How Does Teacher Retention Affect Student Achievement?

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Abstract

This paper attempts to analyze the impact that teacher retention has on student achieving. This study estimates the effects of teacher retention on 324 10th grade high school ELA and Math MCAS scores in Massachusetts as a whole while also including economically disadvantaged and English as a Second Language selected-student populations. The results indicate that teacher retention specifically does not have much of an effect on their scores. The effects appeared to be slightly greater with the ELA MCAS scores in schools that are low-performing where the retention rates are lower due to the economically disadvantaged populations.

Table of Contents

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Introduction:

As Ever Garrison once said, “A teacher is a compass that activates the magnets of curiosity, knowledge, and wisdom in the pupils.” Teachers have a tremendous impact on students and foster their learning for the entire time they are with them. The impact and the learning does not cease even after the students have moved on.

While it is apparent that teacher turnover rates vary by schools and districts, this paper will evaluate whether high turnover negatively affects student achievement. I will try to determine if there is an impact on students’ test scores in Massachusetts due to teacher turnover. I will combine the teacher retention rates data with the 2016-2017 test scores data for tenth grade that I obtained from the Massachusetts Department of Elementary and Secondary Education and do a regression analysis.

The paper will begin by discussing the reasons for teacher turnover. I will then summarize previous findings on how turnover affects student achievement, specifically research that was administered in New York as well as in England. I will then explain the test scores and the test itself as well as some of the other factors that would affect the state of Massachusetts high schools’ test scores. Then, I will provide my data and analysis and report my findings on how teacher turnover rates affects or doesn’t affect student achievement. Lastly, I will then state my conclusion and report on how the data is supported by previous data.

Literature Review:

Previous studies have researched the effects on student achievement due to teacher turnover. Ronfeldt, Loeb, and Wyckoff (2011) wrote about the assumption of teacher turnover harming student achievement. The paper tries to answer three questions.

First, what is the effect of turnover on student achievement? Second, is the effect different for different schools? Third, what explains the correlation between turnover and achievement?

The article tries to answer these questions by analyzing data received from the New York City Department of Education and the New York State Education Department. The focus of the 625,000 observations are of 4th and 5th grade students in all of New York City. The years of this study are 2000-2002 and 2004-2007. The study uses a unique identification strategy that measures the turnover in each year by individual grades in individual schools. The data includes tables that provide student characteristics, teacher-year characteristics, grade-by-school characteristics, and the mean of all of these individual characteristics. The first method uses a regression model of "school-by-grade fixed effects" while the second method uses a regression model of "school-by-year". There are a lot of controlled characteristics that vary depending on the specific model they use. Their research shows that "teacher turnover has a significant and negative effect on student achievement in both math and ELA. Moreover, teacher turnover is particularly harmful to students in schools with large populations of low-performing… students" (Ronfeldt, Loeb, & Wyckoff, 2011). After having read this prior literature, I decided to also look at the impact in richer districts versus poorer districts.

One of the questions in their research was if the effect of teacher turnover is the same or different for different schools? What their suggestions were included schools with low performing and minority students tend to have higher turnover rates. Some of the selected-populations I plan on taking a look at include English Language Learners

and economically disadvantaged student populations. These will be two of the factors included in my regression to see if they have an impact on student achievement.

Similarly, Gibbons, Scrutinio, and Telhaj (2018) analyzes the impact of teacher entry and/or exit on student achievement in England while holding characteristics of the school, students, and teachers constant. The article analyzes data from teacher records connected by schools and subjects to students' achievement. The student-level data was received from the Department for Education's National Pupil Database as well as teacher records from the Schools Workforce Census, and the Database of Teacher Records added to that. The study also analyzed the data with an empirical analysis with controlled characteristics.

The main finding is that students in year 11, which is their final year of compulsory schooling, typically do not score as well on their end of year assessments if teacher turnover was high. The study found that boys are more affected than girls.

In addition to the two articles previously examined, Guin (2004) examines urban schools that experience chronic teacher turnover. The evidence that the author uses are staff climate surveys as well as case studies for five individual schools. This paper explores the topic of disorganized schools in an urban setting that provide education for poor and minority students and how these students are affected due to high rates of turnover.

While the research does not list the exact location of the district and individual schools, it shares the information that the variables that were used in the study include "percentage of minority students in a school and the percentage of students meeting standard on the statewide (4^{th} grade) math and reading assessments" (Guin, 2004). The

research collected demographic and performance data from a statewide database as well as five years of data for the percentages of minority students in a school and six years of data for the statewide assessment of performance. In order to calculate the teacher turnover rates, state-mandated staffing form collected information on the staff within schools.

There were two main findings in this article. First, the connection between teacher turnover rates and the percentage of minority students within a school was positive and notable. In addition, the correlation between student performance and turnover rates was significant, but negative in that the higher the teacher turnover rates were, the lower the scores were for student performances. What this means is that the schools with higher turnover rates had fewer students who were meeting standard on statewide assessments. In my analysis, I plan to consider the following student population: economically disadvantaged. Guin refers to this population as the "poorest" student population when discussing one of the elementary schools she is researching and conducting interviews in.

Data and Empirical Model

Data:

The Massachusetts Department of Elementary and Secondary Education offers a lot of useful information about all schools within Massachusetts. Pertaining to this paper, it provides information on the MCAS test results of each district and each high school school specifically within those districts. The Massachusetts and Secondary Education Department, where I obtained my data from, serves many purposes. The Department of Elementary and Secondary Education's (DESE) purposes involve the distribution of state and federal education money, providing aid to the districts to implement learning

standards, monitoring schools and districts, supervising statewide standardized tests, and lastly, collecting data on districts and schools.

The data I collected is from the 2017 MCAS achievement results for grade 10 and the teacher retention rates for the state of Massachusetts, more specifically the individual high schools within the district. Almost all of the high schools that administer the MCAS (except for Boston) were included in this analysis. Boston's data regarding teacher retention rates was not readily available to me and was therefore excluded. There was great consideration put into the exclusion of Boston in its entirety. I believe their lack of data was due to them being behind in providing their data to the DESE website. In total, I have 324 observations for both ELA MCAS scores as well as MATH MCAS scores. The MCAS stands for Massachusetts Comprehensive Assessment System. It is a Massachusetts statewide standards-based summative assessment that begins testing in the 3rd grade and goes all the way to the 10th grade testing in English and ELA and science in the 8th-10th grades.

- Table 1: Descriptive Statistics

	ELA	MATH	Teacher % Retained	ELL %	Economically Disadvantaged %
Mean	91.98	79.05	84.22	4.7	27.05
Standard Deviation	9.99	17.66	10.25	7.67	19.04
Minimum	27	7	41.7	0	3.1
Maximum	100	100	100	54.7	84.1

Empirical Model:

To explore the effect of teacher retention rates on high school student achievement in Massachusetts, I estimated the following equation

$$Y_i = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \varepsilon_i$$

Where Y_i is the MCAS, X_1 is teacher retention rate…

β_0 is the intercept, β_1 is the coefficient of teacher retention rate…

ε_i is the error term.

My ELA and Math MCAS scores were based off of the percent of students who received Proficient and Advanced. According to the DESE, this number captured the percent of students who were able to pass and demonstrated a "solid understanding of challenging subject mature and solve a wide variety of problems" as well as students who demonstrated a "comprehensive and in-depth understanding of rigorous subject matter, and provide sophisticated solutions to complex problems." The two other scores I could have received my data from were: needs improvement and warning/failing (failing is a category in high school).

According to my Descriptive Statistics table above, the Math average from all 324 schools was 79.05 whereas the ELA average from all 324 schools was 91.98. This means that more students were able to receive a proficient or an advanced score in ELA than in Math.

My independent variables consisted of teacher retention rates, ELL %, and economically disadvantaged %. ELL percentage stands for the English Language Learners percentage in a particular school/district. Economically disadvantaged means the percent of students

who are essentially low income. However, this name was changed on the DESE to economically disadvantaged, so that means the recent data cannot be compared to past data where "low income" was the terminology used. Lastly, my teacher retained % is the percentage of teachers who came back the following year to teach at the same school.

The Results:

The first example shows the regression of students' ELA scores on teacher retention rates.

Regression Statistics	
Adjusted R Square	0.17
Observations	324

	Coefficients	*Lower 95%*	*Upper 95%*
Intercept	57.98	49.766	66.193
% Retained	0.403	0.307	0.500

Table 1:

The adjusted R square tells us how much of the difference in student ELA scores we are able to explain using teacher retention rates. It is roughly 0.17, which means we can explain about 17% of the variation. The coefficient is 0.4 which means that one 1% increase in teacher retention rates leads to a .4 increase in ELA MCAS scores. If the retention rate was to go up 10%, then this would lead to an increase of 4% for the ELA MCAS scores. The confidence interval is from .31 to .50. This means that based on my estimate of .4, I am pretty sure that the true value is between .31 and .50. A 4% increase is too small to worry about or to make a big impact on the scores. With the lowest percentage of passing students being 7%, it would not dramatically increase this.

The second example shows the regression of students' ELA scores on teacher retention rates, but also adds in the ELL percentage and the economically disadvantaged percentage.

Regression Statistics	
Adjusted R Square	0.551
Observations	324

	Coefficients	*Lower 95%*	*Upper 95%*
Intercept	101.061	93.132	108.992
% Retained	0.015	-0.070	0.100
ELL %	-0.056	-0.175	0.064
Economically Disadvantaged %	-0.373	-0.424	-0.320

Table 2:

The adjusted R square indicates about 55% of the variation in student achievement is explained by the regression model. This is due to the added independent variables, ELL% and Economically Disadvantaged %, that are able to make more of an impact on the ELA MCAS scores instead of just the teacher retention rates. According to the coefficient of teacher retention rates, a 1% increase in teacher retention rates could lead to a 0.015 increase. This is not significant considering the confidence interval ranges from -0.070 to 0.100. The impact of ELL% increasing by 1% and everything remaining the same would mean a negative impact, at -0.056. The confidence interval for the ELL % goes from -0.175 to 0.064, so while the estimate is negative, the true value could be zero or positive, meaning that it is insignificant. Potentially, if the estimate is accurate, then this means that increasing ELL % lowers the ELA MCAS scores. Likewise, with economically disadvantaged, there is a negative relationship between this and student

achievement. Specifically, a 1% increase in economically disadvantaged student population results in a -0.37 decrease in high school student achievement. The confidence intervals are from -0.424 to -0.320 which means that the true value is likely to be negative allowing the estimate to be significant.

In *Table 3*, I ran the same regression as above, but for Math MCAS scores as our dependent variable instead. This table shows the regression of students' Math scores on teacher retention rates.

Regression Statistics	
Adjusted R Square	0.159
Observations	324

	Coefficients	*Lower 95%*	*Upper 95%*
Intercept	20.013	5.205	34.822
% Retained	0.701	0.5261	0.875

Table 3:

The adjusted R square tells us how much of the difference in student Math scores we are able to explain using teacher retention rates. It is roughly 0.16, which means we can explain about 16% of the variation. The coefficient is 0.7 which means that one 1% increase in teacher retention rates leads to a 0.7 increase in Math MCAS scores. The confidence interval is from .53 to .88. This means that based on my estimate of .7, the confidence interval is significant. Compared to ELA, both regressions were able to explain roughly the same amount of the variation, 16% to 17%. The coefficient for this regression is slightly higher than that for the ELA scores. So if the retention rate was to go up 10%, then this would lead to a 7% increase for the Math MCAS scores as opposed to a 4% increase for ELA MCAS scores. Both still have minimal impact.

Table 4 below shows the regression of students' Math scores on teacher retention rates, but also adds in the ELL percentage and the economically disadvantaged percentage as independent factors to show the impact they have on student scores as well.

Regression Statistics	
Adjusted R Square	0.711
Observations	324

	Coefficients	*Lower 95%*	*Upper 95%*
Intercept	110.405	98.959	121.850
% Retained	-0.106	-0.229	0.017
ELL %	0.195	0.022	0.368
Economically Disadvantaged %	-0.875	-0.951	-0.798

Table 4:

The adjusted R square indicates about 71% of the variation in student achievement is explained by the regression model. According to the coefficient of teacher retention rates, a 1% increase in teacher retention rates leads to a 0.10 decrease. This means that higher retention leads to lower test scores, which is the opposite of what I expect. However, the confidence interval ranges from -0.229 to 0.017, which means that the negative estimate may not be correct and the true value could be zero or positive. The impact of ELL% increasing by 1% and everything remaining the same would mean a positive impact, at 0.20. This means that increasing ELL % raises the Math MCAS scores. The confidence interval for the ELL % goes from 0.022 to 0.368, meaning that the true value is most likely positive. With economically disadvantaged, there is a negative relationship between this and student achievement. Specifically, a 1% increase in economically disadvantaged student population results in a -0.88 decrease in high

school student achievement. For the economically disadvantaged percentage, the estimate is negative and the confidence intervals are from -0.951 to -0.798 which means that the true value is likely negative.

For my last set of examples, I decided to look at whether retention has the same impact in rich and poor districts. To do this, I ran a regression of ELA MCAS scores. The first regression that I did included the first 154 schools with the largest percentages of economically disadvantaged percentages. percentages. The observations were not cut directly down the middle because if this was done, then some of the same percentages would be included in both regressions. For example, cutting the observations right down the middle would mean that both sets would have 22% in them, so I decided to cut it where some of the numbers were not the same in the regressions. I decided to leave out the ELL percentage because it did not make as much of an impact in previous regressions ran and this was not my focus of these regressions.

Regression Statistics	
Adjusted R Square	0.504
Observations	154

	Coefficients	*Lower 95%*	*Upper 95%*
Intercept	117.96	104.32	131.60
% Retained	-0.073	-0.205	0.0589
Economically disadvantaged %	-0.602	-0.709	-0.495

Table 5:

This set has a selected-student population of economically disadvantaged students ranging from 23% of the students to 84.1%. The adjusted R square is .504, which means we can explain about 50% of the variation. The coefficient for percentage of teachers retained is -0.073. The estimate is insignificant as the confidence interval ranges from -

0.205 to 0.0589. The coefficient for percentage of economically disadvantaged students is -0.602. This means, that if everything else was to stay the same, if the percentage was to increase by 1%, then the ELA MCAS scores would decrease by .602. The confidence interval is between -0.709 and -0.495. This means that the estimate is supported by the confidence intervals and it is negative as one would anticipate.

Regression Statistics	
Adjusted R Square	0.356
Observations	170

	Coefficients	*Lower 95%*	*Upper 95%*
Intercept	101.479	96.707	106.250
% Retained	-0.0141	-0.068	0.039
Economically disadvantaged %	-0.276	-0.332	-0.220

Table 6:

This second analysis is of 170 out of 324 schools. This set has a selected-population of economically disadvantaged students ranging from 3.1% to 22%. The adjusted R square is 0.356. This means that we can only explain about 36% of the variation. The coefficient for percentage of teachers retained is -0.0141. This is not significant as the confidence interval ranges from -0.068 to 0.039, meaning that the true value could also be zero or positive. The coefficient for economically disadvantaged percentage is -0.276. This is significant considering the confidence interval range is negative. The coefficients, while still negative, are not as impactful as *Table 5*. This can be explained due to the populations of schools who have a higher percentage of economically

disadvantaged students. There is less of a percentage of low-income students in this regression reflected in *Table 6* than in *Table 5*.

Conclusion

The question that this paper was trying to answer was if there is an impact on Massachusetts' high school test scores due to teacher turnover. Based off of the data I gathered, teacher retention rates had a minimal impact on both sets of MCAS scores, Math and ELA. With this being said, teacher retention rates did have more of an impact on the Math scores overall. This includes when the regression was with and without the additional variables. Relating to prior literature, both Ronfeldt et al. (2011) and Guin (2004) mention selected-student populations. They discuss minorities within the schools and districts and I decided to do that as well for my ELL percentages as well as my economically disadvantaged percentages. When these variables were added into the regression, the impact of teacher retention decreased. One of the variables, economically disadvantaged, was able to account for a lot more than the others which is to be expected. This factor showed to have the most negative impact on student achievement as opposed to the ELL% in the schools and teacher retention rates. Overall, the results were similar to what prior research had suggested. Prior research showed that the impact on teacher turnover rates were apparent and negative with student achievement. With my research, the results were unclear. It appears to have an impact, but when other variables are included, the impact diminishes.

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