ies NATIONAL CENTER FOR EDUCATION EVALUATION AND REGIONAL ASSISTANCE
Institute of Education Sciences

DO DISADVANTAGED STUDENTS GET LESS EFFECTIVE TEACHING?
KEY FINDINGS FROM RECENT INSTITUTE OF EDUCATION SCIENCES STUDIES

TECHNICAL APPENDIX

A. Summary of Related, Non-Peer-Reviewed Studies

Although this brief focuses on the three peer-reviewed studies sponsored by IES, these are just part of a growing body of evidence that examines access to effective teaching based on student outcomes rather than teacher inputs. Table A.1 summarizes the key aspects of five studies from this emerging literature. The table indicates the number of states and districts in each study, subject areas, grade levels, time periods, approaches to measuring effective teaching and access to effective teaching, and a summary of the key findings. Findings from these additional studies are consistent with the overall finding presented in the brief; disadvantaged students have access to less effective teaching on average.

B. Methods for Comparing Findings from the Sass et al. and Isenberg et al. Studies

The studies we reviewed in the brief used different methods that had to be reconciled before we could compare the findings. For example, Isenberg et al. (2013) compared the average teacher value added for FRL and non-FRL students. Sass et al. (2012), on the other hand, compared teacher value added for higher- and lower-poverty schools without accounting for differences in effective teaching between FRL and non-FRL students within these schools.[1] The latter approach may underestimate the differences in effective teaching if FRL students are assigned to less effective teachers within schools. However, Sass and colleagues provided additional detail that we were able to use to account for these differences.[2]

To present the findings from Sass et al. using an analogous metric to that of Isenberg et al., we recalculated the results from Sass et al. based on a comparison of average teacher value added for FRL and non-FRL students. Besides providing more comparable results, this approach accounts for three sources of unequal access: differences between districts, between schools, and within schools. We describe our approach to re-calculating the Sass et al. results at the student level below.

Our approach was to use the estimates of average value added for the four combinations of school and student type listed below, estimate their sample proportions, and compute weighted averages by student type instead of school type, as Sass et al. had done. The four groups are as follows:

(1) FRL students in higher-poverty schools
(2) FRL students in lower-poverty schools
(3) Non-FRL students in higher-poverty schools
(4) Non-FRL students in lower-poverty schools

Table A.1. Key Aspects of Non-Peer-Reviewed Studies on Access to Effective Teaching

Aspect of the Study	Tennessee Department of Education (2007)	Steele et al. (2010)	Mansfield (2010)	Hahnel and Jackson (2012)	Students First (2013)
Number of states and districts	All districts in 1 state (Tennessee)	1 district (large, urban district in the South)	All districts in 1 state (North Carolina)	1 district (Los Angeles, CA)	1 district (New York, NY)
Subjects	Math	Math, English/ language arts, science, and social studies	Math, English/ language arts, science, and social studies	Math and English/ language arts	All subjects
Grade levels	4 through 8[a]	4 through 8	9 through 12	3 through 11 (English/language arts) 3 through 8 (math)	Elementary, middle, and high school grades[b]
Time period	2005–06	2004–05 through 2008–09	1997–98 through 2005–06	2007–08 through 2009–10	2011–12
Measure of effective teaching	Value-added score	Value-added score	Value-added score	Value-added score	District's teacher evaluation rating
Measure of access to effective teaching	Compare the percentage of highest- and lowest-performing teachers in schools with the highest and lowest rates of FRL and minority students	Compare average teacher effectiveness for school quartiles based on student performance and proportion of minority students	Compare average teacher effectiveness for highest and lowest quartile schools based on student performance and proportion of FRL and minority students	Compare percentage of FRL and non-FRL students who were taught by teachers in the top and bottom quartile for effectiveness	Compare percentage of teachers receiving an unsatisfactory evaluation rating in schools with the highest and lowest student achievement as well as proportion of FRL and minority students
Main finding, according to the authors	The highest-performing teachers were underrepresented in schools with the highest proportion of FRL and minority students	Schools with lower-achieving students and more minority students received less effective teaching in math, reading, science, and social studies than other schools	Schools with the lowest-achieving students as well as schools with the most FRL and minority students received less effective teaching than other schools	Disadvantaged students were less likely to be taught by the highest-performing teachers and more likely to be taught by the lowest-performing teachers	A higher percentage of teachers received an unsatisfactory rating (1) in schools with a high proportion of FRL and minority students and (2) in low-performing schools

a. There is no mention of the grade levels in this study. Given that the state assessment covers grades 3 through 8, we assumed the study focused on grades 4 through 8. Third grade would not be included because the value-added analysis requires one year of test scores to serve as a pre-test.

b. The authors of this study do not define the grade levels included, but the study includes elementary, middle, and high schools.

Whereas Sass et al. reported the weighted average value added of groups (1) and (3) together and compared it to the weighted average of (2) and (4) together, we calculated the weighted average of (1) and (2) together and compared it to the weighted average of (3) and (4), to be comparable to Isenberg et al.

To obtain the weights, we first calculated the proportion of all FRL students in each state who were in lower-poverty schools, with the remainder being in higher-poverty schools. We used information reported in Sass et al. on (1) the proportion of teachers in each school type (high versus low poverty) and (2) the proportion of students in each school type who were FRL eligible (Table B.1). We assumed that the proportion of all students in each school type was equal to the proportion of all teachers in each school type. These weights are shown in Table B.1, columns (c) and (d). Weights in column (c) were used with value-added estimates in column (e) and weights in column (d) were used with value-added estimates in column (f) to produce average value added by student type. Table B.2 shows the same weights applied to value-added estimates for English/language arts.

Table B.1. Calculating Differences in Effective Teaching Between Non-FRL and FRL Students for Math Using Data from Sass et al. (2012)

			Estimated Sample Proportions (weights)		Average Teacher Value Added in Standard Deviations of Student Achievement		
	(a) Proportion of All Teachers	(b) Proportion of Students Eligible for FRL	(c) Non-FRL (a)*[1-(b)]	(d) FRL (a)*(b)	(e) Non-FRL Students	(f) FRL Students	(g) Difference Between Non-FRL and FRL Students
Florida							
Lower-poverty schools	0.65	0.40	**0.390**	**0.260**	0.0439	0.0242	
Higher-poverty schools	0.35	0.85	**0.053**	**0.298**	0.0349	0.0240	
Weighted average					**0.0429**	**0.0241**	**0.0188***
North Carolina							
Lower-poverty schools	0.81	0.41	**0.478**	**0.332**	0.0330	0.0026	
Higher-poverty schools	0.19	0.86	**0.027**	**0.163**	-0.0100	-0.0216	
Weighted average					**0.0307**	**-0.0054**	**0.0361***

Source: Sass et al. (2012) with our calculations in bold.

Note: Higher-poverty schools are those with 70 percent or more of their students eligible for FRL. The remainder are lower-poverty schools. The average teacher value-added estimates for FRL and non-FRL students in each school type are from Tables 4a and 4b in Sass et al. (2012). Weighted averages in column (e) use weights from column (c). Weighted averages in column (f) use weights from column (d).

* Difference between non-FRL and FRL students is significantly different from zero at the 0.05 significance level.

Table B.2. Calculating Differences in Effective Teaching Between Non-FRL and FRL Students in Reading Using Data from Sass et al. (2012)

			Estimated Sample Proportions (weights)		Average Teacher Value Added in Standard Deviations of Student Achievement		
	(a) Proportion of All Teachers	(b) Proportion of Students Eligible for FRL	(c) Non-FRL (a)*[1-(b)]	(d) FRL (a)*(b)	(e) Non-FRL Students	(f) FRL Students	(g) Difference Between Non-FRL and FRL Students
Florida							
Lower-poverty schools	0.65	0.40	**0.390**	**0.260**	0.0482	0.0268	
Higher-poverty schools	0.35	0.85	**0.053**	**0.298**	-0.0018	-0.0229	
Weighted average					**0.0424**	**0.0003**	**0.0421***
North Carolina							
Lower-poverty schools	0.81	0.41	**0.478**	**0.332**	0.0307	0.0070	
Higher-poverty schools	0.19	0.86	**0.027**	**0.163**	-0.0335	-0.0450	
Weighted average					**0.0273**	**-0.0101**	**0.0374***

Source: Sass et al. (2012) with our calculations in bold.

Note: Higher-poverty schools are those with 70 percent or more of their students eligible for FRL; the remainder are lower-poverty schools. The average teacher value-added estimates for FRL and non-FRL students in each school type are from Tables 4a and 4b in Sass et al. (2012). Weighted averages in column (e) use weights from column (c). Weighted averages in column (f) use weights from column (d).

* Difference between non-FRL and FRL students is significantly different from zero at the 0.05 level.

We tested the statistical significance of the difference in average teacher value added for FRL and non-FRL students by using additional information provided by the authors on the standard errors of average teacher value added for teachers of FRL and non-FRL students within each school type (Table B.3).

We used the data in Table B.3 to calculate the variance of the difference in average teacher value added between FRL and non-FRL students for Sass et al. Equation 1 shows this variance expressed as the variance of average teacher value added for FRL students [$Var(VA_{FRL})$] plus the variance of average teacher value added for non-FRL students [$Var(VA_{nonFRL})$], minus two times the covariance of average value added for the two types of students. However, Sass et al. provided information on the variance of average teacher value added separately for teachers in higher- and lower-poverty schools (as shown in Table B.2). Equations 2 and 3 show how we defined the variance in average teacher value added for FRL and for non-FRL students when using these separate variance estimates for higher- and lower-poverty schools (for example, $VA_{nonFRL,HP}$ is the variance in average teacher value added for non-FRL students in higher-poverty schools). Equation 4 defines the covariance of the average value added for FRL and non-FRL students using separate variance estimates for higher- and lower-poverty schools. Equation 5 combines equations 2, 3, and 4.[3]

Table B.3. Standard Errors of Average Teacher Value Added for FRL and Non-FRL Students in Higher- and Lower-Poverty Schools

	Math		Reading	
	FRL Students	Non-FRL Students	FRL Students	Non-FRL Students
Florida				
Lower-poverty schools	0.0004	0.0002	0.0002	0.0002
Higher-poverty schools	0.0005	0.0012	0.0004	0.0008
North Carolina				
Lower-poverty schools	0.0005	0.0004	0.0004	0.0003
Higher-poverty schools	0.0009	0.0019	0.0007	0.0015

Source: Information provided by the authors of Sass et al. (2012).

We then calculated the standard error based on the variance in equation 5 and tested the statistical significance of differences in average teacher value added between non-FRL and FRL students.

(1) $$Var(VA_{nonFRL} - VA_{FRL}) = Var(VA_{nonFRL}) + Var(VA_{FRL}) - 2 \times Cov(VA_{nonFRL}, VA_{FRL})$$

(2) $$Var(VA_{nonFRL}) = Var[(VA_{nonFRL,HP} \times Pct_{nonFRL,HP}) + (VA_{nonFRL,LP} \times Pct_{nonFRL,LP})]$$
$$= (Pct_{nonFRL,HP})^2 \times Var(VA_{nonFRL,HP}) + (Pct_{nonFRL,LP})^2 \times Var(VA_{nonFRL,LP}) + 0$$

(3) $$Var(VA_{FRL}) = Var[(VA_{FRL,HP} \times Pct_{FRL,HP}) + (VA_{FRL,LP} \times Pct_{FRL,LP})]$$
$$= (Pct_{FRL,HP})^2 \times Var(VA_{FRL,HP}) + (Pct_{FRL,LP})^2 \times Var(VA_{FRL,LP}) + 0$$

(4) $$Cov(VA_{nonFRL}, VA_{FRL}) = Cov\{[(VA_{nonFRL,HP} \times Pct_{nonFRL,HP}) + (VA_{nonFRL,LP} \times Pct_{nonFRL,LP})], [(VA_{FRL,HP} \times Pct_{FRL,HP}) + (VA_{FRL,LP} \times Pct_{FRL,LP})]\}$$
$$= [Pct_{nonFRL,HP} \times Pct_{FRL,HP} \times Cov(VA_{nonFRL,HP}, VA_{FRL,HP})] + [Pct_{nonFRL,LP} \times Pct_{FRL,LP} \times Cov(VA_{nonFRL,LP}, VA_{FRL,LP})]$$

(5) $$Var(VA_{nonFRL} - VA_{FRL}) =$$
$$[(Pct_{nonFRL,HP})^2 \times Var(VA_{nonFRL,HP}) + (Pct_{nonFRL,LP})^2 \times Var(VA_{nonFRL,LP})] + [(Pct_{FRL,HP})^2 \times Var(VA_{FRL,HP}) + (Pct_{FRL,LP})^2 \times Var(VA_{FRL,LP})] -$$
$$[2 \times Pct_{nonFRL,HP} \times Pct_{FRL,HP} \times Cov(VA_{nonFRL,HP}, VA_{FRL,HP})] - [2 \times Pct_{nonFRL,LP} \times Pct_{FRL,LP} \times Cov(VA_{nonFRL,LP}, VA_{FRL,LP})]$$

Although Sass et al. presented results separately by state, we combined the results from the two states for this brief. For each subject, we averaged the results for the two states as shown in Table B.4. To calculate the variance of the difference in average teacher value added between FRL and non-FRL students for both states, we summed the variance of the two states and assumed that the covariance between the estimates from the two states was zero.

Table B.4. Aggregating Differences in Average Teacher Value Added Between FRL and Non-FRL Students for North Carolina and Florida

	Differences in Average Teacher Value Added Between Non-FRL and FRL Students
Reading	
Florida	0.042
North Carolina	0.037
Two-state average	0.040
Math	
Florida	0.019
North Carolina	0.036
Two-state average	0.027

C. Converting Standard Deviations into "Weeks of Learning"

Both Isenberg et al. (2013) and Sass et al. (2012) presented their results as standard deviations of student achievement. To make these results more meaningful for educators, we converted the standard deviations into "weeks of learning." In this section, we discuss the conversion process and the assumptions we made.

From Hill et al. (2008), we obtained estimates of the number of standard deviations of growth a student makes in a year on a typical test. We used these estimates to convert the differences in average teacher value added between FRL and non-FRL students from standard deviations to years of learning. We divided the differences in value added between FRL and non-FRL students by the average growth that students make in a year from Hill et al. (2008). We then converted this from years of learning to weeks of learning by assuming a nine-month school year and 4.33 weeks per month. Table C.1 shows the translation of the results from standard deviations of student achievement to weeks of learning.

Table C.1. Translating Results from Standard Deviations of Student Achievement to Weeks of Learning

	One Year of Achievement Growth	Difference in Average Teacher Value Added Between FRL and Non-FRL Students	
Unit	(a) Standard Deviations of Student Achievement	(b) Standard Deviations of Student Achievement	(c) Weeks of Learning, =9*4.33*(b)/(a)
Isenberg et al. (2013), Grades 4–8			
Reading	0.315	-0.034	-4.2
Math	0.390	-0.024	-2.4
Sass et al. (2012), Grades 4–5			
Reading	0.360	-0.040	-4.3
Math	0.485	-0.028	-2.2

Source: Calculations based on data from Isenberg et al. (2013) and Sass et al. (2012).

Notes: We assumed a nine-month school year, with 4.33 weeks per month. Hill et al. (2008) provided information on average achievement growth for students at each grade level. We averaged these values across grades and weighted by the number of students in each grade for Isenberg et al. (2013). Given that we did not have information on the number of students by grade level for Sass et al. (2012), we weighted grades equally when taking the average of achievement growth across grades 4 and 5 for that study.

Endnotes

[1] Sass et al. (2012) defined higher-poverty schools as those with 70 percent or more of students eligible for FRL. The remainder were classified as lower-poverty schools.

[2] Sass et al. (2012) report four versions of their results, based on different value-added models. We focused on the version of the value-added model that used the authors' preferred approach ("partial persistence in prior school inputs and student covariates"). However, we used the value-added results where shrinkage had not been applied because that aligns more closely with the approach used by Isenberg et al. (2013).

[3] We assumed that the covariance in average teacher value added for higher- and lower-poverty schools is zero because the teachers in these two types of schools are independent.