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Sector Differences in Student Learning: Differences in Achievement Gains Across School Years and During the Summer

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FOCUS SECTION

SECTOR DIFFERENCES IN STUDENT LEARNING: DIFFERENCES IN ACHIEVEMENT GAINS ACROSS SCHOOL YEARS AND DURING THE SUMMER

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Public and private schools have been the focus of considerable research, comparing student achievement, attendance, dropout rates, graduation rates, disciplinary incidents, and a variety of educational and prosocial outcomes across sectors. Comparative studies of student achievement have tended to concentrate on the high school years and without any effort to measure gains or losses during specific years. This study concludes that sector differences in learning vary across grade levels and that summer learning rates vary by school sector. More study of sector differences in learning is recommended, especially longitudinal studies that examine seasonal gains across school sector over the entire span of a student's academic career.

Prior studies of public and private schools have provided important insights into how school organization matters for academic outcomes (Bryk, Lee, & Holland, 1993; Coleman & Hoffer, 1987; Gamoran, 1996). Most quantitative studies of sector differences have analyzed data from two nationally representative data sets: High School and Beyond (HS&B) and the National Education Longitudinal Study of 1988 (NELS:88). Unfortunately, these data sets share some key shortcomings that limit our understanding of the relationship between school sector and student learning. First, these data sets provide a truncated record of students' academic careers that focuses exclusively on students' secondary school experiences: HS&B provides information about achievement gains from 10th through 12th grade, while NELS:88 examines gains from eighth to 12th grade. Second, neither HS&B nor NELS:88 isolate gains that occur specifically during the school year; rather, the data span multiple academic years as well as summer recesses when students are not in school. Both of these limitations in the data may

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distort the true relationship between school sector and student learning.

In this study, a data set that circumvents both of these limitations – the Early Childhood Longitudinal Study (ECLS) – is analyzed and two key questions about school sector and student learning are addressed: (1) do sector effects on student learning vary across academic years in students' careers?, and (2) does summer learning vary across school sector, and if so, does this artificially inflate sector effects on student learning? The results indicate that (1) sector differences in learning vary across grade levels, (2) summer learning rates vary by school sector, and (3) estimates of sector differences in learning that exclude summer learning differences differ from those that include summer learning. Implications for both our substantive understanding of sector differences and future research in this area are discussed.

STUDENT LEARNING AND SCHOOL SECTOR: VARIABLE EFFECTS ACROSS GRADE LEVELS

Data sets analyzed in prior studies of school sector and student learning have two important limitations: (1) learning gains are measured late in students' academic careers, and (2) measures of student learning typically cover only a few years of the many that students spend in school. For example, in HS&B, researchers studied sector differences in student learning gains from the spring of 10th grade though the spring of 12th grade (Bryk, Lee, & Holland, 1993; Hoffer, Greeley, & Coleman, 1985). The NELS:88 data have examined sector differences in learning gains from (1) the spring of eighth grade through the spring of 12th grade (Hoffer, 1998), (2) the spring of 10th grade through the spring of 12th grade (Morgan, 2001; Morgan & Sørensen, 1999), and (3) the spring of eighth grade through the spring of 10th grade (Gamoran, 1996).

In each of these studies, sector differences in gains across these time periods were assumed to be continuous and linear. However, it is possible that achievement gains varied across academic years, and furthermore, that observed sector effects on learning differed across academic years as well. Indeed, studies of the NELS:88 data suggest that sector effects differ depending upon how gains are measured. Hoffer (1998) found a Catholic school advantage in all four NELS:88 tests when examining eighth to 12th grade gains, but Gamoran (1996) found gains only in reading and math, both of which were non-significant after controlling for differences in the composition of the student body. This inconsistency across studies suggests that sector differences in learning may be less important early in students' high school careers, but increase in importance toward the end of high school.

Figure 1 provides a hypothetical illustration of the limitation inherent to measuring student gains across grade levels. In this example, gains in learning are estimated by using the spring 10th and 12th grade tests. By estimating the sector differences in gains at these two time points, we see that the hypothetical results are consistent with the findings of prior research: private school students enjoy greater academic gains between the first and second time points.

The main limitation in this analysis is that student learning in the spring of grade 11 is unobserved. Consequently, it is impossible to discern whether sector differences among students are present in both grade levels, or whether they apply to only one academic year but not the other. For example, let us assume that the gains for private school students are equal in grade 11 and 12. The dotted line in Figure 1 represents one possible pattern for public school gains. As the figure demonstrates, learning gains in the two sectors are equal in 11th grade, but diverge in 12th grade, where public school students fall behind private school students. While this is an entirely hypothetical example, it is not implausible to think that sector differences in gains might be isolated to 12th grade: since many more students in private schools attend 4-year colleges (when compared with public school students), it is possible that the 12th grade curriculum is more academically rigorous in private high schools than public.

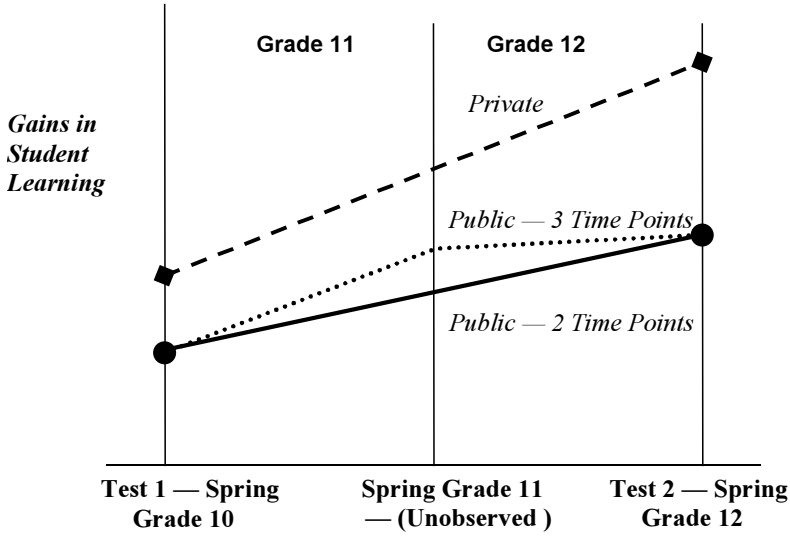

Figure 1: Hypothetical Sector Differences in Achievement Gains with Constant and Varying Effects of School Sector across Grade Levels

The main issue raised by the hypothetical example from Figure 1 echoes an

important question raised by Jencks (1985) in his evaluation of the research on school sector: are the differences in gains across sector in the last 2 years of high school also present throughout the full range of students' academic careers? If the differences in student gains across sectors are present throughout students' academic careers, the overall magnitude of the effects of school sector might be quite substantial. Perhaps more important, consistent sector differences across students' academic careers might suggest that there are some fundamental sector differences in school organization that make private schools more effective than public schools. If consistent gains across school years are not observed, then sector differences might reflect more idiosyncratic differences in curriculum offerings, expectations for students, or other miscellaneous factors that do not reflect the entirety of students' K-12 academic careers. Thus, the first major question addressed in this study is: are sector differences in student gains consistently found across grade levels?

SUMMER LEARNING AND SECTOR EFFECTS

Prior research on student learning suggests that academic gains are not restricted solely to the academic year. Students continue learning during the summer months when school is not in session, albeit at a slower rate (Entwisle, Alexander, & Olson, 1997; Heyns, 1978). One of the most interesting findings regarding summer learning pertains to socioeconomic and racial differences in summer learning. During the school year, socioeconomic status (SES) does not predict student gains in achievement (Entwisle et al., 1997; Heyns, 1978). For example, Entwisle, Alexander, and Olson (1997) found that high and low SES students gained exactly the same amount in math and nearly the same in reading during elementary school. However, during the summer months, high SES students continued to show impressive gains in both reading and math, while low SES students failed to show gains in either subject. This general pattern also applies to comparisons of Black and White students, although the results are somewhat more pronounced when examining family background (Heyns, 2002).

These findings regarding summer learning raise an important issue for studies of sector differences in student learning. One important difference among private and public schools involves the SES of students attending these different schools: on average, students attending private school come from higher SES families and are more likely to be White than students attending public schools (Bryk, Lee, & Holland, 1993; Coleman, Hoffer, & Kilgore, 1982). Since higher SES families are more likely to undertake the types of practices that create student gains during the summer (Lareau, 2000), students attending private schools might experience greater learning gains during the summer months when compared with public school students.

How might public-private differences in summer learning affect estimates of sector differences in student learning? Figure 2 displays another hypothetical example to illustrate the potential problem. As in Figure 1, the example in Figure 2 examines the last 2 years in high school. Unlike Figure 1 where the data are divided up into academic years, Figure 2 further divides the data into both aca-

demic years and summers. Doing so emphasizes that two summers and two school years are nested between the spring of 10th and 12th grade. The solid and dashed lines represent the divergence in gains by school sector that prior studies of sector effects have documented. The dotted lines below each of these represent a hypothetical series of gains if test scores were available at all four time points. In Figure 2, 11th and 12th grade gains during the school year are assumed equal across school sector; however, summer gains are allowed to differ across sectors, so that public school students have no net gain during the summer, but private school students have a positive net gain that is smaller than private school gains made during the school year.

The two sets of lines tell two very different stories. The first set of lines indicates that private school students outgain public school students in the time between the end of 10th and the end of 12th grade. Scholars have interpreted those effects to be related to students' experiences within school. However, the second set of lines that account for summer learning reveal that students are learning at similar rates across sector when they are in school. The difference in the initial set of lines is due entirely to differences in rates of summer learning. The hypothetical example in Figure 2 assumes stark differences across sector that may or may not reflect reality in order to more forcefully convey an important point: prior studies showing sector differences in learning do not provide any direct evidence that sector differences in student gains actually reflect different rates of learning while children are in school.

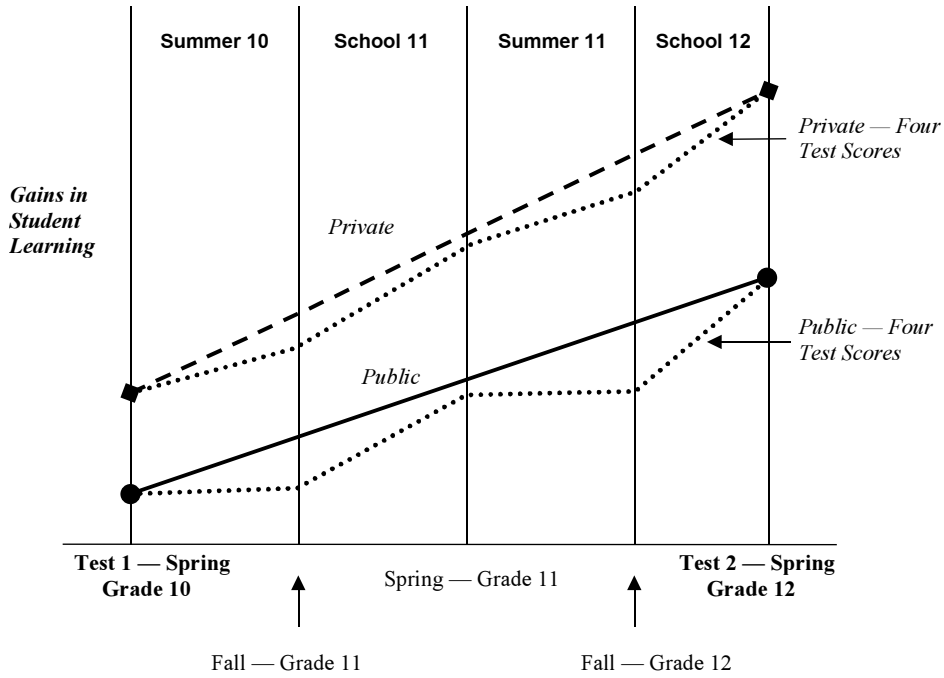

Figure 2: Hypothetical Sector Differences in Achievement Gains with Constant and Varying Effects of School Sector across Summers

Given that prior studies of school sector control for student SES and race, it is possible that any sector differences in summer learning are purged from the estimates of sector differences in learning. However, since SES serves as a proxy for the types of behaviors that families engage in to produce enhanced summer learning, differences in such behaviors across sector may still remain when controlling for SES. Unlike the regression approach, which always risks this type of omitted variable bias, estimates of sector differences that isolate learning during the summer provide a superior way of examining this important issue because they focus solely on learning that occurs during the school year. Thus, the second major question explored in this study is: does summer learning vary by school sector, and if so, does this bias the results of sector effects that ignore differential rates of summer learning by school sector?

DATA

Data analyzed in this study came from the kindergarten and first grade samples of the Early Childhood Longitudinal Study (ECLS). The ECLS is a nationally representative sample of 21,000 students, their parents, and teachers. In kindergarten, the students were assessed in both the fall and spring. In first grade, 25% of the students from the longitudinal cohort were randomly selected for assessment in the fall, while the full longitudinal cohort was tested in the spring. The ECLS sampling design is ideally suited for the questions raised in this study because (1) it allows data from early in students' school careers to be analyzed, (2) it enables gains in learning to be estimated separately by school years, and (3) it allows estimates of summer learning to be calculated and isolated from achievement gains during the school year.

ANALYTICAL SAMPLE

Five different samples are used in the analyses that follow. Figure 3 describes each of the five samples. Each sample corresponds to a specific set of learning gains: for example, the first sample includes students with test scores from the fall and spring of kindergarten. As described in the "methods" section below, each of these samples provides distinct estimates of sector effects in student learning. Since the ECLS employs a longitudinal design, there is a great deal of overlap in students across samples.

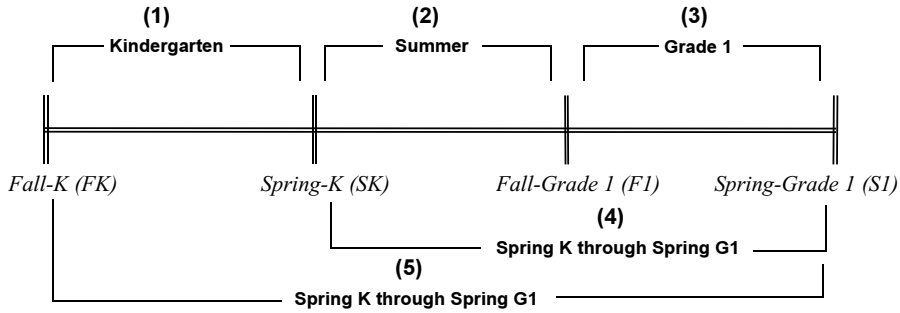

Figure 3: Five Estimates of Student Learning Gains

Each of the five samples is constructed by using listwise deletion based on the test scores that define each cohort. The sample sizes differ markedly across the five samples because the first grade fall sample is only one-quarter the size of the other three sample waves. Normally, attrition from the sample of this magnitude would be very problematic. However, since the fall grade-one test sample is a *random* sub-sample of the larger sample, listwise deletion will not bias the results. Inspection of the data revealed that there was no difference in fall kindergarten (FK), spring kindergarten (SK), and spring grade one (S1) test scores for students who were included in the fall grade one (F1) cohort and those who were not. In addition, there were no differences in the basic demographic composition of the students who were included in the (F1) sample and those who were not. Hence, in this case, listwise deletion provides unbiased estimates that maximize the statistical power of the analytical models for each sample.

DEPENDENT VARIABLES

In order to examine gains in student learning, gains scores for each subject (reading, math, and general knowledge) were created to serve as the dependent variables in the analyses. For example, when examining kindergarten gains in math, the (FK) score was subtracted from the (SK) score, and this difference served as the dependent variable in the analysis. Means and standard deviations for these gain scores are provided in Table 1.

Table 1: Means and Standard Deviations for Selected Variables Used in the Multivariate Analyses

Dependent Variables	***Mean***
Reading Gains	
FK-SK (Kindergarten)	10.22
	(6.35)
SK-F1 (Summer)	5.28
	(5.52)
F1-S1 (Grade One)	17.24
	(8.16)
SK-S1	22.82
	(8.98)
FK-S1	33.07
	(10.34)
Math Gains	
FK-SK (Kindergarten)	8.08
	(5.00)
SK-F1 (Summer)	4.98
	(5.06)
F1-S1 (Grade One)	10.61
	(5.69)
SK-S1	15.55
	(6.11)
FK-S1	23.61
	(6.61)
General Knowledge Gains	
FK-SK (Kindergarten)	5.10
	(4.04)
SK-F1 (Summer)	2.96
	(3.86)
F1-S1 (Grade One)	4.79
	(4.00)
SK-S1	7.51
	(4.39)
FK-S1	12.55
	(4.83)
Independent Variables	***Mean***
Reading Scores	
Fall Kindergarten (FK)	23.25
	(8.79)
Spring Kindergarten (SK)	33.29
	(10.99)
Fall Grade One (F1)	38.84
	(12.96)
Spring Grade One (S1)	55.80

	(13.83)
Math Scores	
Fall Kindergarten (FK)	19.83
	(7.25)
Spring Kindergarten (SK)	27.85
	(8.76)
Fall Grade One (F1)	32.80
	(9.55)
Spring Grade One (S1)	43.37
	(9.18)
General Knowledge Scores	
Fall Kindergarten (FK)	22.52
	(7.51)
Spring Kindergarten (SK)	27.27
	(7.85)
Fall Grade One (F1)	30.22
	(7.94)
Spring Grade One (S1)	34.40
	(7.68)
School Sector	
Kindergarten	
Public (Omitted)	.79
Catholic	.11
Private, Secular	.06
Other Religious	.04
Grade One	
Public (Omitted)	.82
Catholic	.11
Private, Secular	.05
Other Religious	.02
Kindergarten and Grade One	
Public (Omitted)	.79
Catholic	.11
Private, Secular	.05
Other Religious	.02
Some Other Combination	.03

Note: Standard deviations are in parentheses

INDEPENDENT VARIABLES

Standard controls for students' background characteristics, such as gender, ethnicity, and socioeconomic status were used in the analyses. Additional controls for whether students' families are "intact" (i.e., whether they live with both of their biological parents), their mother's age at first birth, the number of siblings, and whether English is their first language were also used as additional controls for family background. For analyses that included a kinder-

garten assessment, a dummy variable indicating whether the student attended an all day program was included as a predictor of learning gains. Students in full-day kindergarten learn more than students attending a half-day program, and more importantly, full-day attendance varies across school sector (Carbonaro, 2002). In addition, the students' age at their initial assessment as well as the number of weeks between the assessments served as additional controls in the analyses. Students who had more time between their fall and spring assessments were undoubtedly exposed to more instruction than students with less time between assessments, and hence more likely to have greater achievement gains. Finally, students' test scores in reading, math, and general knowledge at the first time point used in calculating the gain score were included as predictors of learning gains. (Means and standard deviations for these variables are provided in Table 1). For example, when looking at summer learning, the three test scores from the spring (not *fall*) of kindergarten were added as controls in the models. Together, this full array of controls should account for any student differences across sectors that might account for sector differences in learning gains over time.

Indicators of school sector divided students into four basic groups: public, Catholic, private secular, and private, other religious (i.e., non-Catholic). (Percentage breakdowns for each cohort are provided in Table 1). It is likely that private, secular and private, other religious schools are more heterogeneous categories than public or Catholic. However, there is certainly sufficient homogeneity within each of the four categories to make each one a coherent category that is distinct from the others. Information regarding the sector of the student's school was collected during each of the four survey waves. The sector variables for the kindergarten and first grade samples were created from the spring reports of school sector, since the fall reports were only available for one-fourth of the first graders. Some students attended schools in different sectors for kindergarten and first grade. These changes were easily accommodated in the models that assessed kindergarten and first grade gains separately – separate measures of school sector in each year allowed the students' school sector to vary across kindergarten and first grade. However, difficulties emerged with the summer and cross-grade-level models. For the summer learning models, the first grade report of school sector was used because any summer learning effects in the cross-grade-level models should show up as a sector difference that is interpreted as a first grade gain. For the cross-grade-level analyses, separate dummies to denote students who switched and the nature of the switch (e.g., public-K to private-G1, private-K to public-G1, and mixed private sector) were created and added as controls in the analyses. Since the effects of switching and the coefficients for these variables were significant in only a few cases, the coefficients for these variables were not included in the tables.

METHODS

The major goal of this study was to estimate sector differences in learning gains during kindergarten, first grade, and the summer between them. A sum-

mary description of the models used in the analyses is displayed in Figure 3. This figure describes five different estimates of gains in student learning: (1) gains during kindergarten (FK-SK), (2) gains during the summer between kindergarten and first grade (SK-F1), (3) gains during first grade (F1-S1), (4) gains from the spring of kindergarten to the spring of first grade (SK-S1), and (5) gains from fall kindergarten to spring of first grade test scores (FK-S1). Models 1 and 3 will provide estimates of sector effects by grade level, and Model 2 will provide estimates of sector effects on summer learning. The results of Models 1-3 will then be compared with results from Models 4 and 5 to examine whether separate estimates of learning by grade level and summer learning provide different estimates of sector effects than the conventional models where gains were estimated across grade levels and summer recess.

These five models will be applied to the three outcomes of interest: growth in student learning in the subjects of reading, math, and general knowledge. Design effects from the ECLS sample will be corrected by using information about the sampling strata and primary sampling unit (PSU) in combination with the survey command in STATA.

RESULTS

DO SECTOR DIFFERENCES IN STUDENT GAINS VARY ACROSS GRADE LEVELS?

The first set of analyses examined whether sector differences in learning gains vary by grade level. By examining fall to spring gains for kindergarten and first grade, it is possible to see whether both the magnitude and direction of any sector effects vary by grade level. Table 2 displays the unadjusted learning gains for kindergarten and first grade in reading, math, and general knowledge. These models use gain scores as the outcome, and dummy variables for school sector are the only controls in the model. Thus, these models examine sector differences in achievement growth, not achievement levels. In other words, differences in prior achievement among students across sectors were accounted for in the unadjusted models, but sector differences in other factors that are related to achievement gains were unaccounted for in the model. Table 3 shows the significant differences displayed in Table 2 as percentage differences from the average gain for a public school student. For example, a 10% advantage for private secular school students in reading indicates that, on average, private secular school students gain 10% more than public school students in that subject for that academic year.

Table 2: Unadjusted Gains across School Sector

	Kindergarten (1)	Summer (2)	1st Grade (3)	SK-S1 (4)	FK-S1 (5)
			Reading Skills		
Intercept (Public)	10.117***	5.088***	17.397***	22.691***	32.802***
Catholic	.284	.547*	1.280**	.438*	.941**
Private, Secular	1.003***	1.596***	2.238***	2.628***	3.624***
Other Religious	.349	.715	-4.009***	-2.264***	-1.510**
			Math Skills		
Intercept (Public)	8.004***	4.989***	10.952***	15.759***	23.721***
Catholic	.292*	.361	-1.101***	-.839***	-.670***
Private, Secular	.879***	-.327	-.196	-.706**	.388
Other Religious	-.108	-.583	-3.312***	-2.870***	-2.750***
			General Knowledge		
Intercept (Public)	5.137***	2.971***	4.877***	7.618***	12.677***
Catholic	-.030	-.302	-.321	-.545***	-.601***
Private, Secular	-.303*	.676**	-.073	-.224**	-.559**
Other Religious	-.170	-.716*	-1.152**	-1.189***	-1.264***

* $p < .05$ ** $p < .01$ *** $p < .001$

Table 3: Sector Differences in Unadjusted Gains as a Percentage of Public School Gains

	Kindergarten	Summer	1st Grade	SK-S1	FK-S1
	(1)	(2)	(3)	(4)	(5)
			Reading Skills		
Catholic		+10.8%*	+7.4%*	+1.9%*	+2.9%**
Private, Secular	+10.0%***	+31.4%***	+9.9%**	+11.6%***	+11.0%***
Other Religious			-23.0%**	-10.0%***	-4.6%*
			Math Skills		
Catholic	+3.7%*		-10.0%**	-5.3%**	-2.8%**
Private, Secular	+11.0%***			-4.4%*	
Other Religious			-30.2%**	-18.2%***	-11.6%***
			General Knowledge		
Catholic				-7.1%**	-4.7%**
Private, Secular	-5.8%*	+22.7%**		-2.9%*	-4.4%*
Other Religious		-24.1%*	-23.6%**	-15.6%***	-10.0%***

Note: Blank cells in the table indicate that the coefficient was not statistically significant at the .05 level.

* $p < .05$ ** $p < .01$ *** $p < .001$

The intercepts in Table 2 are the public school gains. The non-public dummy variables indicate whether the gains in a given sector are significantly different from the average public school gain. Public school gains in both kindergarten and first grade are quite large. In both kindergarten and first grade, public school students are learning one standard deviation or more.

The results indicate that there are significant sector effects in learning gains, but these gains vary by both grade level and academic subject. When comparing Catholic and public school students, Catholic school students enjoy greater learning gains in first grade reading and kindergarten math. However, public school students have greater gains than Catholic school students in first grade math. Gains are the same among Catholic and public school students in general knowledge for both academic years. Private secular school students outperform public students by roughly 10% in reading for both kindergarten and first grade. However, the private school advantage in math gains is limited to kindergarten. In general knowledge, public school students outperform private school students in kindergarten, but hold no advantage in first grade. Finally, for other religious school students, the pattern is consistent across all three academic subjects: in kindergarten, achievement gains are the same among public and other religious school students, but in first grade, achievement gains for other religious school students are anywhere from 23% to 30% less than those enjoyed by public school students.

While the unadjusted models provide some sense as to how gains vary across sector and across grade levels, it is possible that sector differences among students rather than sector differences in schooling account for the observed differences in gains across sector. To eliminate such differences among students, controls for differences in student background characteristics such as SES, race, gender, and initial academic achievement were included as predictors of learning gains. The results of these analyses are reported in Tables 4 and 5.

Table 4: Adjusted Gains across School Sector

	Kindergarten (1)	Summer (2)	1st Grade (3)	SK-S1 (4)	FK-S1 (5)
			Reading Skills		
Intercept (Public)	8.074***	-4.990***	18.592***	10.819***	20.947***
Catholic	-.565**	.017	1.144**	-.286	-.616**
Private, Secular	.296	1.063**	2.816***	1.532***	1.826***
Other Religious	-.670*	-.679	-1.706*	-3.247***	-3.740***
			Math Skills		
Intercept (Public)	3.627***	-2.608	11.360***	11.649***	17.501***
Catholic	-.286*	.290	-.231	-.681***	-.928***
Private, Secular	.366*	-.486	.147	-.152	-.021
Other Religious	-.841***	-1.034*	-1.644**	-2.688***	-3.181***
			General Knowledge		
Intercept (Public)	5.249***	3.573***	7.877***	10.206***	13.967***
Catholic	-.061	-.052	.239	-.078	-.165
Private, Secular	-.327*	.301	.097	-.030	-.299
Other Religious	-.260	-1.015**	-1.160**	-.918***	-.941***

Note: Controls for race, gender, SES, whether the student came from an intact family, whether English was the first language spoken in the home, the age at which their mother first gave birth, the number of siblings in the household, the child's age at the first time-point for the gain score, and the elapsed time in weeks between the two time-points used to create the gain score are included as predictors of learning gains in all of the models in the table.

* $p < .05$ ** $p < .01$ *** $p < .001$

Table 5: Sector Differences in Adjusted Gains as a Percentage of Public School Gains

	Kindergarten (1)	Summer (2)	1st Grade (3)	SK-S1 (4)	FK-S1 (5)
			Reading Skills		
Catholic	-5.6%*		+6.5%**		+1.8%**
Private, Secular		+20.8%***	+16.1%***	+6.8%***	+5.5%***
Other Religious	-6.6%*		-9.8%***	-14.3%***	-11.4%***
			Math Skills		
Catholic	-3.5%*			-4.3%***	-3.9%***
Private, Secular	+4.6%*				
Other Religious	-10.5%**	-20.7%*	-15.0%***	-17.1%***	-13.4%***
			General Knowledge		
Catholic					
Private, Secular	-6.3%*				
Other Religious		-34.2%**	-23.7%*	-12.1%***	-7.4%***

Note: Controls for race, gender, SES, whether the student came from an intact family, whether English was the first language spoken in the home, the age at which their mother first gave birth, the number of siblings in the household, the child's age at the first time-point for the gain score, and the elapsed time in weeks between the two time-points used to create the gain score are included as predictors of learning gains in all of the models in the table.

* $p < .05$ ** $p < .01$ *** $p < .001$

Overall, sector differences in "adjusted" gains were slightly different than the sector differences in unadjusted gains displayed in Tables 2 and 3. For Catholic school students, the positive effect in first grade reading remains, but there is now a significant negative effect in kindergarten reading. Also, the negative effect in first grade math gains is no longer significant in the adjusted models, but the positive math unadjusted gains in kindergarten become negative in the adjusted model. For private, secular schools, the positive effect in reading during kindergarten is no longer significant, but the other effects observed in the unadjusted models remain significant, although the magnitude of the effects differs. Finally, for other religious schools, negative effects now appear in reading and math in kindergarten. A substantial proportion of the other religious school gap in unadjusted gains is explained by background factors: for reading and math, the negative adjusted public-other religious differ-

ences in gains decrease by roughly 60% and 50%, respectively. Despite these differences between the adjusted and unadjusted models, there is enough agreement between the two sets of models to conclude that both the magnitude and direction of the relationships between school sector and learning gains differ from kindergarten through first grade.

DOES SUMMER LEARNING VARY ACROSS SCHOOL SECTOR?

While the results from Tables 2 to 5 indicate that some sector differences in learning gains are present during the school year, the question remains: are sector differences in summer learning present as well? Tables 2 and 3 show differences in unadjusted summer gains across school sector (see column 2). Catholic school students gain roughly 11% more in reading during the summer than public school students. However, public and Catholic school summer gains do not differ in math and general knowledge. Private, secular school students have even more impressive summer gains: compared with public school students, private secular school students gain 31.4% and 22.7% more in reading and general knowledge respectively. In contrast, other religious school students have the same gains as public school students in reading and math, but actually gain 24% less in general knowledge during the summer than public school students.

The adjusted scores are especially revealing when examining summer learning, because SES and the home environment play a larger role in affecting achievement gains when school is not in session (Heyns, 2002). In addition, if the summer sector effects disappear after controlling for student background characteristics, then the conventional models that measure student gains across summers may not bias estimates of sector effects. If the sector differences summer gains remain significant in the adjusted models, the possibility remains that the conventional measures of sector effects might be biased.

The adjusted models (see column 2 in Tables 4 and 5) indicate that sector differences in summer learning are still present during the summer even after controlling for student background characteristics. The positive Catholic school effect in reading is no longer significant in the adjusted model. The private, secular effect on reading remains significant, but the magnitude of the relationship is reduced by roughly one-third. However, the positive private secular school effect in general knowledge observed in the unadjusted model is no longer significant in the adjusted model. Finally, the gap in summer learning between public and other school students in general knowledge remains significant and grows larger in the adjusted model. In addition, a statistically significant negative effect on summer learning emerges in math for other religious school students in the adjusted model.

When sector differences in summer learning are compared with sector differences during the school year, two conclusions can be drawn. First, sector differences in summer learning are less common than sector effects during the

school year (Table 5). Second, when sector effects are present during the summer, they are larger in magnitude than the sector differences in learning gains during the school year. The larger sector differences in the summer suggest that the out of school environments of students in different sectors are more unequal than the learning environments that students encounter during the school year.

ARE CONVENTIONAL ESTIMATES OF SECTOR EFFECTS BIASED?

The analyses discussed above lead to two main conclusions: (1) sector effects differ in significance and magnitude in kindergarten and first grade, and (2) summer learning varies significantly across school sector. One important question remains unanswered: do "conventional" measures of sector effects (i.e., those that are estimated across grade levels and summers) lead to different conclusions about sector differences in student learning than the "revised" estimates account for sector differences by grade level and in summer learning? By comparing the conventional and revised estimates of sector effects, it is possible to identify whether the failure to account for sector differences in learning by grade level and during the summer distort our understanding of how student learning varies across school sector.

First, do estimates of sector differences in yearly gains differ from estimates of gains that combine academic years? To answer this question, kindergarten and first grade gains were compared with gains combining academic years. In Tables 2 and 3, unadjusted gain scores in columns 1 (kindergarten) and 3 (first grade) were compared with those in columns 4 (gains spanning the spring of kindergarten through the spring of first grade) and 5 (gains spanning the fall of kindergarten through the spring of first grade). The results indicate that the different sets of estimates lead to different conclusions about sector effects. For example, in reading, Catholic school students enjoy greater gains relative to public school students in first grade, but not in kindergarten. The conventional estimates of the Catholic school effect in reading are significant, but notably smaller in magnitude than the estimate of first grade reading gains. For other religious schools, the conventional gains displayed in columns 4 and 5 are smaller than those of public school students, but the differences are much less pronounced when compared with the gains that are specific to kindergarten and first grade. The adjusted models tell a similar story with some slight differences, and the overall conclusion is the same: sector differences in gains computed across academic years overlook important differences in sector effects from year to year.

Table 6 summarizes the discrepancies in sector differences in gains by grade level. The coefficients in Tables 2 and 4 are removed in Table 6 and replaced with symbols that denote whether there is a significant effect for a given sector in a given subject, its direction, and finally, in the last column, whether the indicators of gains by grade level (columns 1 and 3 in Tables 2 and

4) are consistent with the conventional indicators across grade levels (columns 4 and 5 in Tables 2 and 4). For the unadjusted gains, only one set of estimates shows consistency: private, secular students hold a positive advantage in both the conventional and yearly estimates of gains in reading. However, none of the other comparisons indicate consistent results. The adjusted results show slightly more consistency: three of the nine comparisons show consistent results between the yearly and conventional estimates. In particular, the estimates for other religious schools are consistent in reading and math, but not general knowledge. Only one of three estimates for Catholic schools (general knowledge) and none of the three estimates for private, secular schools are consistent. Hence, Table 6 suggests that conventional estimates of sector effects are likely to overgeneralize sector effects across grade levels, and hence distort our understanding of when sector differences are present in students' academic careers.

Table 6: Differences in Estimates of Sector Effects across Models

		Seasonal Gains			*Combined Years*		*Consistency in Results?*
		UNADJUSTED GAINS					
Sector	*Subject*	*FK-SK*	*SK-F1*	*F1-S1*	*SK-S1*	*FK-S1*	
Catholic	Reading	0	+	++	+	++	No
	Math	+	0	---	---	---	No
	G.K.	0	0	0	---	---	No
Private, Secular	Reading	+++	+++	+++	+++	+++	Yes
	Math	+++	0	0	--	0	No
	G.K.	-	++	0	--	--	No
Other Religious	Reading	0	0	---	---	--	No
	Math	0	0	---	---	---	No
	G.K.	0	-	--	---	---	No
		ADJUSTED GAINS					
Sector	*Subject*	*FK-SK*	*SK-F1*	*F1-S1*	*SK-S1*	*FK-S1*	
Catholic	Reading	-	0	++	0	++	No
	Math	-	0	0	---	---	No
	G.K.	0	0	0	0	0	Yes
Private, Secular	Reading	0	+++	+++	+++	+++	No
	Math	+	0	0	0	0	No
	G.K.	-	0	0	0	0	No
Other Religious	Reading	-	0	---	---	---	Yes
	Math	--	-	---	---	---	Yes
	G.K.	0	--	-	---	---	No

Note: The information in the table is derived entirely from the results displayed in Tables 2 and 4. A +, ++, and +++ sign indicates a statistically significant effect at the .05, .01, and .001 levels (respectively). A -, --, and --- sign indicates a statistically significant effect at the .05, .01, and .001 levels (respectively). A 0 indicates that the sector effect is not statistically significant at the .05 level. Yes indicates that there is a statistically significant coefficient at the .05 level, with matching signs in the FK-SK, F1-S1, and either SK-S1 or FK-S1. No indicates that these conditions are not met.

Next, do sector differences in summer learning distort estimates of sector differences of gains from schooling? Table 7 provides estimates of student gains with and without summer learning gains. In this case, the "conventional" estimate of student learning that includes summer learning is the gain score from the fall of kindergarten to the spring of grade 1 (shown in column 5 in Tables 3 and 5). In contrast, the "revised" estimate of student gains that excludes summer learning is simply the sum of the estimates of learning during kindergarten and first grade (columns 1 and 3 in Tables 2 and 4) divided by the sum of the unadjusted public school gains in kindergarten and first grade for each subject. If the two estimates are very similar, then the sector effects on student learning are not biased by sector differences in summer learning. If the two estimates are substantially different, then the sector differences in summer learning are likely biasing the conventional estimates of sector differences in learning gains.

Among the unadjusted gains, most of the differences in the two sets of estimates are fairly small, although some, such as reading gains in other religious schools, are fairly large differences. Interestingly, the bias in the conventional estimates is actually downward, rather than upward, as predicted. In two cases, there is a lack of agreement regarding statistical significance among the conventional and revised estimates.

Table 7: Differences from Public School Gains with and *without* Summer Learning

	Unadjusted Gains			*Adjusted Gains*		
	Conventional Estimate (With Summer Included)	Revised Estimate (Excluding Summer Gains)	Difference between Estimates	Conventional Estimate (With Summer Included)	Revised Estimate (Excluding Summer Gains)	Difference between Estimates
Sector	*Reading Skills*					
Catholic	+2.9%	+4.7%	↓1.8%	+1.8%	+2.1%	↓0.3%
Private, Secular	+11.0%	+11.7%	↓0.7%	+5.5%	+10.2%	↓4.7%
Other Religious	-4.6%	-14.5%	↓9.9%	-11.4%	-8.6%	↑2.8%
	Math Skills					
Catholic	-2.8%	-4.3%	↓1.5%	-3.9%	-1.5%	↑2.4%
Private, Secular	N.S.	+4.6%	↓4.6%	N.S.	+1.9%	↓1.9%
Other Religious	-11.6%	-17.5%	↓5.9%	-13.4%	-13.1%	↑0.3%
	General Knowledge					
Catholic	-4.7%	N.S.	↑4.7%	N.S.	N.S.	0.0%
Private, Secular	-4.4%	-3.0%	↑1.4%	N.S.	-3.2%	↓3.2%
Other Religious	-10.0%	-11.5%	↓1.5%	-7.4%	-11.6%	↓4.2%

Note: The information in this table is derived entirely from the information displayed in Tables 2 and 4. For the FK-S1 estimates of sector effects, N.S. indicates that the coefficient was not statistically significant at the .05 level. For the estimates of sector effects that exclude summer learning, N.S. indicates that neither the kindergarten nor first grade coefficient was statistically significant at the .05 level. Shading indicates that the summer learning coefficients in Tables 2 and/or 4 were statistically significant at the .05 level. A down arrow (↓) indicates that the conventional estimate of the sector effect is downwardly biased. An up arrow (↑) indicates that the conventional estimate of the sector effect is upwardly biased.

Comparison of the adjusted conventional and revised estimates tends to show more substantial differences between the two sets of estimates. Accounting for sector differences in summer learning does little to change either estimates of Catholic school effects in reading and general knowledge, or the other religious effects for math. However, several of the estimates of sector effects differ substantially when comparing the conventional and revised coefficients. For example, the conventional estimate of the private, secular effect in reading is only about half that of the revised estimate. The other religious effect on general knowledge is also underestimated by the conventional measure of student gains: using the conventional indicator learning reveals a negative effect on general knowledge that is on average 63% as large

as the effect estimated using the revised estimator. In two cases, the conventional indicator of student gains overstated the size of the sector effects: the conventional estimate of the Catholic school effect on math gains is 2.5 times larger than the revised estimate, and the conventional estimate of the other religious school effect on general knowledge is roughly 1.3 times greater than the revised estimate. Finally, in two cases, there is lack of agreement in statistical significance between the conventional and revised estimates. For private secular math and general knowledge, the conventional indicator is not statistically significant, but the revised estimate is.

Were the conventional indicators of sector effects most likely to be biased when there were significant sector differences in summer learning? Table 7 indicates that this is generally true in two of the three cases where significant sector effects on summer were observed in Table 5. However, inaccuracy in the conventional estimates was not limited to cases where there were significant sector effects.

In sum, the analyses suggest two shortcomings in conventional estimates of sector effects. First, as expected, conventional estimates of sector effects tended to over generalize sector differences across grade levels. Second, the conventional estimators did not adequately describe sector differences in learning that occurred during the school year from learning that occurred during the summer. However, while it was hypothesized that the conventional estimates of sector effects would be upwardly biased, errors tended to run in both directions (i.e., estimates of sector effects on learning that were too high or too low). Hence, the conventional estimators may suffer from a reliability problem, rather than a problem related to bias.

DISCUSSION

Two main questions regarding school sector and student achievement were examined in this study: (1) do sector effects observed in high school generalize to other grade levels?, and (2) do sector effects apply to summer learning, and if so, do these sector differences in summer learning affect conventional estimates of sector effects on learning? In general, the analyses reported here suggest (1) sector effects vary across grade levels and generally do not correspond well with the findings of prior research on school sector differences in high school learning, and (2) summer learning varies by sector and conventional estimates of sector differences in learning are somewhat distorted when such differences are not accounted for. Both the substantive and methodological implications of each of these findings for our understanding of sector differences in academic achievement merit further attention.

SCHOOL SECTOR AND STUDENT LEARNING IN ELEMENTARY SCHOOL

While the analyses reported here revealed sector differences in student learning, the results are not as straightforward as those focused on sector differences among high school students. After adjusting for student differences across school sector, sector differences in achievement varied by year, sector, and academic subject. Catholic school students had slightly smaller gains in kindergarten than public school students. However, in first grade, Catholic school students did about the same as public school students in math and general knowledge, but outperformed public school students in reading. The only differences between private secular and public school students were in kindergarten math and first grade reading (both favoring private secular school students), and kindergarten general knowledge (favoring public school students). Other religious school students showed the most consistent differences from public school students: public school students gained more than private religious school students in all subjects in both kindergarten and first grade (with the exception of kindergarten general knowledge, where there was no difference).

The findings reported here differ from prior research in three main ways. First, while prior research suggests Catholic school students outperform public school students in high school by a modest amount (Bryk, Lee, & Holland, 1993; Coleman & Hoffer, 1987; Hoffer, 1998), Catholic school students do not appear to enjoy the same advantage early in their school careers. This is an important finding that suggests that the Catholic school effect may be limited primarily to high school. Second, the most consistent sector effect observed in the analyses was the negative effect of other religious schools on student learning. While other studies have suggested that private school effects are limited to Catholic schools (Coleman & Hoffer, 1987; Coleman, Hoffer, & Kilgore, 1982; Gamoran, 1996), the results reported here suggest that other types of private-public comparisons are worthy of examination. Finally, the results of this study suggest that public school students do much better relative to private school students when they begin their school careers than when they finish their secondary schooling.

What explains these differences between research on school sector and student learning at the beginning and end of students' academic careers? To answer this question, it is useful to recall Bidwell and Kasarda's (1980) distinction between schools as "an organization that conducts instruction" (p. 401) and schooling as "the process through which instruction occurs" (p. 401). This important distinction highlights the process by which the many resources held by a school are translated into student learning. Hence, differences in school organization that are related to curriculum, instruction, teacher quality, professional development, and other factors related to student learning are all likely and viable explanations for sector differences in student outcomes.

For example, much of the research on school sector explores how Catholic high schools are "communally organized" in contrast to the more bureaucratic

structure found in public high schools (Bryk, Lee, & Holland, 1993). Are these public-Catholic differences in school organization absent in elementary school? Or, do such differences matter less because they play out in ways that do not strongly impact students' learning opportunities within schools? These types of questions could be immensely useful when applied to future studies that examine variation in sector differences in student learning across grade levels.

Another explanation worthy of examination is variation in curriculum and instruction across school sector at different points in students' academic careers. For example, it is possible that curricular demands may be equal across sectors in elementary school, but important differences may emerge when students enter high school. Thus, the timing of when students in different sectors are exposed to a given part of the curriculum might explain why sector differences in student learning vary across grade levels.

Exploring each of these issues in greater depth will provide important insights into how school sector is ultimately related to student outcomes. Fortunately, the ECLS provides good data to explore many of these possible explanations in greater depth in future studies.

RETHINKING THE MEASUREMENT OF SECTOR EFFECTS ON STUDENT LEARNING

Two concerns about analytical limitations due to data shortcomings were examined in this study. The first concern focused on whether conventional measures of learning gains distort our understanding of sector effects on learning by falsely assuming sector differences are constant across grade levels. The analyses revealed that sector effects differed across grade levels, and consequently, conventional measures of sector effects fail to pinpoint exactly when sector differences emerge in students' careers. The second issue focused on whether sector differences in summer learning might bias the conventional estimates of sector effects. There was some evidence that sector differences in summer learning distorted estimates of sector differences in learning during the school year. Both of these findings raise important issues for research on sector differences in student learning that must be addressed.

First, as Jencks (1985) argued, it is difficult to assess the size of sector differences in learning when gains are measured in the last 2 years of high school because such differences may not apply to students' prior 10-plus years of schooling. The results reported here largely validate the relevance of this concern: (1) sector differences in learning are not consistent across kindergarten and first grade, and furthermore, (2) sector differences in learning in kindergarten and first grade are not consistent in magnitude or direction with those found in high school. One way to satisfy this concern about measuring sector effects would be to (1) calculate learning gains by comparing test scores at the beginning of elementary and end of high school, and (2) examine the sector differences in gains among those who stayed in the same sector for elementary and secondary school. Since sector differences would be estimated over the entire course of students' elementary and

secondary careers, the problem of varying sector differences in achievement gains across grade levels would no longer be a concern.

While this strategy is technically correct, it suffers from two main limitations. First, even if significant sector differences in K-12 gains are observed, it remains unclear as to how or when these differences in student learning emerge. One possibility is that small, but similar sector differences in student achievement gains are present at each grade level. Alternatively, students in different sectors may experience similar rates of growth until high school, at which time achievement gains across sectors begin to diverge. Each of these possibilities leads to a different interpretation of why sector effects emerge. The first possibility – constant, incremental change over time – would suggest that schools in different sectors have fundamental differences in organization or governance that translate into different levels of overall effectiveness in instructing students. In contrast, the results indicating the sudden emergence of sector differences at a given point in students' careers would indicate a more idiosyncratic explanation focusing on sector differences in course taking patterns, curriculum, or instruction that are specific to a given level of schooling. While it would be valuable to know which explanation of K-12 sector differences is correct, it is impossible to do so by measuring K-12 gains without any estimates of yearly gains.

There is a second shortcoming in measuring K-12 gains without estimating annual gains in student learning. The following example illustrates the problem. If public school students gain a quarter of a standard deviation more than private school students in elementary school, but private school students outgain public school students by the same amount in high school, the K-12 estimate of public-private differences in learning would be zero. While in a technical sense, the K-12 model would correctly describe the overall sector effect as zero, this finding is very unhelpful because it obscures potentially important sector differences that vary across grade levels, but nevertheless reflect differences in school organization, resources, and other important factors that affect student outcomes.

The second issue of concern in estimating sector differences in learning focuses on sector differences in summer learning. While measures that estimate yearly gains in achievement would be tremendously helpful in studying the importance of school sector for student outcomes, they would have the added benefit of providing estimates of summer learning as well. The results presented here indicated that sector differences in summer learning sometimes bias the estimates of sector effects if they are unaccounted for. Since the K-12 estimates of learning gains would also include gains from many summer intervals, the possibility that sector differences in summer learning would contaminate the estimates of K-12 learning is great.

In addition, there is good reason to believe that examining more summer intervals at different points in students' careers might lead to increased bias or unreliability in estimates of sector effects. First, it may be that sector differences in summer learning become more pronounced after first grade. As stu-

dents begin receiving grades and are assessed on exams for possible placements in honors classes or gifted programs, more privileged parents may engage in more structured and carefully targeted academic preparation during the summer. In addition, as students age and grow more independent, they become more capable of spending time outside the home, and their learning opportunities in the summer may begin to diverge to a greater degree. More affluent students (who are more likely to attend private school) may begin enrolling in summer programs and camps that enrich their academic knowledge and skills, while less privileged students (who are more likely to attend public schools) may begin spending more time outside their homes with their peers in neighborhoods that do not enhance their learning. Finally, as students get older and have the capacity to read, write, and study on their own, students in different sectors may begin to make different choices about how to spend their free time during the summer (e.g., watching television vs. reading books) that create greater sector differences in summer learning.

To conclude, the results reported in this study suggest that our current understanding of sector differences in learning is far from complete. A great deal could be learned from a longitudinal study that examines seasonal gains in learning across school sector over the entire length of a student's academic career. The main drawback of this design would be the long time period required to collect the data and the strong possibility that sample attrition would compromise the external validity of the sample. An alternative and likely more viable research design might follow students currently enrolled in kindergarten through 11th grade for a shorter time period (e.g., 2 years) and assess each student at the beginning and end of each school year. This design would use these multiple, contiguous longitudinal samples to simulate a K-12 longitudinal design by estimating school and summer learning over the entire range of students' careers in private and public schools. In addition, it would allow for a direct comparison of school attributes – such as school organization, and curriculum—at one point in time. Such a study would be an ambitious undertaking. However, the potential benefits of such a study would be substantial and many of the unanswered questions about how student learning differs by school sector could be answered with much greater precision and clarity than prior studies.

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