Making Connections

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Puerto Rico school characteristics and student graduation: Implications for research and policy

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Key findings

This study of high school graduation rates and school characteristics in Puerto Rico finds that a school's percentage of students proficient in Spanish language arts was associated with higher graduation rates for all groups of students (male students, female students, students living in poverty, and students in special education), after other school characteristics were accounted for. Additionally, lower student–teacher ratios were associated with higher graduation rates for some groups of students (male students, students living in poverty, and students in special education), after other school characteristics were accounted for. Finally, high schools with a lower percentage of highly qualified teachers had higher graduation rates after other school characteristics were accounted for.

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Summary

High school graduation is a critical milestone for students as it has implications for future opportunity and success on both individual and societal levels (see Alexander, Entwisle, & Kabbani, 2001; Cataldi, Laird, & Kewal-Ramani, 2009; Kozol, 2005; Rumberger, 2011; Tyler & Lofstrom, 2009). In Puerto Rico recent changes in how high school graduation rates are calculated have drawn closer attention to the issue of high school graduation and thus a growing interest in understanding the relationship between Puerto Rico's high school characteristics and graduation rates. This report presents findings from a correlational study of high school characteristics and high school graduation in Puerto Rico.

Using data from the Puerto Rico Department of Education and publicly available data about the cohort of grade 10 students who entered Puerto Rico high schools during the 2010/11 school year, the study analyzed the correlation between graduation rates and two types of variables. The two types of variables are school-level student composition variables and school characteristic variables. School-level student composition variables refer to characteristics that are not amenable to intervention by educators (for example, the percentage of students who are male), and school characteristic variables refer to characteristics that can be changed or, in other words, that are amenable to intervention (for example, the student–teacher ratio). The study then estimated the conditional association between these characteristics and on-time graduation (within three years) using regression analyses to control for other factors. The key findings associated with school characteristics —those amenable to intervention—are:

- Puerto Rico high schools with a higher percentage of students who were proficient in Spanish language arts had higher graduation rates overall and for all students subgroups examined (male students, female students, students living in poverty, and students in special education). These relationships were also found after other school characteristics were controlled for.
- High schools with higher percentages of students who were proficient in math had higher graduation rates for all students and for all student subgroups except female students. However, the relationships were not apparent after other school characteristics were controlled for.
- High schools with lower student–teacher ratios had higher rates of graduation overall and for all subgroups. After other school characteristics were controlled for, the relationships were still found for male students, students living in poverty, and students in special education but not for all students or for female students.
- Contrary to the expectation that having more qualified teachers in a school would result in higher graduation rates, this study found that high schools with lower percentages of highly qualified teachers—teachers who attain full state (regular) certification in the subject taught[1]—had higher graduation rates for all students and for all subgroups except male students. After other school characteristics were controlled for, schools with fewer highly qualified teachers still had higher graduation rates overall and for male students, students living in poverty, and students in special education.

These findings provide a starting point for Puerto Rico stakeholders interested in data-driven decisionmaking to address the low rates of graduation in their high schools and communities. Two strategies that might be helpful in raising graduation rates are:

- Implementing interventions to increase the percentage of students who score at the proficient level in assessments of Spanish language arts.
- Lowering the student–teacher ratio for students living in poverty and students in special education.

The findings of this study may also be useful for educators and researchers interested in understanding on-time high school graduation rates in U.S. territories, such as Puerto Rico, where research has been limited and information on graduation trends remains scarce.

Contents

Why this study?

In recent years researchers, policymakers, educators, and concerned citizens across the United States have focused on the challenge of ensuring that every student graduates from high school. Although the proportion of high school students graduating within four years has surpassed 80 percent nationally, more than 3 million students continue to drop out of high school each year—an average of more than 8,000 each day (Alliance for Education, 2010; Stetser & Stillwell, 2014). The consequences of dropping out are numerous. Nongraduates are likely to earn less income and require more public assistance than high school graduates. They are liable to commit more crimes. They are likely to die younger. They put the civic health of their local communities at risk by being less likely to vote or volunteer, pay taxes, or provide adequately for their families (Alexander, Entwisle, & Kabbani, 2001; Cataldi, Laird, & Kewal-Ramani, 2009; Kozol, 2005; Rumberger, 2011; Tyler & Lofstrom, 2009).

Puerto Rico is often excluded from research on dropout prevention because of problems in data alignment, data availability, and potential contextual differences

Puerto Rico, too, faces this challenge but is often excluded, along with other U.S. territories, from research on dropout prevention because of problems in data alignment, data availability, and potential contextual differences. For instance, the National Center for Education Statistics excludes Puerto Rico from its documentation relating graduation rates to student characteristics such as race, sex, and age. One reason is that high school in Puerto Rico covers three years (grades 10–12), while the National Center for Education Statistics uses a four-year high school graduation rate.[2] Similarly, Puerto Rico has been excluded from explorations of dropout prevention in schools and communities across the United States (see, for example, Balfanz and Letgers, 2004). Without additional research, the factors associated with high school graduation in Puerto Rico and the extent of the dropout crisis will remain unknown.

Interest in Puerto Rico in factors associated with graduation and dropping out has also been stimulated by a change in how the Puerto Rico Department of Education calculates high school graduation rates. The new method gives a better basis for exploring and developing policies to increase graduation rates. In the past Puerto Rico calculated graduation rates as the percentage of students who enrolled in grade 12 and graduated that same school year (Stillwell, Sable, & Plotts, 2011). This method did not capture some students who entered high school but left before starting grade 12 or students who graduated late. Recently the Puerto Rico Department of Education, along with many other U.S. state education agencies, adopted the cohort graduation rate, which uses the number of students enrolled in the first year of high school—grade 10 in Puerto Rico—as the denominator (Stetser & Stillwell, 2014). School-level data for the cohort examined in this study provide the first chance to identify school characteristics that may be relevant to three-year graduation rates in Puerto Rico. However, because the Puerto Rico Department of Education uses a three-year cohort graduation rate, it is not comparable to the more common four-year cohort rate used and reported in the United States.

Regional Educational Laboratory (REL) Northeast & Islands conducted this study with the Puerto Rico Research Alliance for Dropout Prevention to help alliance members use this new school-level data to explore high school graduation rates and develop policies aimed at increasing them. This study, by describing the school characteristics of high school graduates and identifying characteristics that have a significant association with school-level graduation rates, provides an important first step in understanding graduation trends in Puerto Rico.

What the study examined

The REL Northeast & Islands study team examined two types of variables for each school. First are school-level student composition variables—student gender, socioeconomic status (measured as the percentage of students living below the poverty line), and special education status—that are not amenable to intervention by educators. In 2010/11 roughly half of students across all schools lived below the poverty line, though the proportion at individual schools varied from 2 percent to 90 percent. This reflects Puerto Rico overall: more than 45 percent of Puerto Ricans live below the poverty line according to recent census data. Nearly 37 percent of families depend on the federal program of Nutrition Assistance for Puerto Rico, and almost a quarter million families live on less than $10,000 a year (Bishaw and Fontenot, 2014). In contrast, in Mississippi, the most impoverished U.S. state, 22 percent of the population lives at or below the poverty line. For the cohort of students graduating in 2012/13, the proportion of high school students in special education in 2010/11 varied from 0 percent to 71 percent, with an average of 15 percent.

The study analyzed the relationship of two types of variables to high school graduation rates: school-level student composition variables that are not amenable to intervention by educators and school characteristics that are amenable to intervention by educators (and others)

The second type of variable consists of four school characteristics that are amenable to intervention by educators (and others): student achievement in Spanish language arts, student achievement in math, student–teacher ratio, and rate of teacher certification.

The study team analyzed the relationship of both types of variables to high school graduation rates for each school (see box 1 for definitions of these variables). The study addresses the following research questions:

- How are three school-level student composition variables that are not amenable to intervention by educators (gender, socioeconomic status, and special education status) correlated with graduation rates?
- How are school characteristics that are amenable to intervention (student achievement and characteristics of educators) correlated with graduation rates overall and for subgroups of students in each school categorized by gender, socioeconomic status, and special education status?
- How are school characteristics that are amenable to intervention associated with graduation rates after other school characteristic variables are controlled for?

To answer these questions for a three-year cohort of Puerto Rico high school students, the study team analyzed student demographic data for the 2010/11 school year, when the cohort was in grade 10, and graduation rates for 2012/13, when the cohort was expected to graduate (see box 2 for a summary of data and methods and the appendix for a detailed description).

What the study found

Sixty-eight percent of all students who started high school in Puerto Rico in grade 10 in 2010/11 graduated on time three years later. Schools' graduation rates varied by their school-level student composition and by their school characteristics amenable to intervention by educators. Correlation results are presented first. Regression analyses are then used to describe the relationship of each schools' graduation rates to these characteristics after other factors are controlled for.

Box 1. Key terms

School-level student composition variables. These are variables that describe the school but that are not amenable to change based on intervention by educators within the school. They include the school-level percentages of students by gender, socioeconomic status (measured as the percentage of students living below the poverty line), and special education status.

School characteristic variables. These are variables that describe a school and that are amenable to intervention by educators (and others) such as student achievement outcomes and allocation of resources in terms of the number and qualification of teachers. For this study the variables are the percentage of students who are proficient in Spanish language arts and math as well as the student–teacher ratio and the rate of teachers who are certified, which is aligned with the designation of being a highly qualified teacher.

Not amenable to intervention. This refers to characteristics that describe the school in terms of the percentages of student subgroups that the school serves and that are therefore not alterable through policy or practices. For this study these characteristics are the school-level student composition variables, which include the percentages of students by gender, socioeconomic status (measured as the percentage of students living below the poverty line), and special education status.

Amenable to intervention. This refers to characteristics of a school that describe student outcomes and allocation of resources that are not fixed and that can be altered by educators (and others). For this study these are the school characteristic variables, which include student outcomes on assessments (achievement in Spanish language arts and math) and the allocation of resources in terms of the number and qualification of teachers.

Box 2. Data and methods

The Puerto Rico Department of Education, through the Puerto Rico Institute of Statistics, provided graduation rates for all public high schools in Puerto Rico for students who started grade 10 in 2010/11 and were expected to graduate at the end of the 2012/13 school year. These were the most recent graduation data available. The study included all regular public schools with students in grades 10–12, regardless of the overall school structure (some schools, for example, included grades 6–12). The Puerto Rico Department of Education calculated and reported graduation rates using the three-year adjusted cohort analysis method for the first time for the 2010/11 cohort. Thus, school-level data for this cohort provide the first chance to identify school characteristics that may be relevant to three-year graduation rates in Puerto Rico. See table for descriptions of variables and sources of data.

The data for students who entered high school in 2010/11 were used to calculate correlations between school-level graduation rates and school-level student composition and school characteristics (the first two research questions). In addition, the study used regression modeling to estimate the association of each school characteristic with graduation rates, holding all of the other characteristics constant (third research question). A full overview of the data collection process and methodology used in this study is provided in the appendix.

(continued)

Box 2. Data and methods *(continued)*

Puerto Rico public high school data sources

School level variable	Variable description	Number of schools with data[a]
Student composition (not amenable to intervention)		
Gender[b]	Percentage of male high school students in 2010/11	195
Socioeconomic status[b]	Percentage of high school students living below the poverty line in 2010/11[c]	195
Special education status[b]	Percentage of high school students in special education in 2010/11	195
School characteristics (amenable to intervention)		
Student achievement, Spanish language arts[b]	Percentage of students who score at the proficient level on the grade 11 language portions of the annual assessments Pruebas Puertorriquenas de Aprovechamiento Academico in 2011/12	192
Student achievement, math[b]	Percentage of students who score at the proficient level on the grade 11 math portions of the Pruebas Puertorriquenas de Aprovechamiento Academico in 2011/12	192
Student–teacher ratio[d,e]	Number of students per teacher in 2010/11	192
Teacher certification[b,d]	Percentage of high school classes taught by a highly qualified teacher in 2010/11	188
High school graduation rate[f]	Percentage of 2010/11 grade 10 students who graduated on time in 2012/13 (three-year cohort high school graduation method)	195
High school graduation rate by gender, socioeconomic status, and special education status[f]	Percentage of 2010/11 grade 10 students, by subgroup (gender, socioeconomic status, and special education status) who graduated on time in 2012/13 (three-year cohort high school graduation method)	195

a. There are a total of 202 high schools serving students in grade 12. However, the seven alternative schools serving special populations of students (for example, focusing on dropout prevention and recovery) were excluded from the sample because they did not report graduation rates or served very small populations of students. Thus the analysis includes 195 regular public schools in Puerto Rico.

b. Data are from the Puerto Rico Department of Education.

c. The Puerto Rico Department of Education uses information about students living in poverty, rather than students eligible for the federal school lunch program, as a key socioeconomic indicator.

d. The Puerto Rico Department of Education calculates student–teacher ratio data and highly qualified teacher data for all students in all grades in a school. If a school includes grades below grade 10, the ratios include those grades.

e. Common Core of Data (U.S. Department of Education, 2015).

f. Data are from the Puerto Rico Department of Education through the Puerto Rico Institutes of Statistics.

Higher graduation rates were correlated with lower percentages of students living below the poverty line and lower percentages of students in special education

Sixty-eight percent of all students who started high school in Puerto Rico in grade 10 in 2010/11 graduated on time three years later

Schools with higher graduation rates had lower percentages of students living below the poverty line (correlation –.16) and lower percentages of students in special education (–.31; table 1).

Higher graduation rates were correlated with higher percentages of students who scored at the proficient level in Spanish language arts and math, a lower average student–teacher ratio, and a lower percentage of highly qualified teachers

A school's percentage of students who scored at the proficient level or higher in Spanish language arts in grade 11 was correlated with the school's on-time graduation rates.

Table 1. Overall correlation coefficients between school-level student composition in 2010/11 and Puerto Rico high school graduation rates for 2012/13

Outcome	School level student composition		
	Percentage of male students, 2010/11	Percentage of students living below poverty line, 2010/11	Percentage of special education students, 2010/11
Graduation rate, 2012/13 (three-year cohort high school graduation method)	–.08	–.16*	–.31*

* Significant at $p < .05$.

Note: Number of schools = 195. The graduation rate is the three-year adjusted cohort method, which divides the number of students who graduate in grade 12 three years after entering grade 10 by the number of students who entered grade 10, adding students who later transfer in and subtracting students who transfer out, emigrate, or die.

Source: Authors' analysis based on 2010/11 data on school-level student composition from the Puerto Rico Department of Education and 2012/13 graduation rate data from the Puerto Rico Department of Education through the Puerto Rico Institute of Statistics.

Overall, the correlation between a school's percentage of students who were proficient in Spanish language arts in grade 11 and the school's graduation rate was .51 (table 2). A positive correlation was found between a school's Spanish language arts proficiency rate and graduation rates for all subgroups at a school. The correlation was highest for students living below the poverty line (.45) and students in special education (.39; table 2).

A positive correlation was found between a school's Spanish language arts proficiency rate and graduation rates for all subgroups at a school

A school's percentage of students proficient in math in grade 11 also was positively correlated with its graduation rate (correlation of .22). A similar correlation was found for the graduation rates of all school-level student subgroups with the exception of female students (see table 2). However, this correlation does not hold in the regression analyses reported below.

Table 2. Correlation coefficients between school characteristics and Puerto Rico high school graduation rates for 2012/13 by school-level student composition variable

School characteristic	Overall graduation rate, 2012/13	Graduation rate of student subgroups			
		Male students, 2012/13	Female students, 2012/13	Students living below poverty line, 2012/13	Students in special education, 2012/13
Percentage of students proficient in Spanish language arts in grade 11, 2011/12	.51*	.28*	.33*	.45*	.39*
Percentage of students proficient in math in grade 11, 2011/12	.22*	.21*	.12	.24*	.23*
Student–teacher ratio,[a] 2010/11	–.24*	–.23*	–.18*	–.26*	–.26*
Percentage of highly qualified teachers[a], 2010/11	–.23*	–.08	–.19*	–.22*	–.28*

* Significant at $p < .05$.

Note: The number of schools reporting data varies by school-level student composition and school characteristics. The graduation rate is the three-year adjusted cohort method, which divides the number of students who graduate in grade 12 three years after entering grade 10 by the number of students who entered grade 10, adding students who later transfer in and subtracting students who transfer out, emigrate, or die.

a. For schools that include grades below high school, these values include students and teachers in lower grades.

Source: Authors' analysis based on 2010/11 school-level student composition data and teacher certification data from the Puerto Rico Department of Education; 2011/12 student proficiency data from Puerto Rico Department of Education; 2010/11 student–teacher ratio data from the Common Core of Data (U.S. Department of Education, 2015); and 2012/13 high school graduation rate data from the Puerto Rico Department of Education through the Puerto Rico Institute of Statistics.

A school's 2010/11 student–teacher ratio and its 2012/13 graduation rate were significantly and negatively correlated. The overall correlation was –.24, indicating that a lower number of students per teacher was correlated with a higher graduation rate, and this same relationship was found for graduation rates of all student subgroups (see table 2). This correlational relationship holds for only some subgroups of students in the regression analyses reported below.

Surprisingly, having a lower percentage of highly qualified teachers within a school was correlated with a higher graduation rate (–.23). This negative correlation with graduation rates was statistically significant for all subgroups except male students (see table 2). The finding that having fewer highly qualified teachers was correlated with higher graduation rates is counterintuitive and worth further investigation. This finding is discussed below for the regression analyses.

A lower number of students per teacher was correlated with a higher graduation rate for all student subgroups

Many of the four school characteristic variables are correlated with each other and with the school-level student composition variables (table 3). The percentage of students at a school who are proficient in Spanish language arts is positively correlated with the percentage of students who are proficient in math (.60). The percentage of students in special education is negatively correlated with the percentages of students with Spanish language

Table 3. Correlation coefficients between school characteristics and school-level student composition for Puerto Rico high schools

	School level student composition			School characteristic		
School characteristic or school level student composition variable	Percentage of students living below poverty line 2010/11	Percentage of students in special education 2010/11	Percentage of students proficient in Spanish language arts in grade 11[a], 2011/12	Percentage of students proficient in math in grade 11[a] 2011/12	Student–teacher ratio[a] 2010/11	Percentage of highly qualified teachers[a] 2010/11
Percentage of male students, 2010/11	.13	.16*	–.25*	–.01	.21*	–.18*
Percentage of students living below poverty line, 2010/11		.19*	–.20*	–.08	.16*	–.03
Percentage of students in special education, 2010/11			–.36*	–.18*	–.12	–.16
Percentage of students proficient in Spanish language arts in grade 11,[a] 2011/12				.60*	–.10	.06
Percentage of students proficient in math in grade 11,[a] 2011/12					–.03	–.07
Student–teacher ratio[a], 2010/11						.33*

* Significant at $p < .05$.

Note: The number of schools reporting data varies by school-level student composition and school characteristics. The graduation rate is the three-year adjusted cohort method, which divides the number of students who graduate in grade 12 three years after entering grade 10 by the number of students who entered grade 10, adding students who later transfer in and subtracting students who transfer out, emigrate, or die.

a. Characteristic amenable to change or interventions in the short run.

Source: Authors' analysis based on 2010/11 school-level student composition data and teacher certification data from the Puerto Rico Department of Education; 2011/12 student proficiency data from Puerto Rico Department of Education; 2010/11 student–teacher ratio data from the Common Core of Data (U.S. Department of Education, 2015); and 2012/13 high school graduation rate data from the Puerto Rico Department of Education through the Puerto Rico Institute of Statistics.

arts proficiency (–.36) and math proficiency (–.18). Schools with higher percentages of highly qualified teachers tend to have more students per teacher (.33) and smaller percentages of male students (–.18).

The correlational analyses showed associations between two characteristics at a time, and regression analyses showed the association of each school characteristic with graduation rates while all the other school characteristics are controlled for in the model

In regression analyses that examined individual variables and controlled for school-level student composition and school characteristics, some variables were associated with school-level graduation rates overall or for specific student subgroups, while other variables were not

To answer the third research question, regression modeling was used to measure the association between school characteristics amenable to intervention and school-level graduation rates while controlling for school-level student composition and school characteristics. The correlational analyses showed associations between two characteristics at a time, and the regression analyses showed the association of each school characteristic with graduation rates while all the other school characteristics are controlled for in the model (table 4). The analyses also were conducted for graduation rates of specific subgroups of students, such as students living below the poverty line, to understand how school-level student composition variables relate to different subgroups' graduation rates.

Table 4. Regression coefficients for the association between school-level student composition and school characteristic variables and graduation rates in Puerto Rico high schools overall and by student subgroup, after both types of variables are controlled for

Characteristic or statistic	Overall graduation rate, 2012/13	Graduation rate of student subgroups			
		Male students, 2012/13	Female students, 2012/13	Students living below poverty line, 2012/13	Students in special education, 2012/13
Percentage of male students, 2010/11	0.26*	0.50*	0.17	0.39*	0.09
Percentage of students living below poverty line, 2010/11	–0.04	–0.08	–0.06	–0.04	–0.03
Percentage of students in special education, 2010/11	–0.20	–0.38*	–0.42*	–0.31*	–0.67*
Percentage of students proficient in Spanish language arts in grade 11,[a] 2011/12	0.40*	0.14*	0.20*	0.35*	0.35*
Percentage of students proficient in math in grade 11,[a] 2011/12	–0.10	–0.06	–0.07	–0.06	–0.04
Student–teacher ratio,[a] 2010/11	–0.42	–0.76*	–0.59	–0.73*	–1.74*
Percentage of highly qualified teachers,[a] 2010/11	–0.16*	–0.18*	–0.11	–0.15*	–0.20*
Adjusted R^2	0.34	0.19	0.18	0.30	0.32
Number of schools	185	185	185	185	177

* Significant at $p < .05$.

Note: Student–teacher ratio and percentage of highly qualified teachers include students and teachers in grades below the high school level. Variables were not mean-centered. The results are from a multivariate regression analysis (see the appendix).

a. Characteristic that is amenable to change or interventions in the short run.

Source: Authors' analysis based on 2010/11 school-level student composition data and teacher certification data from the Puerto Rico Department of Education; 2011/12 student proficiency data from Puerto Rico Department of Education; 2010/11 student–teacher ratio data from the Common Core of Data (U.S. Department of Education, 2015); and 2012/13 high school graduation rate data from the Puerto Rico Department of Education through the Puerto Rico Institute of Statistics.

A higher percentage of students proficient in Spanish language arts was associated with higher graduation rates for a school overall and for all student subgroups, after other school characteristic variables were controlled for

Having a higher percentage of students who were proficient in Spanish language arts was associated with higher graduation rates for the school when all other school variables that are amenable to intervention were held constant (for example, percentage of students proficient in mathematics, student–teacher ratio, and percentage of highly qualified teachers). Every 1 point increase in the percentage of students who scored proficient in Spanish language arts was associated with an approximately .40 percentage point increase in the graduation rate, when other school characteristics in the model are kept constant. School-level Spanish language arts proficiency rates were positively associated with graduation rates for each subgroup, most notably for students living in poverty (correlation of .35) and students in special education (.35; see table 4).

Though math proficiency was positively associated with graduation rates in the correlation analyses, the association was not significant when other school characteristic variables were controlled for

The percentage of students proficient in math was not associated with graduation rates, after other school characteristic variables were controlled for

A school's percentage of students who scored proficient in math was not associated with graduation rates for the school overall or for subgroups of students when school-level student composition variables and other school characteristic variables amenable to intervention by educators were controlled for (see table 4). Even though math proficiency was associated with graduation rates in the correlation analyses (correlation .22; see table 2), the association was not significant on its own, when other school characteristic variables were controlled for. The difference between the initial correlation and the analyses that control for other variables may be due in part to the sizable correlation (.60; see table 3) between math proficiency and Spanish language arts proficiency. After the correlation between graduation rates and Spanish language arts proficiency are accounted for, math proficiency contributes little unique correlation.

Lower student–teacher ratios were associated with higher graduation rates for male students, students living in poverty, and students in special education, after other school characteristic variables were controlled for

Significant negative relationships were found between a school's student–teacher ratios and graduation rates of male students (–.76), students living in poverty (–.73), and students in special education (–1.74; see table 4). For these subgroups of students, being in a school with fewer students per teacher is associated with higher graduation rates.

A higher percentage of highly qualified teachers was associated with lower graduation rates overall and for male students, students living in poverty, and students in special education, after other school characteristic variables were controlled for

A school's percentage of highly qualified teachers was negatively associated with high school graduation rates overall and for all subgroups except female students (see table 4). Although high schools in Puerto Rico generally have a high percentage of highly qualified teachers, high schools with the highest graduation rates for male students, students living in poverty, and students in special education have some of the lowest percentages of highly qualified teachers. This finding is counterintuitive, because a higher percentage of highly

qualified teachers in a high school would generally be expected to be associated with a higher graduation rate.

There were significant relationships between some school-level student composition characteristics and graduation rates for specific subgroups

The percentage of male students in a school was positively associated with higher graduation rates overall and higher graduation rates for male students and for students living below the poverty line, when other school characteristic variables were controlled for (see table 4). The percentage of students in special education in a school was negatively associated with graduation rates for all subgroups of students when other school variables were controlled for. In other words, when schools with similar student composition characteristics were compared, schools with higher percentages of special education students had lower graduation rates.

Implications of the study findings

The findings suggest that efforts to increase the percentage of students who are proficient in Spanish language arts and decrease student–teacher ratios may boost graduation rates in Puerto Rico high schools

The findings suggest that efforts to increase the percentage of students who are proficient in Spanish language arts and decrease student–teacher ratios may boost graduation rates in Puerto Rico high schools. Additional studies are needed to identify causal relationships between school characteristics and graduation rates.

Implications are not clear for the counterintuitive finding that the percentage of highly qualified teachers in a school was negatively associated with high school graduation rates overall and for all subgroups except female students. Perhaps teacher certification, the requirement for highly qualified teacher status in Puerto Rico, is not an important factor in high school graduation rates. Perhaps highly qualified teachers are more likely to choose to work in schools with higher proportions of students who are less likely to graduate. Or perhaps highly qualified teachers have trouble identifying with and motivating students at risk of dropping out.

Puerto Rico's definition of highly qualified teachers, which is based on certification requirements within content areas, is consistent with the definition in the No Child Left Behind Act of 2002 (Puerto Rico Department of Education, 2008). Some of the requirements in the act for being designated a highly qualified teacher (holding a bachelor's degree or higher from a four-year institution, having the content knowledge required to teach core academic subjects, and having a state teaching license) have been found to have statistically significant associations with student achievement (Cavalluzzo, 2004; Goldhaber, 2002; Goldhaber & Brewer, 2000; Laczko-Kerr & Berliner, 2002). But researchers also have found significant relationships between teacher experience in the classroom, as well as teacher salary, and student performance (Grissmer, Flanagan, Kawata, & Williamson, 2000; Hanushek, Kain, & Rivkin, 1999; Nye, Konstantopoulos, & Hedges, 2004). The act's requirements for highly qualified teachers may not be as important for increasing graduation rates in Puerto Rico as other teacher characteristics not captured in the definition. Additional research is needed to determine which teacher credentials are important in increasing educational achievement and attainment.

Additional school-level student composition variables and school characteristics may also affect graduation rates. A fuller understanding of all the major factors associated with

higher graduation rates will allow educators and policymakers to focus on schools that are struggling to raise graduation rates and may lead to greater interest in additional studies on the entire range of these factors. A review and inventory of the data on school-level student composition variables and school characteristics collected in Puerto Rico could help researchers identify and examine other potential factors associated with high school graduation. For example, if data on additional factors, such as student attendance or rates of behavioral infractions are available, then these may be considered for study.

While this research provides insights into variables that are associated with high school graduation rates in Puerto Rico, there is a need to further understand the factors that may contribute to higher graduation rates. For example, are there strategies or programs that are in place in schools with higher graduation rates? Having more information about the types of school supports available to students may enable study of these variables and their association with high school graduation.

Limitations of the study and directions for further research

The availability of data on factors associated with graduation rates from the Puerto Rico Department of Education limited the number of potentially important factors the study could examine. (Table A1 in the appendix details the data elements that were requested and those that were actually provided for this study.)

Although the available data provided important insight into graduation rates in Puerto Rico and the school characteristics that might have an effect on school-level graduation rates, this insight is somewhat limited due to the incomplete availability of variables and the paucity of complete data sets for all high schools

Although the available data provided important insight into graduation rates in Puerto Rico and the school characteristics that might have an effect on school-level graduation rates, this insight is somewhat limited due to the incomplete availability of variables and the paucity of complete data sets for all high schools. In addition, the school-level student–teacher ratio and highly qualified teacher variables in the study included students and teachers in grades below high school (about 4 percent of the schools in the study included grades below grade 7, and another 15 percent included grades between 7 and 9).[3]

Additional data would have increased the number of variables examined and the precision of the findings. The study identified some variables that might be associated with school-level graduation rates, such as the average number of students per class and the number of chronically absent students (see table A1 in the appendix). In addition, student participation in dropout prevention programs and afterschool programs was considered for inclusion in the study, but the data were not available.

Efforts to assess the precision and stability of the correlations were limited because data were available for only one cohort of students whose graduation rate was calculated using the three-year adjusted cohort method. When data are available on additional student cohorts, researchers could pool the data into one regression analysis and add school dummy variables to the model to implicitly control for all school-level variables that are unobserved and remain fixed over time. Additionally, a year by year analysis could provide information about the stability of the results over time.

Finally, the methods used to examine school graduation trends limit the findings of this study. Although correlation and regression analyses identify relationships, they do not identify causal relationships. So although the study points to a potentially important relationship between the percentage of students proficient in Spanish language arts and

school-level graduation rates, it does not provide any evidence that boosting the percentage of students proficient in Spanish language arts would increase on-time graduation rates. Further research is needed to determine the extent to which changes in these school characteristics would change graduation rates.

Appendix. Data and methodology

The study team from the Regional Educational Laboratory (REL) Northeast & Islands requested relevant school-level data for this study from the Puerto Rico Department of Education and the Puerto Rico Institute for Statistics, addressed issues related to data cleaning and missing data, provided basic descriptive statistics of high school graduation characteristics based on these data, and used regression analysis to identify which characteristics were most strongly associated with school-level graduation rates in Puerto Rico.

Data collection and preparation

The Puerto Rico Department of Education, through the Puerto Rico Institute for Statistics, provided school-level graduation rates for the 2012/13 cohort, along with school characteristics for all public high schools within the territory as reported for the 2010/11 school year. Because the purpose of this study was to identify school characteristics correlated with graduation rates, the study is limited to regular public schools containing students in grade 12 regardless of the overall school structure (for example, K–12, 7–12, 10–12). Seven alternative schools serving special populations of students (for example, focusing on dropout prevention and recovery) were excluded from the sample because they did not report graduation rates or served very small populations of students. The analysis includes the 195 regular public schools in Puerto Rico that meet these criteria.

Members of the REL Northeast & Islands Puerto Rico Research Alliance for Dropout Prevention and the study team purposely chose to use school-level student composition data from the 2010/11 school year. That was the first year of high school for students in the Puerto Rico Department of Education's first use of the three-year adjusted cohort analysis method for calculating and reporting graduation rates. The three-year adjusted cohort method is calculated by dividing the number of students who graduate in grade 12 three years after entering grade 10 by the number of students who entered grade 10, adding students who later transfer in and subtracting students who transfer out, emigrate, or die. Thus, school-level data from 2010/11 provide the first look at school-level student composition and school characteristics that may be relevant to graduation rates in 2012/13. Table A1 provides an overview of the variables requested and their use in this study.

After receiving the requested data, the study team worked with the Puerto Rico Department of Education to ensure the data were in a suitable form for analysis. Because this was the first time that the department had shared these data, it was not possible to predict confidently the extent of problematic or missing data. The Puerto Rico Department of Education does not have the same regulations, oversight, or authority as the U.S. Department of Education for obtaining accurate and complete data from schools, and there are no data quality checks at the territory level. As a result, a number of data-cleaning procedures were used to ensure that all of the variables of interest were in a suitable form for analysis. Data were screened to identify duplicate or problematic cases, inspect inconsistencies across multiple records of the same school, and flag values that were out of range. The prevalence of problematic data was minimal and the study team felt confident that the data provided was suitable for analysis.

Table A1. Requested data elements for the study of Puerto Rico high school graduation rates

Data element	Element description	Variable status
High school name	School name	Used
Unique school identifier	Unique school identifier	Used
Three-year adjusted cohort graduation rate, by school	School graduation rate as calculated by the number of students entering in 2010/2011 who graduated on time three years later in 2012/13	Used
Gender	Percentage of students male or female	Used
Socioeconomic status (poverty level)	Percentage of students living below the poverty line	Used
Special education status	Percentage of students in special education status	Used
Student achievement—Spanish	Percentage of students who were proficient on the Spanish portions of the Pruebas Puertorriquenas de Aprovechamiento Academico in grade 11	Used
Student achievement—English	Percentage of students who were proficient on the English portions of the Pruebas Puertorriquenas de Aprovechamiento Academico in grade 11	Not provided
Student achievement—math	Percentage of students who were proficient on the math portions of the Pruebas Puertorriquenas de Aprovechamiento Academico in grade 11	Used
Student achievement—science	Percentage of students who were proficient on the science portions of the Pruebas Puertorriquenas de Aprovechamiento Academico in grade 11	Not provided
Average daily attendance rate	Average percentage of enrolled students in attendance across the school year	Not provided
Chronically absent	Percentage of students who missed 10 percent or more of school days	Not provided
Average class size	Average class size, across all classes offered	Not provided
Average core class size	Average class size, across all core classes (English, math, social studies, and science) offered	Not provided
Leader or principal's years of service in position	Number of years of service in the current position at any school	Not provided
Leader or principal's total years of service	Total number of years of service	Not provided
Leader or principal's certification	Leader or principal certification for position	Not provided
Teacher's years of service in position	Average number of years of service in current position at any school	Not provided
Teacher's total years of service	Average number of total years of service	Not provided
Student–teacher ratio	Student–teacher ratio from Common Core of Data (all grades)	Used
Teacher certification	Percentage of highly qualified teachers in the school (all grades)	Used
Teacher average daily attendance rate	Average percentage of teachers in attendance across the school year	Not provided

Note: Some variables were not available because of difficulty constructing them (for example, average core/class size, attendance). All variables in this table refer to school-level information unless otherwise specified. Socioeconomic status is reported by the Puerto Rico Department of Education as students who live below the poverty line rather than the more commonly used measure of students eligible for the federal school lunch program.

Source: Authors' compilation.

Analysis steps

Because this was the first time that the Puerto Rico Department of Education had shared these school-level variables, descriptive analyses of the available data were conducted to inform Puerto Rico Research Alliance for Dropout Prevention members about the data and determine the procedures for the proposed analyses that followed.

To address the first two research questions, the Pearson's coefficient was calculated using the following equation:

$$r = \frac{n(\Sigma xy) - (\Sigma x)(\Sigma y)}{\sqrt{\left[n\Sigma x^2 - (\Sigma x)^2\right]\left[n\Sigma y^2 - (\Sigma y)^2\right]}}$$

For this study, a correlation between an independent variable (a school characteristic) and graduation rates was considered to be statistically significant if the p-value was less than .05. A separate analysis was conducted for each school characteristic. Each analysis is based only on schools with nonmissing data for all variables used in that analysis. Less than 10 percent of schools were dropped from any analysis because of missing data. Variables are not mean-centered. Coefficients are unstandardized. The correlations in this study are based on samples ranging from 188 to 195.

A series of regression analyses were employed with the school-level, three-year graduation rates as the outcome predicted by the school-level variables. Continuous graduation rates were used rather than quartiles because the categorization of continuous variables into discrete categories can result in a loss of potentially valuable information (Shaw, Huffman, & Haviland, 1987).

School-level variables (school-level student composition and school characteristics) were added to the regression model as outlined in the following equation:

$$\textit{Graduation Rate} = \beta_0 + \sum_{k=1}^{K} \beta_k \left(\textit{School Variables}\right)_k + \varepsilon$$

This model states that the predicted graduation rates are a function of an intercept (β_0), a slope for every school characteristic (β_1 through β_k) as well as residual error variance (ε).

Notes

1. Additional information on the definition of highly qualified teachers in Puerto Rico can be found in Puerto Rico Department of Education (2008).
2. The National Center for Education Statistics has conducted some analyses focusing on Puerto Rico (for example, calculating the average freshman graduation rate), but it has not conducted many of the analyses that are the focus of the current report. For more information, see Stillwell, Sable, and Plotts (2011).
3. Schools with wider grade spans were smaller, on average, than schools with only grades 10–12. Schools with grades below grade 7–12 had an average total enrollment of 207. Schools with grades 7–12 or 8–12 had an average total enrollment of 407. Schools with grades 10–12 had an average total enrollment of 575.

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