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The influence of health education teacher characteristics on students' health-related knowledge gains

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Abstract

BACKGROUND: Studies have examined relationships between teacher characteristics and student achievement in courses such as math and science. This study is among the first to examine effects of teacher characteristics on student knowledge in a health course.

METHODS: Student (N = 6,143) pretest and posttest data were linked to teacher (N = 67) data. Changes in student knowledge scores from pre- to post-course were explored using mixed-effects linear models. Teacher characteristics included professional development (PD) attendance, having

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Human Subjects' Approval Statement

Study protocol and materials were reviewed and approved by the ICF Institutional Review Board for the Protection of Human Subjects (ICF IRB FWA00000845) and the participating school district's Committee for External Research Review (#020-16).

a dedicated classroom, certification type, educational background, years' experience, and athletic coaching status.

RESULTS: Teacher characteristics associated with greater student knowledge gains included: being certified to teach health vs. not certified ($p < .001$), having a dedicated classroom vs. no classroom ($p = .017$), and for middle school teachers, having attended ≥3 PD sessions vs. ≤2 ($p = .023$). Less knowledge gain was associated with teachers that coached vs. non-coaches ($p = .040$) and having a health degree vs. no health degree ($p = .049$). Post-hoc analyses revealed the negative effect of health degree was only significant among coaches ($p = .026$).

CONCLUSIONS: Findings suggest opportunities for maximizing student knowledge gains through tailored selection of health teachers and provision of appropriate teaching support.

Keywords

School Health Instruction; Health Educators; Teacher Characteristics; Health Teacher; Student Learning

Teachers are key to student academic achievement.[1] They can be particularly important in health education (HEd) classes where students develop knowledge, skills, and positive attitudes to support lifelong health. Reduced rates of sexually transmitted infections (STIs), reduced rates of obesity, and increased physical activity have all been associated with students' exposure to HEd curricula.[2,3] However, limited attention has been given to teachers who implement these curricula, teachers' attributes, and influences of these attributes on student achievement.[4]

Researchers have identified three broad teacher characteristics related to student achievement: teacher qualifications, teacher certification, and professional development (PD).[5,6] Goe and Stickler define teacher qualifications as credentials, knowledge, and experiences teachers possess before they enter the classroom.[7] This includes teaching experience, college degree, subject-matter education, and teacher certifications. Considerable attention has been given to the relationship between years of teaching and student achievement, with mixed results. Some researchers have found students of experienced teachers attain greater achievement than students of teachers with three or fewer years of experience.[1,8] In addition, teachers' subject matter expertise has been strongly associated with improvements in student achievement. Unfortunately, most studies to date have focused on teachers' knowledge of general education topics (eg, English, math, science) and have not been specific to HEd.[7,9]

The relationship between teacher certification and student achievement has been long debated. Most often, teachers are certified through a traditional certification process, including completion of a formal teaching program and major in education, or an alternative process such as Teach for America, where individuals may have less formal coursework in pedagogy and hold only a provisional teaching certification prior to entering the classroom. Several studies have found a positive relationship between teacher certification and student achievement.[9–11] Additionally, a recent study by Goldhaber and Brewer found students whose teachers went through alternative certification processes performed similarly to students whose teachers received traditional certification.[12] Previous research also shows

certified teachers (traditionally or alternatively certified) assigned to teach courses inconsistent with their formal training or education (i.e., out-of-field teaching, a teacher certified in math assigned to teach health) negatively impact student achievement.[13]

In addition to teacher qualifications, teachers' continuous engagement in PD is imperative for improving subject-matter knowledge, instruction, and student achievement.[5,14–16] Furthermore, PD covering both content knowledge and instructional technique has been found more effective in improving student test scores than PD without such skill-building activities.[17]

To date, most researchers examining relationships between teacher characteristics and student achievement have looked at courses such as mathematics, science, and language arts; the present study is among the first to examine the effect of teacher characteristics on student achievement in HEd. We sought to expand current literature by investigating teacher characteristics such as educational background, type of teaching certification, and years of teaching experience. In addition to these attributes more commonly addressed in existing literature, we also examined having a dedicated, permanent classroom space to teach HEd and teacher athletic coaching status because the participating school district expressed interest in these characteristics, and there is limited research to suggest both can influence student learning.[18,19] Specifically, the study examined the influence of these characteristics on student knowledge gains in HEd.

METHODS

Participants

Quantitative data were collected from students and teachers in an urban Texas school district. Student data included existing records of pre/post health knowledge tests and administrative data. Student data were linked to teacher data, which included evaluation forms from PD events and existing administrative records from the school district.

In total, 7,555 middle school (MS) and high school (HS) students had both a HEd pretest and posttest during the 2015–2016 school year. Student data were limited to students of HEd teachers who attended at least one PD event during the school year. Of 87 teachers who attended at least one PD event, 18 did not complete evaluation forms and one did not teach during the data collection period. These teachers (n=19) and their corresponding students (n=1,399) were excluded from analyses. Thirteen additional students were removed from analyses, one due to an unmatched teacher ID and 12 others due to the timing or number of school district transfers. The final analytic sample included data from 6,143 students enrolled in HEd (2,979 MS and 3,164 HS students) matched with 67 health teachers (40 MS and 27 HS teachers) for a total of 12,286 individual pre or posttests.

Procedure

Student data collection.—MS and HS students enrolled in HEd completed a 50-item grade-level specific, standardized pretest at the beginning of the course and an identical posttest at the end of the course to assess student knowledge of health curriculum content, including but not limited to lessons on sexual health, emotional health, substance use, and

physical activity/nutrition. Pre/posttests were completed via Scantron form and administered by HEd teachers. The study team obtained test results as de-identified secondary data from the school district. Data included unique identifiers to link pretests to posttests and students' data to teachers' data.

Teacher data collection.—A 22-item PD evaluation form was administered following PD events in August 2015 and February 2016. The retrospective pre-post evaluation form assessed characteristics such as educational background, type of teaching certification, years teaching experience, having a dedicated classroom to teach health, and coaching status. In April 2016, the school district provided the PD evaluation data for secondary analysis.

Instrumentation

Student knowledge.—Student knowledge was measured by calculating the percentage of correct items on a 50-item, multiple-choice pre/posttest. Questions addressed a range of health topics, including physical activity, nutrition, emotional health, sexual health, and tobacco, alcohol, and other drugs.

Student demographic information.—The school district provided student demographic information from administrative records using the same identifier in the pre/posttest data, allowing the two datasets to be linked. Demographic characteristics included grade level, ethnicity, sex, gifted or talented status, limited English proficiency (LEP) status, designation as "economically disadvantaged" defined as eligible for free or reduced-price lunch or other public assistance, and designation of being "at risk" for dropping out of HS. The Texas Education Agency delineates students "at risk" for dropping out of HS as those who are 26 years of age or younger that possess one or more of the following indicators: poor/unsatisfactory student early education performance (prekindergarten, kindergarten, and grades 1–3), poor student grades, poor performance on standardized tests, history of expulsion, judicial criminal records, and unstable home/family situations (eg, homeless, pregnant or a parent, residing in foster care or other residential placement).[20] The school district also provided average absenteeism data for each school.

Teacher PD attendance.—Teacher PD attendance was verified through attendance records from each event. There were three PD training events for HS teachers (August 2015, October 2015, and February 2016) and four PD training events for MS teachers (August 2015, October 2015, February 2016, and March 2016). A dichotomous variable was created that categorized PD attendance as less than 3 times or 3 or more times.

Teacher certification type.—Teacher certification was assessed by one item on the PD evaluation form. Teachers were asked, "How did you receive your certification to teach health?" (Response options: "through traditional certification", "through alternative certification", and "I am currently not certified to teach health").

Teacher educational background.—Teacher educational background was measured by one item: "Do you have a degree in health (eg, HEd, public health)?" (Response options: "yes" and "no").

Teaching experience.—Teaching experience was measured using one item with five response options, “How many years have you taught HEd to youth in school?” (response options: “I have never taught HEd to youth in school before”, “1–2 years”, “3–4 years”, “5–10 years”, and “more than 10 years”). This variable was recoded into two categories for analysis: less than 5 years’ experience and 5 or more years’ experience.

Dedicated classroom.—One item on the PD evaluation form asked if teachers had a dedicated classroom in which to teach health (response options: “yes” and “no”).

Coaching status.—Information on each teachers’ athletic coaching status was obtained from the school district. A yes or no response was provided for each teacher by ID number only.

Data Analysis

We examined change in student knowledge scores from the beginning to the end of the HEd course using hierarchical linear (main effects and interaction effects) models (HLM or mixed effects) with random school, teacher, and student intercepts to account for grouping of students by teacher and by school. These models correct for the correlated error structures present in the data by estimating the grouped effects of higher levels (teachers, schools) alongside the individual-level variables of interest (eg, student characteristics). Of central concern were the effects of teacher characteristics on posttest student knowledge scores after accounting for clustering, pretest scores, individual-level characteristics of students, and average school absenteeism. We used Stata 14 to perform descriptive, multivariable, and posthoc analyses.

RESULTS

Participant Characteristics

Table 1 presents a descriptive summary of student characteristics. All MS students enrolled in health during the 2015–2016 academic year were in 6^{th} grade. Approximately 45% of HS students enrolled in health were in the 9^{h} grade. The majority of students in the final sample were Hispanic (68%), economically disadvantaged (79%), and designated as “at risk” for dropout (75%).

Across teachers, 39% held a health degree and 42% had at least 5 years of teaching experience (see Table 2). Most had used a traditional certification process (64%) and had dedicated classrooms for teaching HEd (66%). The majority of teachers (82%) were also athletic coaches.

Table 3 contains summary statistics of student health knowledge scores for MS, HS, and all students. Student knowledge increased from the beginning to the end of the health course ($p < .001$) for both MS and HS students, as well as in the full sample ($p < .001$), but MS students had, on average, lower pre- and posttest scores compared to HS students ($p < .001$).

Multivariable Analyses

In Table 4, we present the results of multi-level models predicting change in student test scores for the full sample of students, as well as for MS and HS student samples, respectively. Models controlled for sex of student, race/ethnicity, grade level, average school absenteeism, as well as for students having an LEP, being gifted, economically disadvantaged, or being at-risk for dropout.

When examining the effects of teacher characteristics on change in student health knowledge, we observed similar patterns for all students combined and MS students, in particular. For HS students, we saw no significant effects of teacher characteristics on student knowledge change.

Among the full sample, three teacher characteristics were associated with greater knowledge gain, being certified to teach HEd (either through traditional or alternative means) compared to no certification, having a dedicated classroom, and PD attendance. Students with teachers certified to teach HEd scored at least 4 percentage points higher overall, irrespective of certification type. MS students scored at least 5.5 points higher on the posttest, if their teachers were certified to teach HEd. If teachers had a dedicated classroom to teach HEd, student scores increased on average by 2.6 percentage points from pre to posttest. In the MS sample (but not full or HS samples), PD attendance was associated with higher knowledge gain. MS student scores were 1.25 percentage points higher when teachers attended at least 3 PD events.

Among the full and MS samples, two teacher characteristics were associated with lower knowledge gain—having a health degree and being a coach. In the full sample, knowledge scores were 1.38 percentage points lower for students whose teachers had a health degree compared to students of teachers without a health degree and 1.92 points lower for students whose teachers were coaches compared to students whose teachers were not. MS students, in particular, were most adversely affected with 2.7 and 3.7 point drops in posttest scores for students of teachers with a health degree and students of teachers who were coaches, respectively.

To further explore the relationship between teachers' coaching status, health degree and certification, we estimated multi-level models accounting for potential interactions (see Table 5). Examining the interaction of health degree with coaching status revealed the negative effect of health degree was only significant among coaches ($p = .026$ for the full sample and $p = .001$ in MS sample; not significant in the HS sample). Examining the interaction of certification with coaching status revealed that students whose health teachers were coaches performed significantly better when they were certified to teach HEd (traditional or alternative) as opposed to students of non-certified health teachers who were coaches ($p < .02$).

Examining the interaction between coaching status, health degree, and certification revealed posttest scores were lower for students whose teachers were coaches and not certified to teach HEd, irrespective of having a health degree ($p < .001$ in both full and MS samples).

Additionally, among students whose teachers had a health degree and were certified to teach HEd, posttest scores were lower if the teacher was also a coach ($p < .05$).

DISCUSSION

Across students, we observed significant increases in health knowledge while controlling for factors at student, teacher, and school levels—suggesting HEd can improve student knowledge. Although knowledge gains alone are not predictive of positive health behaviors, the importance of school-based HEd is established in the literature.[2,21] To best understand our HEd-related findings, it is important to understand the context of HEd in the participating school district. In recent years, the district introduced an adapted version of an evidence-informed curriculum (*HealthSmart*). The curriculum was in its first year of use in MS and second year of use in HS, which may account for differences in knowledge increases across MS and HS students. Although increases in student knowledge alone is noteworthy, our study also sought to identify salient HEd teacher characteristics associated with student knowledge gains. We specifically examined the relationship between teachers' PD participation and student knowledge increases and, consistent with the literature,[22] found these to be significantly associated in the MS sample. Because MS teachers were using the adapted curriculum for the first time as opposed to HS teachers which were on year two of implementation, this finding may suggest PD is particularly beneficial for those without previous exposure to the curriculum.

Additionally, our finding in the full sample that greater knowledge gains were seen among students whose teachers had a dedicated classroom emphasizes the importance of dedicated classroom space. Research supports the classroom environment as a key factor affecting student learning.[23,24] Teachers with dedicated classrooms can tailor rooms to reflect curriculum content and often have better access to technology to stimulate student learning.[23] Alternatively, we hypothesize teachers who float among multiple locations or use shared spaces such as a gym or cafeteria are unable to display relevant course material and may encounter more interruption due to passersby which could interfere with both teaching and learning.

We also found that certification to teach HEd, both traditional and alternative, was positively associated with student knowledge gains in the full and MS samples. Our findings suggest that either type of certification has benefits and is preferable to no certification. Similarly, our results align with previous research on the association between teacher certification and increased student achievement across various subject areas (eg, English, math) and add to the current literature by illustrating this relationship also holds for HEd.[9–12]

Distinctly, our findings from the full and MS samples document a complex relationship between teacher certification, coaching status, and having a health-related degree that warrants further study. Our results show that regardless of degree type, students with teachers who are also coaches but are not certified to teach HEd, have lower knowledge gains. Certification to teach HEd, while advantageous for all health teachers, appears particularly important for teachers who are also coaches.

Results also illustrate that among students of teachers who were coaches and certified to teach HEd, students had lower knowledge gains if the teacher also had a health-related degree. Existing research concerning the role of a teacher's degree on student achievement has shown mixed results. Some studies have indicated a positive association between a related degree to the content being taught,[25,26] while others have not.[8,27,28] Without additional information on the exact degree type obtained by teachers, we cannot fully explain the observed association between health degree and student knowledge. Our data did not specify type of health degree, so we cannot further elucidate what this may mean. However, we speculate that coaches with health degrees may have degrees in areas such as exercise science instead of degrees in education where pedagogy and teaching methods are emphasized. Thus, their training and educational background may be markedly different from their colleagues with more formal teacher training. Still, this is speculative and worthy of investigation in future studies.

The negative effect of coaching status on student knowledge gains is fairly consistent in our findings; however, we cannot explain whether simply being a coach is associated with this negative impact, or if coaching status is indicative of other variables (eg, teacher attendance or limited background in pedagogy, classroom management, or other essential teaching skills) that could be negatively impacting student learning. Future research may better explain these findings.

Limitations

This study offers several strengths, specifically the large sample size and use of data at multiple levels to account for potential confounding variables when examining student outcomes. However, there are several limitations to consider. This study did not involve a control or comparison condition, and therefore, findings may be attributed to factors not accounted for in the design. Analyses relied on existing data collected by the school district. Data on teachers is subject to issues commonly associated with self-report. Measures had not been previously validated; therefore, issues related to measurement error, such as the sensitivity and specificity of measures, cannot be ruled out. In addition, measurement of health degree was not specific enough to distinguish between various types of health degrees, and as a result, our understanding of its relevance to student outcomes is limited. Finally, participants in this study come from a single, urban, Texas school district, and are not generalizable to other populations of youth and teachers.

Conclusions

This study represents a first attempt to explore the relationship between HEd teacher characteristics and student learning. It documents a number of teacher characteristics linked to student knowledge gains, providing important considerations for school districts in terms of both selecting and training teachers to best support student achievement. Future studies could further explore these nuanced relationships.

IMPLICATIONS FOR SCHOOL HEALTH

Our study has several implications for practice—primarily related to considerations for hiring HEd teachers or enhancing the impact of current teachers. In terms of hiring, teacher certification, through traditional or alternative methods, appears to be especially important. Our findings suggest that school districts may want to consider certification to teach HEd a priority characteristic when hiring. Among HEd teachers also serving as coaches, obtaining certification to teach HEd may be more important than having a health-related degree. Furthermore, although many school districts rely heavily on coaches and physical education teachers to teach HEd and may see this as a natural fit, our findings suggest that this approach may not result in the greatest knowledge gains for students. In terms of enhancing the impact of existing teachers, our findings also suggest teacher participation in PD does matter and should be supported. As such, school districts could consider offering a variety of PD opportunities for HEd teachers to enhance teaching strategies and strengthen content knowledge. Additionally, providing all HEd teachers with dedicated classrooms may promote greater knowledge gains among students.

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Table 1.

Descriptive Summary of Student Characteristics

	All Students		Middle School Students		High School Students	
Variable	**N**	**%**	**N**	**%**	**N**	**%**
Sex						
Female	3019	49.1	1517	50.9	1502	47.5
Male	3124	50.9	1462	49.1	1662	52.5
Ethnicity						
Hispanic	4161	67.7	2019	67.8	2142	67.7
Asian or Native Hawaiian/Pacific Islander	112	1.8	49	1.6	63	2.0
Black	1163	18.9	580	19.5	583	18.4
American Indian/Alaska Native or Multi-race	87	1.4	41	1.4	46	1.5
White	620	10.1	290	9.7	330	10.4
Grade						
6	2979	48.5	2979	100.0		
9	1407	22.9			1407	44.5
10	880	14.3			880	27.8
11	678	11.0			678	21.4
12	199	3.2			199	6.3
Gifted and talented						
No	5278	85.9	2508	84.2	2770	87.5
Yes	865	14.1	471	15.8	394	12.5
At risk [+]						
No	1548	25.2	641	21.5	907	28.7
Yes	4595	74.8	2338	78.5	2257	71.3
Limited English Proficiency (LEP) Status						
LEP [++]	1288	21.0	970	32.6	318	10.1
1st year monitoring	467	7.6	385	12.9	82	2.6
2nd year monitoring	178	2.9	133	4.5	45	1.4
Non-LEP	4210	68.5	1491	50.1	2719	85.9
Economically disadvantaged [+++]						
No	1276	20.8	462	15.5	814	25.7
Yes	4867	79.2	2517	84.5	2350	74.3
Total	6143	100.0	2979	100.0	3164	100.0

[+]A student is identified as at risk of dropping out of school based on state-defined criteria found in Texas Education Code (TEC §29.081.) This definition includes students with LEP.

[++]Fort Worth Independent School District monitors students who have been identified as having LEP for two years to make sure they have the support they need to develop English proficiency. After the two year monitoring period ends, if students have not reached proficiency, they will remain categorized as “LEP”. Also, students who have not been monitored will remain classified as LEP until they begin their first year monitoring period. Following testing, students are able to graduate out of the LEP 1st or 2nd year monitoring category and get reclassified as Non-LEP.

[+++]“Economically disadvantaged” is defined as eligible for free or reduced-price lunch or eligible for other public assistance.

Table 2.

Descriptive Summary of Teacher Characteristics

Variable	All Teachers		Middle School Teachers		High School Teachers	
	N	%	N	%	N	%
Health degree						
No	37	55.2	20	50.0	17	63.0
Yes	30	44.8	20	50.0	10	37.0
Certification type *						
Traditional certification	44	65.7	25	62.5	19	70.4
Alternative certification	20	29.9	12	30.0	8	29.6
Not currently certified	3	4.5	3	7.5		
Years of Experience						
Less than 5 years	39	58.2	24	60.0	15	55.6
5+ years	28	41.8	16	40.0	12	44.4
Professional development exposure						
Attended <3 PD sessions	37	55.2	15	37.5	22	81.5
Attended 3+ PD sessions	30	44.8	25	62.5	5	18.5
Coach						
No	12	17.9	11	27.5	1	3.7
Yes	55	82.1	29	72.5	26	96.3
Dedicated Classroom						
No	23	34.3	7	17.5	16	59.3
Yes	44	65.7	33	82.5	11	40.7
Total	67	100.0	40	100.0	27	100.0

* Traditional certification typically includes completion of a formal teaching preparation program with a major in education whereas alternative certification may include participating in a specialized program such as Teach for America or others where time in the classroom usually precedes full certification.

Table 3.

Student Pretest and Posttest Scores on Health Knowledge Tests

Outcome	All Students (N=6,143)		Middle School Students (N=2,979)		High School Students (N=3,164)		$t^{b\ c}_{(df)}$
	M	SD	M	SD	M	SD	
Percent correct pretest	57.01	(15.38)	52.09	(15.20)	61.64	(14.05)	−25.6*
Percent correct posttest	73.79	(16.90)	67.80	(17.30)	79.42	(14.39)	−28.5*
$t^{a}_{(n-1)}$	101.1*		63.4*		80.7*		

Note:

[a]Matched pair t-tests were used to test for differences in pre- and posttest scores in the full sample, middle school, and high school samples.

[b]Two sample t-tests with unequal variances were used to test for differences in scores (both pre- and post- test scores) between middle school and high school samples.

[c]Reported Degrees of freedom are Satterthwaite's degrees of freedom with $df_{pretest}$=6025.1 and $df_{posttest}$=5804.1.

*one-tailed p-value<.001.

Table 4.

Mixed Effects Linear Model Predicting Change in Student Health Knowledge (Main Effects Model)

	(1)	(2)	(3)
VARIABLES	**All Students (β)**	**Middle School (β)**	**High School (β)**
Fixed Effects			
Health degree (1=Yes)	−1.38*	−2.70**	−0.65
	(0.70)	(0.87)	(1.00)
Traditional certification (1= Yes)	4.42***	5.64***	0.61
	(0.85)	(1.05)	(1.51)
Alternative certification (1= Yes)	4.13***	6.17***	
	(1.08)	(1.33)	
Years of experience (1= 5+ years)	0.23	−0.70	−1.14
	(0.62)	(0.70)	(1.34)
Dedicated classroom (1= Yes)	2.66*	2.62	2.05
	(1.11)	(2.31)	(1.52)
PD exposure (1=Attended PD at least three times)	0.44	1.25*	0.73
	(0.68)	(0.55)	(0.89)
Coaching status (1= Yes)	−1.92*	−3.70***	nr
	(0.94)	(0.92)	
Random Effects			
School	4.65	7.96	0.00
	(2.22)	(4.07)	(0.00)
Teacher	3.98	1.25	4.99
	(1.27)	(1.48)	(2.53)
Student	72.69	77.70	62.43
	(4.23)	(4.80)	(6.28)
Residual	84.59	91.63	76.91
	(7.03)	(7.97)	(9.74)
Observations	All Students N	Middle School N	High School N
Score	12,286	5,958	6,328
Student	6,143	2,979	3,164
Teacher	67	40	27
School	35	21	16
Log-Likelihood value	−47,826	−23,418	−24,269

Notes: Estimated models control for student characteristics listed in Table 1, school level absenteeism rate, and change in student test scores over time. Clustered (at School Level) Standard Errors in parentheses;

* p < .05;

** p <. 01;

*** p < .001.

The baseline for certification coefficients in Columns 1 and 2 is “No certification,” the baseline for traditional certification coefficient in Column 3 is “Alternative certification,” since all high school teachers were certified. Post estimation F-tests, used to examine the differences in students’ scores depending on whether a teacher obtained traditional or alternative certification to teach HEd showed no significant differences in student scores for the full sample (χ^2 = 0.12, p = .73), MS students (χ^2 = 0.20, p = .65), or HS students (χ^2 = 0.16, p = .69). The effect of coaching status is not reported due to extreme lack of variability in High School model (n=1 non coach).

Table 5.

Mixed Effects Linear Model Predicting Change in Student Health Knowledge (Interaction Model)

VARIABLES	(1) All Students β/APE	(2) Middle School β/APE	(3) High School β/APE
Fixed Effects			
Health degree (1=Yes) when Coaching status (1=Yes)	−1.63*	−3.30**	−0.65
	(0.74)	(0.97)	(1.00)
Health degree (1=Yes) when Coaching status (0=No)	0.79	0.31	
	(1.56)	(1.37)	
Traditional certification (1=Yes) when Coaching status (1=Yes)	6.12***	6.88**	
	(1.05)	(2.04)	
Traditional certification (1=Yes) when Coaching status (0= No)	2.20	3.20*	
	(1.32)	(1.39)	
Alternative certification (1=Yes) when Coaching status (1=Yes)	5.96***	7.27**	
	(1.26)	(2.20)	
Alternative certification (1=Yes) when Coaching status (0=No)	0.40	4.32*	
	(1.07)	(1.81)	
Years of experience (1= 5+ years)	0.05	−1.06	−1.14
	(0.64)	(0.54)	(1.34)
Dedicated classroom (1=Yes)	2.92**	2.99	2.05
	(1.13)	(2.67)	(1.52)
PD exposure (1=Attended PD at least three times)	0.66	1.43**	0.73
	(0.60)	(0.45)	(0.89)
Coaching status (1=Yes) when Traditional Certification (1=Yes) and Health degree (0=No)	−1.10 (1.53)	−1.47 (1.11)	
Coaching status (1=Yes) when Traditional Certification (1=Yes) and Health degree (1=Yes)	−3.53** (1.37)	−5.08*** (1.17)	
Coaching status (1=Yes) when Alternative Certification (1=Yes) and Health degree (0=No)	0.53 (1.00)	−2.20 (1.92)	−1.36 (1.85)
Coaching status (1=Yes) when Alternative Certification (1=Yes) and Health degree (1=Yes)	−1.89 (1.30)	−5.81*** (1.26)	
Coaching status (1=Yes) when No Certification (1=Yes) and Health degree (0=No)	−5.02*** (0.82)	−5.16* (2.00)	
Coaching status (1=Yes) when No Certification (1=Yes) and Health degree (1=Yes)	−7.44*** (1.80)	−8.77*** (2.21)	
Random Effects			
School	6.07	8.03	0.00
	(2.84)	(4.20)	(0.00)
Teacher	2.98	0.56	4.98
	(1.21)	(1.77)	(5.93)
Student	72.70	77.75	62.43
	(4.24)	(4.80)	(6.98)
Residual	84.59	91.63	76.91

VARIABLES	(1) All Students β/APE	(2) Middle School β/APE	(3) High School β/APE
	(7.03)	(7.97)	(9.81)
Observations	All Students N	Middle School N	High School N
Score	12,286	5,958	6,328
Student	6,143	2,979	3,164
Teacher	67	40	27
School	35	21	16
Log-Likelihood value	−47,825	−23,416	−24,269

Notes: Estimated models control for student characteristics listed in Table 1, school level absenteeism rate, and change in student test scores over time. Clustered (at School Level) Standard Errors in parentheses;

*
p < .05;

**
p < .01;

***
p < .001.

The coefficients of health degree, coaching status, and certification type are Average Partial Effects (APEs). Missing coefficients in Column 3 are due to the following High School sample data limitations: no teachers with a health degree who are not coaches, no not certified teachers, no traditionally certified teachers who are not coaches irrespective of degree, no alternatively certified teachers with a degree who are not coaches.