Inputs and Student Achievement: An Analysis of Latina/o-Serving Urban Elementary Schools

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One of the most pressing problems in the United States is improving student academic performance, especially the nation's burgeoning Latina/o student population (Rumberger & Anguiano, 2004). According to the federal mandate of No Child Left Behind, all children must test at a proficient level by 2014 (Darling-Hammond, 2007). This goal may prove to be elusive for Latina/os, many of whom struggle academically (Crosnoe, 2005). The achievement gap on some tests is as high as 30 percentage points between Latina/o and White students (Torres, 2001).

In an effort to understand what influences student achievement and the gap between ethnic minority and White students, many variables have been analyzed, such as student, teacher, community, and school characteristics as well as financial expenditures. However, there is a dearth of research on variables associated with student achievement in Latina/o majority schools in urban districts. As the majority of Latina/o students are segregated into central cities (Arias, 1986) and Latina/o achievement issues tend to start in the first three years of school (Espinosa & Ochoa, 1986), a study focused on urban elementary schools would help decipher what variables affect Latina/o student achievement during the first few years of school.

Considering the continuing challenge of the Latina/o achievement gap, an analysis to understand the relationship between key inputs and Latino/a student achievement is important. The purpose of the research was to better understand the association between financial resources, student demographics, school capacity, and student achievement in majority Latina/o schools. This study asked the following questions: What inputs are related to school level status and growth of mathematics and reading achievement? Do these inputs differ for achievement growth in majority Latina/o elementary schools?

Inputs and Student Achievement

Prompted by decades of litigation, many states have changed how they distribute resources—moving from local to state based distribution schemes (Kirst, Goertz, & Odden, 2007). Over the past several decades, school finance reform has been litigated in 45 states (Dunn & Derthick, 2007). Since 2002, the struggle over inadequacy and inequity of resource inputs for schools has led to litigation in 32 states (National Access Network, 2010). Texas was similarly challenged to craft school finance legislation that would survive the state's Supreme Court.

The systems to distribute financial resources to schools are decided by judicial enactments and statute. State and local policy makers seek to use these resources to improve student performance (Dee & Levine, 2004). It is assumed that financial resources impact student achievement and success. However, researchers have debated this relationship. Whereas some studies have demonstrated a relationship between school expenditures and student achievement (Archibald, 2006; Ram, 2004; Roscigno, 2000), others have disagreed (Grubb, 2009; Hanushek, 1997; Okpala, Okpala, & Smith, 2001).

Large disparities in the distribution of school expenditures are evident in many states. Darling-Hammond (2007) reported that U.S. public schools spend $3,000 to $30,000 per pupil—with urban schools tending to be on the lower end of this spectrum—leaving inadequate resources for majority minority schools. Texas has a codified, statewide school funding equalization scheme, but there is still within district variation. Jimenez-Castellanos and Rodriguez (2009) argued that this inequality in resource allocation within districts affects Latina/o student achievement.

What constitutes teacher quality also has been debated in the literature (Rivkin, Hanushek, & Kain, 2005). Teacher experience is an important input for student achievement (Darling-Hammond, 2007; Nye, Konstantopoulos, & Hedges, 2004). Research has shown a positive relationship between teacher certification and student achievement (Darling-Hammond, Berry, & Thoreson, 2001; Darling-Hammond, Holtzman, Gatlin, & Vasquez Heilig, 2005; Lankford, Loeb, & Wychkoff, 2002), but other researchers have not viewed teacher certification as a significant variable (Boyd, Grossman, Lankford, Loeb, & Wyckoff, 2005; Kane, Rockoff, & Staiger, 2006). More specifically, for Latina/o students, bilingual teachers improve achievement for Spanish speakers (Gersten, 1984) and are important for urban student success (Torres-Guzmán & Goodwin, 1995). Bachelors and graduate degrees also have been identified as a factor in making a teacher "highly qualified" (Bolyard & Moyer-Packenham, 2008).

Further debate in the literature is whether student–teacher ratio is associated with student achievement. The student teacher ratio can be similar to class size, but is usually a more conservative estimate (Lewit & Baker, 1997). Hanushek (1999) argued that reducing class sizes does not increase student achievement. Proponents of reducing student teacher ratios have found a significant relationship between increased test scores and reducing class sizes, especially in the first years of school (Achilles, 2001; Haenn, 2002). Notably, minority and disadvantaged students experience larger and lasting achievement gains from reduced class sizes (Haenn, 2002; Nye, Hedges, & Konstantopoulos, 2004; Pate-Bain, Boyd-Zaharias, Cain, Word, & Binkley, 2007).

Student achievement is also associated with socioeconomic characteristics (Woolley, Grogan-Kaylor, & Gilster, 2008). For example, students who live in low income areas often start school with a smaller vocabulary range than their more affluent peers (Krashen, 2005) and underperform on standardized tests (Cunningham, 2006; Kinnucan, Zheng, & Brehmer, 2006). Schools with high concentrations of low income students are more likely to be low performing (Krashen, 2005), and their growth lags behind that of schools in wealthier areas (Lyons, 2004).

Considering the variety of inputs purportedly related to student achievement, this study examined what readily available, observable inputs in the large scale datasets held by the state of Texas are associated with student achievement in schools that are majority Latina/o. We examined input variables in three large, urban school districts in Texas over 4 years (2005–2008). The school districts included in the study are three of the four largest urban school districts in Texas: Austin, Houston, and Dallas. We evaluated variables such as school funding expenditures, tests scores, ethnicity, and teacher certification and degree obtainment to identify any impact on student achievement in urban elementary schools.

Methodology

Overview of Data Set

We constructed a school level dataset of publicly collected Public Education Information Management System (PEIMS) variables for 419 schools from three urban Texas districts over 4 years (2005–2008). Houston, Dallas, and Austin are fairly typical urban school districts, serving mostly low income students who are predominantly Latina/o and African American. In 2007–2008, all of the urban districts enrolled large proportions of students of color, bilingual learners, and low income students (see Table 1).

Table 1

Percentage Student Demographics for Texas Districts and Large Urban U.S. School Districts (2007–2008)

Demographic	Houston	Dallas	Austin	Los Angeles	Chicago	New York City (Geographic District 1)
African American	28.5	28.7	12.1	9.6	46.5	19.0
Latina/o	60.3	65.3	58.0	62.4	39.1	48.0
White	8.0	4.8	26.4	15.4	8.0	13.0
Asian/Pacific Islander	3.2	1.0	3.3	8.2	3.3	*
Native American	0.1	0.2	0.2	0.3	0.2	1.0
Econ. disadvantaged	79.5	84.7	60.8	68.0	83.6	58.0
Bilingual learners	29.5	32.5	28.3	34.7	14.8	12.0

Note. Sources include Popular Annual Financial Report for the Year Ended June 30, 2008, by Chicago Public Schools, 2008, Chicago, IL: Author, and The New York State District Report Card Accountability and Overview Report 2007–08, by New York City Geographic District 1, 2008, New York City, NY: Author.

The PEIMS data include school level demographic characteristics (percentages of students by ethnicity; income; language status; special education status; and at risk status, defined by a multifaceted state index and student teacher ratio), school capacity (percentages of teachers who are novice, have advanced degrees, and are bilingual certified), and Texas Assessment of Knowledge and Skills (TAKS) math and reading achievement scores for each year linked to school level financial variables.

All school level PEIMS financial variables were adjusted from total expenditures by school to a per student basis. Operating expenditures is the most comprehensive financial input variable, as it is composed of instruction, instructional resources and media, curriculum and staff development, instructional leadership, school administration, guidance and counseling services, social work services, health services, transportation, food, co-curricular activities, general administration, plant maintenance and operation, security and monitoring, and data processing services. The instruction variable addresses activities that deal directly with the interaction between teachers and students. The curriculum variable includes money used by instructional staff to plan, develop, and evaluate the process of providing learning experiences for students. Instructional leadership includes financial resources allocated to managing, directing, and supervising staff that provides instructional or instructional related services (Texas Education Agency, 2006).

Analysis

Our analyses were designed to address many of the questions raised in the literature about the effects of student inputs on student performance. We used generalized least squares (GLS) regression models to examine what input changes were associated with TAKS math and reading test score growth (see Appendix for descriptive statistics for variables used).

Using school level data, we examined pass rates on each of the elementary tests over time in relation to changes in financial, school capacity and school demographic inputs. We used a set of GLS regressions to consider the statistical relationships between year-to-year changes in school expenditures (operating, instructional, curriculum, leadership) and changes in school test scores, controlling for changes in the school's teaching capacity and changes in the school's student demographics. The GLS regression models tested the relationship between school level changes in average TAKS exam scores and changes in student progression trends, demographics, and teacher capacity split by a Latina/o majority grouping variable. We analyzed achievement trends for the population of 419 elementary schools arranged in a panel format with school and years as the units of analysis. The model is Yit = b0 + SbkXkit +eit, where eit = ui + vi + wit. GLS regression coefficients are denoted by b, k indexes measured independent variables, i indexes elementary schools, t indexes school years, e is the error term, u is the school component of error, v is the error across years, w is the random component of error, and b0 is the intercept. The dependent variable, Y, is measured as year-to-year changes in percent proficient on TAKS mathematics and reading scores for each school 2005–2008.

To predict changes in school level TAKS scores, we estimated both random effects and fixed effects models. A school fixed effects model is often used to remove bias created by the inability to include controls for unmeasured school characteristics, for example, unchanging aspects of school culture, school staff capacity, parental involvement, and other characteristics that have additive effects (Vasquez Heilig & Darling-Hammond, 2008). In this case, effects were fixed for schools and years. We compared the results of the two models and conducted a Hausman test to determine whether the coefficients estimated by the efficient random effects estimator were the same as those estimated by the consistent fixed effects estimator (Stock & Watson, 2003). The Hausman test found no significant difference, suggesting that the use of fixed effects was not necessary in this case.

The random effects equations used controls for changes in school level demographic variables and measures of teaching capacity, including year-to-year changes in student characteristics (percentage White, bilingual learner, special education, and at risk students) and teacher characteristics (percentage teachers bilingual certified, with fewer than 3 years of experience, and with master's degrees). The dependent variable in the random effects regressions considered change in TAKS reading and math scores for each elementary school. Each year-to-year change represented a separate observation in the random regression models. Year-to-year change variables for school expenditures, school capacity, and student demographics, as well as school-level TAKS proficiency, were calculated as $\Delta V_t = V_t - V_{t-1}$. Together, these analyses helped us to understand the relationship between inputs and student achievement for Latina/o majority schools in large urban districts.

Findings

GLS Regressions: Inputs and Student Achievement

We conducted GLS regression analyses to evaluate whether inputs raised test scores in majority Latina/o schools. Tables 2 and 3 show the results of analyses examining predictors of changes in reading and mathematics scores, using random effects for year and school with a filtering grouping variable for Latina/o majority schools. In each case, we added school expenditures—changes in operating expenditures and then curriculum, leadership, and instructional as separate blocks—having controlled for changes in student characteristics and school capacity (teacher bilingual certification, experience, and advanced degree).

Table 2

Changes in Percentage of Students Passing Texas Assessment of Knowledge and Skills Math: GLS Regression With Random Effects

	Random effects		
Variable	ModelA	Model B	Model C
Constant	1.047***	.878***	.920***
	(.227)	(.271)	(.277)
D school expenditures			
Operating	.001***	.001***	____
	(.000)	(.000)	
Curriculum	____	____	-.001
			(.004)
Instructional	____	____	-.001
			(.004)
Leadership	____	____	-.007
			(.004)
D school capacity			
% novice	____	-.004	-.003
		(.028)	(.028)
% with master's	____	.058	.021
		(3.404)	(.012)
% bilingual	____	-.034***	-.035***
		(.012)	(.012)
D school demographic			
% White	____	.110	.112
		(.113)	(.113)
% bilingual learners	____	.045	.050
		(.045)	(.045)
% special education	____	-.028	-.038
		(.124)	(.125)
% at-risk	____	-.001	-.002
		(.020)	(.021)
Student–teacher ratio	____	-.260*	-.304*
		(.136)	(.138)
R^2	.019	.034	.031
N	*1,169*	*1,118*	*1,118*

*Note. Standard errors are in parentheses. *p < .05. **p < .01. ***p < .001.*

Table 3

Changes in Percentage of Students Passing TAKS Reading: GLS Regression With Random Effects

Variable	ModelA	Model B	Model C
	Random effects		
Constant	2.206***	2.632***	2.609***
	(.200)	(.265)	(.270)
D school expenditures			
Operating	-.001	-.001**	—
	(.001)	(.001)	
Curriculum	—	—	-.007
			(.004)
Instructional	—	—	-.001~
			(.001)
Leadership	—	—	-.001
			(.009)
D school capacity			
% novice	—	-.045*	-.055~
		(.024)	(.027)
% with master's	—	2.545	1.923
		(2.905)	(3.321)
% bilingual	—	-.023*	-.020*
		(.011)	(.011)
D school demographic			
% White	—	.229**	.217*
		(.096)	(.110)
% bilingual learners	—	-.171***	-.152***
		(.038)	(.044)
% special education	—	.149	.170
		(.105)	(.122)
% at-risk	—	-.007	-.018
		(.017)	(.020)
Student teacher ratio	—	-.332***	-.363***
		(.116)	(.134)
R^2	.001	.050	.059
N	*1,169*	*1,118*	*1,118*

*Note. Standard errors are in parentheses. ~p < .10. *p < .05. **p < .01. ***p < .001.*

We found that increases in operating expenditures were significant for predicting increases in math scores and reading scores when controlling for changing teacher quality and demographics. Adding the more specific vector of finance variables (instruction, curriculum, and leadership) increased the proportion of explained variance in math and reading TAKS scores. Increased spending on instruction was significantly related to increases in math scores, whereas a modest decrease in curriculum spending was related to increases in reading scores. (This might be because increases in operations overshadowed curriculum spending.) Some changes in school level variables influenced changes in TAKS scores: For example, the change in the percentage of bilingual certified teachers significantly impacted both math and reading achievement on the TAKS. However, the direction of association was positive for reading scores and negative for math scores. A decrease in the percentage of novice teachers was also associated with an increase in math scores. In terms of student demographics, an increase in the proportion of White students concurrent with a decrease in bilingual students marginally improved reading scores.

After controlling for these changes, the most powerful predictor of changes in reading and math in all models was decreasing the student teacher ratio. In terms of effect size, a decrease of third of a percentage point and a fourth of a percentage point in the student teacher ratio predicted a 1 point increase of percentage proficient in reading and math, respectively. Essentially, decreasing the student teacher ratio by 1 percentage point would increase the percentage of students proficient on the TAKS by 3% for reading and by 4% for math. Not surprisingly, the addition of school capacity and school characteristics increases the variance predicted for both math and reading achievement. Breaking out school expenditures into more detailed categories led to a slight decrease in the R-squared for the math model (from 0.034 to 0.031) but an increase in the reading model (from 0.050 to 0.059).

Discussion

This study breaks new ground by focusing on urban Latina/o majority elementary schools to understand student achievement in relation to inputs. We examined trends in student performance while investigating inputs identified in previous studies: teacher quality, school expenditures, and student demographics. We conducted GLS regression "change" models (which measure the growth) to understand the relationship between inputs and reading and math achievement in urban elementary schools.

As might be expected, the GLS regressions show an influx of White students and bilingual learners have positive and negative associations, respectively, with reading scores. There was no significant association with changes in student populations and math scores. This finding suggests that policy makers and district and school staff should be mindful and proactively develop strategies to address possible shortfalls in reading achievement as student populations change in Latina/o urban schools. Districts can focus resources on inputs such as increasing the numbers of bilingual teachers and reducing the number of novice teachers, as these variables showed a significant relationship to increasing reading scores. A concurrent effect of increases in bilingual teachers appears to be a modest reduction in math scores. Perhaps the proportion of bilingual teachers simply matters less in elementary level math; this might not be the case if the data were focused on middle or high schools, where subject matter competency in math has stronger links to instructional quality and student achievement (see e.g., Clotfelter, Ladd, & Vigdor, 2007).

In the GLS regression models, when controlling for student background and teacher quality, increases in instructional, curriculum, and leadership spending do not appear to increase reading scores in majority Latina/o schools. Yet, we found a statistically significant relationship between increases in instructional spending and mathematics scores. Overall, a more promising input for improving test scores appears to be increasing overall operating expenditures. This calls into question the policy strategies codified in Texas House Bill 3 (2009) that focus mainly on increasing instructional expenditures. Operating expenditures is an all encompassing PEIMS financial category that includes line items such as social work services, health services, transportation, and co-curricular activities. Thus, more work is necessary to understand what specific components of operating expenditures in schools that serve racially and linguistically diverse students that are not typically treated in the research literature and school finance policy are important for increasing student achievement in majority Latina/o schools in urban areas.

These findings do highlight how nuanced educational policy should be and how difficult it is to measure the impact of school finance on student achievement in urban Latina/o majority schools. As more and more scholars are noting, it may not be so much how much money is spent (past a certain minimum threshold) but how the money is spent. While this study is able to delve deeper into how money is spent, we are still bounded by broad categories such as instructional spending. Instructional spending is loosely defined by TEA as including "all activities directly related to the interaction between teachers and students." Moreover, a savvy administrator could likely spend money more effectively in a category that generally leads to less productive gain, which would muddy results in any analysis of spending. Finally, schools spend money in a given area for a reason and this reason likely influences student achievement. For example, a school that is struggling may decide to throw a significant amount of resources into their curriculum. The impact of the new curriculum may take years to appear— after teachers gain experience using it. Until the impact is seen in the classroom, the data show a school whose performance is lagging and is spending a lot on curriculum— which may lead one to incorrectly draw the conclusion that spending on curriculum relates to lower achievement. This, of course, would be the wrong conclusion, but the example does demonstrate how tricky the understanding of school spending relationship to achievement can be in schools that serve large numbers of racial/ethnic and language minority students.

Another interesting finding is that reduction in the student teacher ratio, controlling for changes in other inputs, was the largest predictor of increases in student achievement. A long running debate in the literature regards the efficacy of class size reduction (CSR). California and Tennessee have served as the gold standard for research on CSR in the empirical literature. However, the contexts in these states are somewhat different than Texas. Tennessee does not have the same demographic composition and thus likely has other contextual differences and social history. In California, the statewide implementation of CSR began in the late 1990s; an unfortunate by product on the California teacher labor market was decreased teacher quality in majorityminority schools (Jepsen & Rivkin, 2009). In Texas no statewide CSR policy was enacted, and for urban majority Latina/o schools, investments in reducing the student teacher ratio can have the largest effect of all inputs available in Texas data.

In conclusion, for urban Latina/o majority schools that serve large numbers of ethnically and linguistically diverse students, if the reauthorization of the No Child Left Behind Act focuses on teacher quality inputs such as decreasing the number of novice teachers and increasing the number of bilingual teachers to address the influx of bilingual learners, it could be a boon for majority Latina/o schools. Further, funding increases, whether federal, state, or district, may be best spent on operating expenditures, rather than pigeonholing financial resources into curriculum, leadership, or instructional line items. Although not on the top of the current educational policy agenda, reductions in the student teacher ratio appear to yield the most benefit for increasing both math and reading scores. These findings may not be ubiquitous for schools and students of all types, but boutiqued finance policy solutions for urban, majority Latina/o elementary schools may be more fruitful for increasing achievement rather than the current one-size-fits-all school finance environment in Texas and elsewhere.

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Appendix A:

Summary of Variables Used in School-Level Regression Analyses (2008)					
Variable	**N**	**Minimum**	**Maximum**	**Mean**	**SD**
TAKS scores					
% proficient reading	419	61	99	85	8
% proficient math	419	26	99	83	10
School capacity					
% with 3+ years experience	413	20	100	72	12
% with master's	407	3	54	24	8
% with doctorates	115	1	10	3	2
% bilingual	413	0	77	14	21
School expenditures					
Operating	419	101	22,507	7,097	1,506
Curriculum	419	1	628	128	88
Instructional	419	87	16,232	5,135	1,048
Leadership	419	0	725	94	52
School demographics					
% White	419	0	84	9	17
% bilingual learners	413	0	77	14	21
% special education	419	0	34	7	3
% at risk	418	14	94	65	18
∆TAKS achievement scores					
% proficient reading	1,170	50	-23	27	2
% proficient math	1,170	53	-23	30	2
∆ school capacity					
% novice	1,167	59	-27	31	-1
% master's degrees	1,142	1	0	0	0
% bilingual	1,166	137	-74	63	-6
∆ school expenditures					
Operating	1,169	11,413	-3,109	8,304	461
Curriculum	1,169	572	-233	339	5
Instructional	1,169	8,268	-1,891	6,377	341
Leadership	1,169	546	-273	273	5
∆ school demographics					
% White	1,170	32	-10	21	0
% Bilingual learners	1,170	47	-15	32	2
% Special education	1,170	17	-10	7	-1
% At risk	1,144	144	-73	70	3

1. The PEIMS was created in 1983 to provide a uniform accounting system for Texas to collect all information about public education, including student demo graphics, academic performance, personnel, and school finances.

2. Bilingual learners has emerged as a more accurate term to denote English language learners or limited English proficient students

3. Retrieve at http://www.ritter.tea.state.tx.us/school.finance/forecasting/summaries/ definitions.doc