Examining the Relationship Between Masters Degree Attainment and Student Math and Reading Achievement
Summary Report

TIMOTHY A. DRAKE
NC State University
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Introduction

Education research suggests that teachers are the most important school-level factor in predicting variation in student performance [1, 2, 3] and later life outcomes [4]. Accordingly, researchers have long examined the relationship between student performance and teacher qualifications, including certification(s), degree level, preparation, and experience. Though this work commonly finds that there is no relationship between earning a Masters degree and student achievement, recent work in North Carolina suggests that a more nuanced approach to the analysis—specifically, one that accounts for the type and area in which the degree is earned—reveals important variation in teacher and student outcomes, including teacher evaluation, student attendance, and student achievement [5, 6]. In this report, I build off of these studies by examining the relationship between Masters degree attainment and student math and reading performance in North Carolina. In contrast to these studies, however, I estimate the relationship for all tested grade- and school-levels from 2005-06 to 2015-16. I also examine the extent to which degree type (e.g., Masters of Education, Master of Arts in Teaching) predicts variation in student performance.

Data

Data for this study come from the North Carolina Education Research Data Center (NCERDC), the Integrated Postsecondary Education Data System (IPEDS), and the University of North Carolina General Administration (UNC-GA).

Combined, these data sources provide information on students and teachers in North Carolina public education system from the 2005-06 to 2015-16 school years. Specifically, I combine information on student End-of-grade (EOG) and End-of-Course (EOC) test scores with a variety of student and teacher characteristics to examine the relationship between earning a Masters degree and student performance.

Data Limitations

In the NCERDC data, students are assigned to multiple teachers each school year, especially at the middle and high school levels. Accordingly, I use the course title to identify and match students to the teacher who is most responsible for their learning in a particular subject area (i.e., Math or English-Language Arts). For example, after examining a sample of course titles, I used the terms "math," "alg," "geom," and "calc" to capture teachers assigned to a math class, and "eng," "writ," and "lang" to capture teachers assigned to a reading or English-Language Arts class. I also include elementary school teachers who are responsible for teaching a student in more than one subject (i.e., "self-contained").

Unfortunately, while this process allows me to narrow the number of teachers associated with a particular subject area that are assigned to each student, about 21.3% and 24.8% of the observations of math and reading scores, respectively, include students assigned to multiple teachers *within* a given subject area. Because I cannot be sure which one of these teachers is primarily responsible for the learning in that area during that year, my analyses only include those observations where a single teacher is matched to a single student. Of course, in making the decision to drop those observations with more than one teacher, the resulting sample would no longer representative of the full population of students if the types of students who are assigned to multiple teachers within a given subject area were systematically different than those students assigned to a single teacher.

Although I cannot fully investigate how this sample may differ, I can use observable characteristics of students to compare these two groups of students. Appendix A, Tables 1 through 4 describe the differences between these samples on observable student (Tables 1 & 3) and teacher (Tables 2 & 4) characteristics.

Tables 1 and 3 indicate that, as expected, a lot of the duplicate observations occur at the middle and high school levels, where students may be assigned to multiple math or ELA classes. They further show that there are a higher proportion of males, students of color, free-reduced lunch recipients, limited-English proficient, and exceptional children in the sample with duplicate teachers. As a group, they are also lower performing and are less likely to be enrolled in

AIG. Tables 2 and 4, however, indicate that their teachers are similar, on average, across many observable characteristics. Notable differences occur with respect to National Board Certification and the teachers' standardized Praxis score.

That the proportion of masters degrees is relatively similar in both samples is encouraging in that this is the primary teacher variable of interest in this study. Yet, these results cannot be interpreted as generalizable for the entire population of North Carolina students and teachers, as the analytic sample only includes those students who can be positively matched to a single subject-area or grade level teacher.

Methods

In estimating the relationship between masters degree obtainment and student achievement, it is important to account for observable and unobservable student and teacher characteristics that may affect the assignment of students to teachers. As this process is often not random, it is important to account for the ways in which teacher characteristics may influence the types of students they teach. More specifically, there are at least two important sources of bias, which I will describe with two scenarios.

Scenario 1: *Teachers who earn a Masters degree are able to leverage that degree with their building principals to receive classes full of higher performing students. In this case, the "Masters degree effect" would be biased upwards. That is, the effect of becoming a better teacher through a postsecondary degree is confounded with the ability to leverage that degree to receive higher performing students. Conversely, if building principals decide to teachers with a Masters degree are better prepared to teach lower achieving students and disproportionately assigns them to these students, then the "Masters degree effect" would be biased downwards*.

Scenario 2: *Teachers who earn a Masters degree are not comparable to teachers without the degree because of unobservable teacher characteristics (e.g., motivation, financial stability, good health) which are associated with both the decision to obtain a Masters degree and better teaching. In this case, the "Masters degree effect" would be the combination of teacher motivation and the training associated with the degree, and therefore would be biased upwards.*

My analysis strategy is twofold: first, I address the bias associated with Scenario 1 by estimating a student-fixed effect model, which accounts for differences that arise between students on observable and unobservable characteristics. I also include a set of teacher-level characteristics to account for observable teacher differences, such as class size, Praxis test score, National Board Certification, and years' experience, as well as postsecondary institution-level characteristics, such as institution size, mission, and location. To account for differences that arise across grade-levels and time, I include a grade-by-year fixed effect. Importantly, these models cannot account for *unobserved* differences between teachers who earn a Masters degree and those who do not, as described in *Scenario 2*. The estimates from these models are included in Appendix B, Tables 5 through 12.

To address the bias associated with *Scenario 2*, I estimate a teacher-fixed effect model, which accounts for unobserved differences that arise between teachers. To account for differences in student characteristics, I include a rich set of student characteristics, including prior achievement, race/ethnicity, biological sex, free-reduced lunch status, Exceptional Children, Limited English Proficient, AIG, and daily attendance. I also include grade-year and school fixed effects to account for differences that arise across grade-level, school, and time. Importantly, these models cannot account for unobserved differences between students, as described in *Scenario 1*. They also include a limited sample of teachers, as only those teachers who obtain a Masters degree during the time period (2005-06 to 2015-16) are included in the estimation. The estimates from these models are included in Appendix C, Tables 13 and 14.

Dependent Variable

In this study I use End-of-Grade (EOG) and End-of-Course (EOC) math (i.e., math, algebra I, algebra II, geometry) and reading (i.e., reading, English I, writing) scores. I standardize each score within each grade, subject, and year, and average across scores for students with multiple test scores within a year.

Masters Degree Variables

I identify Masters degree in three ways. First, I examine the "main effect" by estimating the covariate adjusted difference in student math and reading performance between teachers who have any Masters degree and those without one (Appendix tables 5, 9, 13, 14).

I also examine the extent to which a Masters degree that is "In-Area" (i.e., the subject area or elementary license code) and "Out-of-Area" compares with teachers with no Masters degree (Appendix tables 6, 10, 13, 14), as well as examine the subject area of the Masters degree (Appendix tables 7, 11, 13, 14). To do this, I follow the process outlined in Ladd and Sorensen[5] and Bastian[6], by using a combination of the licensure area codes and degree level.

Finally, I received a limited sample of teachers' degree information from UNC-GA, from 2009 to 2015. This information provided me with the type of degree (e.g., Masters of Education, Masters of Arts in Teaching, Masters in Science) a teacher earned. Appendix Tables 8 and 12 report the results from these models.

Summary of Findings

I find a small, positive relationship across both student- and teacher-fixed effect model specifications for earning a Masters Degree and student math achievement (Tables 5, 13). Furthermore, having a Masters degree that is "In-Area" is positively associated with math test scores regardless of model specification (Tables 6, 13). Finally, earning a Masters in math is positively associated with student math performance in the student fixed-effect model (Table 7), though not the teacher fixed-effect model (Table 13).

With respect to English-Language Arts, I find positive results for earning a Masters degree in area across both the student- and teacher fixed-effect model specifications (Tables 10, 14). The subject-area model specifications also suggest that earning a Masters degree in English-Language Arts is also positively associated with student ELA performance.

The limited sample analysis of degree type only includes one significant difference, though the direction and size of the coefficient estimates suggest that with a larger sample degree type could explain differences in math and reading achievement.

A more detailed account of these results by subject area are found below:

Math

The results from the student-fixed effects models for math indicate the following:

- A small, positive relationship between having a teacher with a Masters degree and standardized math score (0.0047, $p < 0.001$, no controls; 0.0032, $p < 0.01$, with controls) (see Appendix B, Table 5).

- Students who have teachers with a “In-Area” Masters Degree seem to contribute to the positive relationship between math score and Masters degree (0.0080, $p < 0.001$, with controls) as “Out-of-Area” is positively associated but not statistically significant after adding controls (0.0019, $p > 0.05$, with controls) (see Appendix B, Table 6).
- Obtaining a Masters degree in math has a positive relationship with student math test score (0.0214, $p < 0.001$, with controls), while obtaining a Masters degree in administration or other non-subject area degree fields are negatively associated with math test performance (see Appendix B, Table 7).
- The limited sample OLS regression analysis for degree type does not show any significant differences (see Appendix B, Table 8).

The results from the teacher-fixed effects models for math indicate the following:

- A positive relationship of 0.0360 standard deviations ($P < 0.001$) between Masters degree attainment and student achievement (see Appendix C, Table 13).
- The relationship is positive for both “In-Area” (0.0226, $p < 0.001$, with controls) and “Out-of-Area” (0.0385, $p < 0.001$, with controls) Masters degrees (see Appendix C, Table 13).
- In examining the subject-area degrees, a degree in ELA is negatively associated with math score (-0.1015, $p < 0.001$, with controls), while degrees in Science, Social Studies, and Unclassified are all positively associated with test scores. Earning a math degree has no relationship with math achievement in these models (see Appendix C, Table 13).

English-Language Arts

The results from the student-fixed effects models for English-Language Arts indicate the following:

- A small, positive relationship between having a teacher with a Masters degree and English-Language Arts score (0.0025, $p < 0.01$, no controls), though the relationship disappears when observable teacher and institution characteristics are included in the model (0.0005, $p > 0.05$, with controls)(see Appendix B, Table 9).
- A small, positive, and statistically significant relationship between “In-Area Masters” Degree and English-Language Arts score (0.0086, $p < 0.001$, with controls), and no relationship between “Out-of-Area”

Masters degree and English-Language Arts score (0.0012, $p > 0.05$, with controls) (see Table 10).

- A positive relationship between a Masters in English-Language Arts and English-Language Arts score (0.0201, $p < 0.001$, with controls). The negative result between Elementary Masters degree and reading score (-0.008, $p < 0.01$) appears to be driving the overall "In-Area" negative result above. Other positive results include Masters in Ex-ceptional Children (0.0223, $p < 0.001$, with controls), math (0.0188, $p < 0.05$, with controls), and social studies (0.0300, $p < 0.001$), though one wonders if these effects are driven by the smaller number of teachers in these categories. (See see Appendix B, Table 11).
- The limited sample OLS regression analysis for English-Language Arts shows lower average achievement for students earning a Masters of Arts Degree in Education, compared with a Masters in Education Degree (-0.1100, $p < 0.05$, with controls) (see Appendix B, Table 8.

The results from the teacher-fixed effects models for English-Language Arts indicate the following:

- Positive, though not significant results for the main effect (0.0037, $p > 0.05$, with controls) (see Appendix C, Table 14).
- Positive, significant results for teachers earning an "In-Area" Masters degree (0.0152, $p < 0.05$, with controls), and not statistically significant differences for teachers with an "Out-of-Area" Masters (see Appendix C, Table 14).
- Positive and significant results for teachers earning a Masters degree in elementary education (0.0217, $p < 0.05$, with controls), English-Language Arts (0.0232, $p < 0.05$, with controls), and Social Studies (0.0273, $p < 0.05$, with controls).

Conclusion

In conclusion, I find that with this sample of North Carolina students as-signed to a single teacher during the time period (2005-06 to 2015-16), a simple examination of whether their teacher earned *any* Masters degree fails to capture the range of effects that occur when the type of degree is taken into consideration. For instance, the results in math and English-Language Arts suggest that teachers earning a Masters degree in math or those earning one designated as "In-Area" have higher average student performance in math across both model specifications.

In short, these results suggest that not all Masters degrees are created equal. In considering the policy implications that may be drawn from this and other studies in North Carolina[5][6], it appears that a more nuanced approach to incentivizing postsecondary degree attainment that accounts for the alignment between the type of Masters degree and the subject area in which the teacher works could translate into lower student absenteeism[5], higher teacher evaluations[6], and positive gains for students. Future work should consider data systems that allow for the positive identification and match of students to teachers, by grade-level and subject area, as this study was unable to account for roughly a quarter of all student observations.

Appendix A: Sample

Math

Table 1: Comparison of students with one math teacher and those with more than one math teacher, by select student characteristics

	One Teacher	More Than One Teacher
Female	0.496	0.480
Native American	0.014	0.015
Asian	0.026	0.023
Hispanic	0.115	0.114
African American	0.266	0.350
White	0.543	0.465
Multiracial	0.035	0.033
Hawaiian or Pacific Islander	0.001	0.001
3rd Grade	0.079	0.008
4th Grade	0.087	0.010
5th Grade	0.100	0.016
6th Grade	0.140	0.062
7th Grade	0.154	0.079
8th Grade	0.162	0.085
9th Grade	0.125	0.366
10th Grade	0.113	0.276
11th Grade	0.032	0.077
12th Grade	0.005	0.020
Free or Reduced Lunch	0.473	0.521
Limited English Proficient	0.052	0.054
Exceptional Children	0.147	0.162
AIG	0.141	0.084
Math Score (Std.)	0.010	-0.083
	(0.998)	(0.949)
Observations	5,583,817	1,512,439
Students	1,950,960	594,690

Note: Standard Deviation in parentheses

Table 2: Comparison of students with one math teacher and those with more than one math teacher, by select teacher characteristics

	One Teacher	More Than One Teacher
Masters	0.329	0.320
In-Area Masters	0.078	0.080
Out-of-Area Masters	0.251	0.239
Masters (Before)	0.235	0.237
Masters (After)	0.094	0.082
Public University	0.654	0.662
North Carolina University	0.657	0.671
Doctoral Granting University	0.343	0.375
Large University	0.599	0.609
National Board Certification	0.150	0.136
Teacher Experience	11.858	11.687
	(9.085)	(9.550)
Praxis Score	-0.070	-0.129
	(0.903)	(0.906)
Class Size	22.845	22.098
	(5.927)	(6.989)
Observations	5,583,817	1,512,439

Note: Standard Deviation in parentheses

Reading

Table 3: Comparison of students with one ELA teacher and those with more than one ELA teacher, by select student characteristics

	One Teacher	More Than One Teacher
Female	0.493	0.470
Native American	0.014	0.016
Asian	0.026	0.027
Hispanic	0.115	0.157
African American	0.264	0.331
White	0.545	0.433
Multiracial	0.036	0.035
Hawaiian or Pacific Islander	0.001	0.001
3rd Grade	0.101	0.036
4th Grade	0.106	0.045
5th Grade	0.113	0.051
6th Grade	0.135	0.192
7th Grade	0.148	0.162
8th Grade	0.151	0.134
9th Grade	0.109	0.163
10th Grade	0.135	0.213
11th Grade	0.000	0.002
12th Grade	0.000	0.001
Free or Reduced Lunch	0.478	0.570
Limited English Proficient	0.052	0.104
Exceptional Children	0.149	0.182
AIG	0.143	0.108
Read Score (Std.)	0.040	-0.110
	(0.993)	(0.935)
Observations	4,952,259	1,635,704
Students	1,869,101	612,422

Note: Standard Deviation in parentheses

Table 4: Comparison of students with one ELA teacher and those with more than one ELA teacher, by select teacher characteristics

	One Teacher	More Than One Teacher
Masters	0.366	0.389
In-Area Masters	0.035	0.017
Out-of-Area Masters	0.330	0.368
Masters (Before)	0.267	0.287
Masters (After)	0.098	0.097
Public University	0.646	0.635
North Carolina University	0.646	0.629
Doctoral Granting University	0.349	0.343
Large University	0.614	0.599
National Board Certification	0.178	0.154
Teacher Experience	11.360	12.073
	(9.009)	(9.430)
Praxis Score	-0.099	-0.055
	(0.883)	(0.887)
Class Size	22.457	20.642
	(6.126)	(7.504)
Observations	4,952,259	1,635,704

Appendix B: Student Fixed Effect Results (All Tables)

Math

Table 5: Within-Student Regression Model, DV: Standardized Math Score

	Model 1	Model 2
Masters Degree	0.0047***	0.0032**
	(0.0009)	(0.0010)
Teacher Experience		0.0003***
		(0.0001)
National Board Certification		0.0177***
		(0.0011)
Praxis Score (Standardized)		-0.0055***
		(0.0006)
Class Size		-0.0005***
		(0.0001)
Public Higher Education Institution		0.0009
		(0.0011)
North Carolina Higher Education Institution		0.0062***
		(0.0010)
Research Institution		0.0039***
		(0.0012)
More than 10,000 students		-0.0013
		(0.0012)
Observations	3,382,649	3,382,649

Robust standard errors in parentheses

Note: Authors calculations based on limited sample of students with only one math teacher

All models include student and grade-by-year fixed effects

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 6: Within-Student Regression Model (In- and Out-of-Area), DV: Standardized Math Score

	Model 1	Model 2
In-Area Masters Degree	0.0099***	0.0080***
	(0.0016)	(0.0017)
Out-of-Area Masters Degree	0.0034***	0.0019
	(0.0010)	(0.0011)
Teacher & Institution Controls		X
Observations	3,382,745	3,382,745

Robust standard errors in parentheses

Note: Authors calculations based on limited sample of students with only one math teacher

All models include student and grade-by-year fixed effects

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 7: Within-Student Regression Model (Subject-Area Masters Degree), DV: Standardized Math Score

	Model 1	Model 2
Elementary	0.0053	0.0066
	(0.0037)	(0.0037)
Exceptional Children	0.0050	0.0059
	(0.0066)	(0.0066)
English-Language Arts	-0.0153	-0.0157
	(0.0117)	(0.0117)
Math	0.0222***	0.0214***
	(0.0040)	(0.0040)
Science	-0.0056	-0.0066
	(0.0055)	(0.0055)
Social Studies	0.0134*	0.0145*
	(0.0060)	(0.0060)
Administration	-0.0219**	-0.0205**
	(0.0069)	(0.0069)
Other	-0.0108**	-0.0112***
	(0.0034)	(0.0034)
Unclassified	0.0049***	0.0035**
	(0.0011)	(0.0012)
Teacher & Institution Controls		X
Observations	3,382,745	3,382,745

Robust standard errors in parentheses

Note: Authors calculations based on limited sample of students with only one math teacher

All models include student and grade-by-year fixed effects

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 8: OLS Regression Model (Masters Degree Type), DV: Standardized Math Score

	Model 1	Model 2
MAT	-0.0906	-0.0467
	(0.0621)	(0.0480)
M.A.	0.1046	0.0481
	(0.0607)	(0.0536)
M.A. in Education	-0.0466	-0.0675
	(0.0625)	(0.0471)
M.S.	-0.1586	-0.0952
	(0.1312)	(0.1162)
M.S.A.	-0.0187	-0.0244
	(0.0555)	(0.0461)
Student, Teacher & Institution Controls		X
Observations	27,165	27,165

Clustered standard errors (school-level) in parentheses

Base Category: M.Ed.

Teacher controls: Experience, NB Certification, Praxis score (std.)

Class time-varying controls: Class size

Institution controls: University status, size, and research classification (Carnegie)

Student controls: race/ethnicity, EC, FRPL status, AIG, mobility, attendance

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Reading & English Language Arts

Table 9: Within-Student Regression Model, DV: Standardized Reading Score

	Model 1	Model 2
Masters Degree	0.0025**	0.0005
	(0.0008)	(0.0009)
Teacher Experience		0.0007***
		(0.0001)
National Board Certification		0.0067***
		(0.0010)
Praxis Score (Standardized)		0.0013*
		(0.0006)
Class Size		0.0022***
		(0.0001)
Public Higher Education Institution		-0.0005
		(0.0010)
North Carolina Higher Education Institution		0.0066***
		(0.0009)
Research Institution		0.0020
		(0.0011)
More than 10,000 students		-0.0035**
		(0.0011)
Observations	3,139,914	3,139,914

Robust standard errors in parentheses

Note: Authors calculations based on limited sample of students with only one ELA teacher

All models include student and grade-by-year fixed effects

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 10: Within-Student Regression Model (In- and Out-of-Area), DV: Standardized Reading Score

	Model 1	Model 2
In-Area Masters Degree	0.0097***	0.0086***
	(0.0014)	(0.0015)
Out-of-Area Masters Degree	0.0008	-0.0015
	(0.0009)	(0.0010)
Teacher & Institution Controls		X
Observations	3,140,609	3,140,609

Robust standard errors in parentheses

Note: Authors calculations based on limited sample of students with only one ELA teacher

All models include student and grade-by-year fixed effects

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 11: Within-Student Regression Model (Subject-Area Masters Degree), DV: Standardized Reading Score

	Model 1	Model 2
Elementary	-0.0098***	-0.0080**
	(0.0029)	(0.0029)
Exceptional Children	0.0212***	0.0223***
	(0.0057)	(0.0057)
English-Language Arts	0.0182***	0.0201***
	(0.0032)	(0.0033)
Math	0.0142	0.0188*
	(0.0085)	(0.0085)
Science	-0.0105	-0.0113
	(0.0095)	(0.0095)
Social Studies	0.0305***	0.0300***
	(0.0043)	(0.0043)
Administration	-0.0191**	-0.0192**
	(0.0064)	(0.0065)
Other	0.0045	0.0038
	(0.0026)	(0.0026)
Unclassified	-0.0012	-0.0034**
	(0.0010)	(0.0011)
Teacher & Institution Controls		X
Observations	3,140,609	3,140,609

Robust standard errors in parentheses

Note: Authors calculations based on limited sample of students with only one ELA teacher

All models include student and grade-by-year fixed effects

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 12: OLS Regression Model (Masters Degree Type), DV: Standardized Reading Score

	Model 1	Model 2
MAT	-0.1680	-0.0606
	(0.0867)	(0.0729)
M.A.	0.0439	0.0028
	(0.0375)	(0.0383)
M.A. in Education	-0.1116	-0.1100*
	(0.0606)	(0.0549)
M.S.	0.0874	0.0910
	(0.1078)	(0.0640)
M.S.A.	0.0018	-0.0145
	(0.0416)	(0.0366)
Student, Teacher & Institution Controls		X
Observations	25,335	25,335

Clustered standard errors (school-level) in parentheses

Base Category: M.Ed.

Teacher controls: Experience, NB Certification, Praxis score (std.)

Class time-varying controls: Class size

Institution controls: University status, size, and research classification (Carnegie)

Student controls: race/ethnicity, EC, FRPL status, AIG, mobility, attendance

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Appendix C: Teacher Fixed-Effect Results (All Tables)

Table 13: Teacher Fixed-Effect Regression Model, DV: Standardized Math Score

	Model 1	Model 2
Masters Degree	0.0359***	0.0360***
	(0.0033)	(0.0033)
	In- and Out-of-Area Analysis	
In-Area Masters Degree	0.0295***	0.0226***
	(0.0055)	(0.0055)
Out-of-Area Masters Degree	0.0371***	0.0385***
	(0.0034)	(0.0034)
	Masters Degree Subject-Area Analysis	
Elementary	0.0162	0.0172
	(0.0134)	(0.0131)
Exceptional Children	0.0615***	0.0526***
	(0.0134)	(0.0132)
English-Language Arts	-0.0870**	-0.1015***
	(0.0290)	(0.0290)
Math	-0.0000	-0.0115
	(0.0126)	(0.0124)
Science	0.0446**	0.0403*
	(0.0160)	(0.0157)
Social Studies	0.0838***	0.0815***
	(0.0205)	(0.0204)
Administration	-0.0363	-0.0377
	(0.0281)	(0.0276)
Other	-0.0041	-0.0033
	(0.0117)	(0.0115)
Unclassified	0.0354***	0.0368***
	(0.0035)	(0.0034)
Teacher time-varying & Student Controls		X
Observations	1,831,747	1,831,747

Robust standard errors in parentheses

Note: Authors calculations based on limited sample of students with only one math teacher

All models include grade-by-year fixed effects, as well as teacher time-varying and student-level controls

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 14: Teacher Fixed-Effect Regression Model, DV: Standardized Reading Score

	Model 1	Model 2
Masters Degree	0.0054	0.0037
	(0.0032)	(0.0032)
In- and Out-of-Area Analysis		
In-Area Masters Degree	0.0237***	0.0152**
	(0.0060)	(0.0059)
Out-of-Area Masters Degree	0.0035	0.0025
	(0.0033)	(0.0032)
Masters Degree Subject-Area Analysis		
Elementary	0.0211	0.0217*
	(0.0109)	(0.0105)
Exceptional Children	0.0112	-0.0014
	(0.0113)	(0.0112)
English-Language Arts	0.0323**	0.0232*
	(0.0106)	(0.0103)
Math	-0.0116	0.0007
	(0.0251)	(0.0243)
Science	-0.0091	-0.0084
	(0.0285)	(0.0270)
Social Studies	0.0359**	0.0273*
	(0.0124)	(0.0121)
Administration	0.0326	0.0222
	(0.0208)	(0.0200)
Other	-0.0085	-0.0117
	(0.0089)	(0.0087)
Unclassified	0.0033	0.0031
	(0.0034)	(0.0033)
Teacher time-varying & Student Controls		X
Observations	1,677,439	1,677,439

Robust standard errors in parentheses

Note: Authors calculations based on limited sample of students with only one math teacher

All models include grade-by-year fixed effects, as well as teacher time-varying and student-level controls

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

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