positive correlation with the percentage of students who score proficient or above on the Keystone Exam. Which means that a one percentage point increase in Asian enrollment at a school, relative to the drop group, is associated with a .005 percentage-point increase in the percent of students who score proficient or above. However, the Hispanic and Black ethnic groups, relative to the drop group, show a negative relationship with Keystone Exam outcomes. So, the higher the enrollments of Hispanic and Black students are associated with a lower percentage of students who score proficient or above on the Keystone Exam. These results align with that of the literature, specifically Lin (2010). These results can be attributed to the fact that some ethnic groups place higher values on education than others. For example, Asian parents could spend more time studying or doing homework with their student, than what Hispanic and Black families. This explains the results that the Asian ethnic group has a positive correlation on student achievement, while the other two ethnic groups of interest negatively affect student achievement. However, the results of the relationship between the ethnic groups and the percentage of students who plan to attend college do not align with this literature because the percentage of Black enrollments is the only ethnic group that represents a positive correlation (Lin 2010).

Parental education attainment is broken into three categories in this dataset, the percentage of parents with a high school education only, percentage of parents with some college education, and percentage of parents with a bachelor's degree and up. These are all compared relative to the drop group, which is the percentage of parents with no high school diploma at all. The percentage of parents with some college education is not statistically significant to the percentage of students who plan to attend college. However, the percentage of parents with high school education only and the percentage of parents with a bachelor's degree or up are both statistically significant to the percentage of students who plan to attend college and the percentage of students who scored proficient or above on the Keystone Exam, relative to parents that did not graduate and receive a high school diploma.

For instance, in regression 1, the percentage of parents with a high school education only is statistically significant at the one percent level to the percentage of students attending college. So, a one percentage point increase of parents that have a high school education only, relative to those who have no high school degree at all, is associated with a .0005 percentage point increase in the percentage of students planning to attend college. This result makes sense because it is likely that the parents who did not go to college influence their children to get a college education because it is something that could have made them more valuable in the labor market.

Similarly, in regression 1, a one percentage point increase of the percentage of parents with a bachelor's degree or up, relative to parents with no high school education at all, is associated with a .005 percentage point increase in the percentage of students who plan to attend college. This result makes sense because parents who attain college degrees would recognize the benefits of attending college, so they would likely influence their child to do the same. Next, a one percentage point increase in the percentage of parents with high school education only,

relative to parents with no high school education at all, is associated with a .419 percentage point increase in the percent of students who scored proficient or advanced on the Keystone Exam.

Also, a one percentage point increase in the percentage of parents with a bachelor's degree or up, relative to parents with no high school education at all, is associated with a .352 percentage point increase in the percent of students who scored proficient or advanced on the Keystone Exam.

Both relationships are significant at the one percent level. It could be possible that parents that have completed any level of education would likely place a high value on their children's education and inflict those values onto their children. Households that place a high value on education are more likely to spend extra time studying or doing homework, which would result in higher Keystone Exam outcomes.

Urban and rural codes of the location of the school districts is broken into three categories within the dataset, city, suburb, town, or rural. School districts located in a city, suburb, or town, are compared to the omitted group, rural school districts. School districts that are in a city and a town, relative to those in a rural area, is not statistically significant to the percentage of students who plan to attend college. However, the school districts that are in a suburb, relative to those located in a rural area, are statistically significant and negatively correlated with the percentage of students who plan to attend college. For instance, school districts in a suburban area will have a 0.008 percentage point reduction in the percentage of students planning to attend college. This is an interesting result because I expected that suburban school districts would have a positive correlation to the percentage of students who choose to attend college. However, the opposite could be true because of the huge financial burden of attending college. Also, living in a more populated, suburban, area, in comparison to living in a

rural area, could lead to more business opportunities or other career options rather than attending college and forgoing your earnings.

Next, the school districts that are in a city, relative to those in a rural area, is not statistically significant to the percentage of students who score proficient or above on the Keystone Exam. However, the school districts that are in a suburb and a town are statistically significant and negatively correlated, at the 10 percent level, to the percentage of students who scored proficient or above on the Keystone Exam. For instance, in regression 3, the results show that the suburban schools have 3.8 percentage points less students scoring proficient and above on the Keystone Exam, than the rural schools. Similarly, in regression 3, a school district located in a town, relative to schools located in a rural area, is associated with a 4.3 percentage point decrease in the percentage of students who scored proficient or above on the Keystone Exam. These results are very interesting to me because I was expecting the opposite to be true. An implication to this finding could be that some schools provide classes that teach a curriculum completely based off the Keystone Exam. For example, my alma mater, Blairsville-Saltsburg School District (BSSD), offers specific Keystone Exam Preparation classes. BSSD is a school district located in a rural area. If many of the other schools that are in a rural area also offer these same kind of Keystone Exam classes, then it is likely the rural areas would have higher Keystone Exam scores than the school districts located in cities and suburbs.

Conclusion

This study examines the quality of education of Pennsylvania public school districts during the school year, 2017-2018. In this study the quality of education is measured by student achievement. Student achievement is defined by the percentage of high school students planning to enroll in a 2- or 4-year degree program and the percentage of students that score proficient or

above on the Keystone Exam. However, it can be affected by many communities, demographic, and economic factors, which are controlled for in the study. In this study, I hypothesize that the school districts with higher average teachers' salaries and longer length of tenure will correlate with the school districts with higher student achievement, controlling for multiple community, demographic, and economic factors that could affect the quality of education.

The results of this study showed that average teachers' salaries do not positively affect student achievement, it has a negative effect on the percentage of students who plan to enroll in college. In addition, it is shown that the average length of teacher tenure positively affects the percentage of students who perform proficient and above on the Keystone Exam, until the average length of tenure reaches above 14.69 years of experience. At this point of tenure in a teacher's career, the Keystone Exam outcomes begin to fall. In further research, I would like to look at the impacts of adding the percentage of students in a school district that qualify for free and reduced lunches, as a variable in this study. This variable would greatly reflect the financial status of a student's family, as well as demonstrate the condition of their family and home.

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Table 2. Description and Source of Variables

Variable (sources)	Description	Mean	Standard Deviation	Minimum	Maximum
Avg. Teachers Salary (1)	Average salary of teachers in each PA school district	11.07	.1535	10.53	11.51
Avg. Teachers Tenure (1)	Average years of tenure of teachers in each PA school district	14.66	1.69	8.8	18.7
Avg. Teachers Tenure² (1)	Average years of tenure of teachers in each PA school district squared	217.8	48.58	77.44	349.69
Median Household Income (3)	Median household income of communities of each PA school district	10.67	.2593	9.7	11.63
Race: Asian (4)	Average Asian students enrolled in school district	127.3	548.7	0	10901
Race: Hispanic (4)	Average hispanic students enrolled in school district	348.2	1565	0	26282
Race: Black (4)	Average Black students enrolled in school district	385.9	3019	0	65211
Parents w/ High School Education Only (3)	Percentage of student's parents with a high school education only, no college	31.88	11.21	3	58
Parents w/ Some College Education (3)	Percentage of student's parents with some college education	30.33	7.003	4	58
Parents w/ Bachelor's degree or up (3)	Percentage of student's parents with a Bachelors, Masters, or Doctoral degree	31.86	16.31	5	88
Location: City (2)	School districts located in city	.0383	.1921	0	1
Location: Suburb (2)	School districts located in suburb	.4737	.4998	0	1
Location: Town (2)	School districts located in town	.1512	.3586	0	1
Expenditure spending % per pupil (2)	The percentage of expenditure spending per pupil in each PA school district	1747	83.28	1528	2190
Chronic absenteeism % (5)	Percentage of students who have been absent from school for 15 or more days	.1342	.0768	.0184	.5322
Student-Teacher Ratio (4)	Number of students per teacher in each PA school district	14.04	1.603	8.27	19.35
Student-Teacher Ratio Squared (4)	Number of students per teacher in each PA school district, squared	199.8	45.21	68.39	374.4
% Students Proficient/above	Percentage of students who scored proficient or	70.69	13.91	16.03	93.6

(Keystone Exams) (2)	advanced on Keystone Exam				
% Students attending college (2)	Percentage of high school seniors who report they plan to enroll in 2-or4-year degree program	.0419	.0358	0	.2554

Sources: (1) Open PA Government, (2) PA Department of Education, (3) ACS-ED, (4) ELSi, (5) OCR Data

