The Impact of One State's Class Size Reduction Legislation on Teacher Staffing

Gerald M. Eads II, Ph.D.
Winifred Nweke, Ph.D.
Comfort Y. Afolabi, M.P.A.
Cynthia E. Stephens, Ed.D.
Thomas Hall, Ph.D.
Katherine Potter, B.Sc.

Division for Educator Workforce Research and Development
Georgia Professional Standards Commission

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Abstract

In March of 2006 the Georgia legislature passed a K-12 public school class size reduction (CSR) initiative to take full effect at the beginning of the 2007 school year in August of 2006, providing the school systems four months to prepare for the acquisition of the requisite additional teachers and classroom space. This study analyzes the law's impact on teacher staffing using extant individual student and teacher data collected semiannually from all state public schools. While more than 20 states and several countries have adopted various policies to reduce class size (Ehrenberg, Brewer, Gamoran & Willms, 2001; Willms & Somers, 2001), this study may be the first to investigate a statewide CSR implementation since the mid-1990's effort in California. It first documents the methodology used to predict the level of staffing required by the new law, then investigates the impact of the legislation on average class size, incidence of classes over the size limits, and age and experience level of new teachers. The data from a statewide teacher vacancy reporting system begun in the 2006-2007 (FY07) school year are used to study variation among schooling levels and proportions of student enrollment eligible for free and reduced lunch.

Review of Literature

While interest in CSR has remained high in the United States, economics, psychology and education literature also suggests interest in England (e.g. Blatchford, 2005; Blatchford, Basset & Brown, 2005; Dustmann, Rajah & van Soest, 2003; Iacovou, 2002; Pedder, 2006), The Netherlands (Dobbelsteen, Levin, and Oosterbeek, 2002; Levin, 2001), Scotland (Wilson, 2002), and Latin America (Willms & Somers, 2001). The value of CSR has been questioned (*e.g.*, Borland, Howsen, & Trawick, 2005; Dobbelsteen, Levin and Oosterbeek, 2002; Hanushek, 1998, 2003; Levin, 2001; Normore & Ilon, 2006; Office for Standards in Education (OSTED), 1995; Stecher, McCaffrey & Bugliari, 2003). Several authors have criticized the methodologies used by detractors of CSR such as OSTED (Iacovou, 2002) and Hanushek (1998, 2003) (Biddle & Berliner, 2002; Kreuger, 2002, 2003). Kreuger (2002) argued CSR to be a cost effective policy mechanism to improve student achievement. Reichardt (2000) noted that CSR may be one of the more likely reform interventions to succeed because of its simplicity. Evaluations of CSR studies and initiatives (Bohrnstedt & Stecher, 2002; Molnar, Smith, Zahorik, Halbach, Ehrle, Hoffman, & Cross, 2001; Mosteller, 1995) and ongoing analyses of these and other data (*e.g.*, Finn, Gerber, & Boyd-Saharias, 2005; Iacovou, 2002; Nye, Hedges, & Konstantopoulos, 2001, 2002, 2004) have generally supported CSR as an effective policy to improve both student achievement as measured by tests as well as more evocative improvements to education, including long term achievement impacts, reduced dropout and increased graduation rates. Literature reviews (*e.g.*, Biddle & Berliner, 2002; Reichardt, 2000; Wilson, 2002) tend to support CSR as a viable intervention. The literature also suggests that CSR is likely more effective in the early grades (K-3), but most of the research has focused on the early grades, and very little data exist on the effect of implementing CSR after grade four. Ehrenberg, Brewer, Gamoran, and Willms (2001) concluded that although some research has been convincing, “Class size reduction initiatives presuppose the availability of teachers who are equivalent in quality to existing teachers to staff the extra classrooms.”

Implementation difficulties documented from the California CSR initiative were: (1) The increase in demand for teachers resulting in a decrease in teacher quality, (2) an exacerbated difference in teacher quality between schools with low and high proportions of disadvantaged students (low and high socioeconomic status (SES)), (3) greater classroom shortages experienced by low SES districts and (4) insufficient funding for low SES districts to meet class size targets. These consequences may have limited the benefit of California’s initiative compared to the well regarded Tennessee CSR experiment (Imazeki, 2003; Jepsen & Rivkin 2003; Reichardt, 2000; and Stecher, Bohrnstedt, Kirst, McRobbie & Williams, 2001).

Introduction

California’s voluntary initiative reduced average class size from more than 29 to just less than 20 over three years (Reichardt, 2000). Georgia’s mandatory initiative required smaller decreases in class size, but specified that class size must not exceed certain levels for elementary grades and certain middle and high school classes. Georgia classes were already legislated to average 21 in grades 1-3; the new law now specified that class size must not exceed 21 in those grades for mathematics, language arts, science and social studies classes. Similarly, Kindergarten classes must be limited to 18 (20 with an aide). Grades 4-8 academic classes were limited to 28 students; formerly such classes could average 30. High school classes in language arts, social studies, mathematics and foreign language were required to average 30 and must now not exceed 32; science classes were required to average 28 and now must not exceed 30. Although class size limits existed in the previous law and are used for comparison, the size average was the focus of prior law. While districts still must monitor average class size; classes affected by the law must not exceed lower specified size limits.

Based on California’s CSR experience, Georgia’s predicted increases in staffing demand should require significantly increased recruiting effort to achieve full staffing without concomitant decreases in the experience levels of newly hired teachers. The literature also documents greater difficulties in staffing for schools with greater proportions of disadvantaged students; whether this outcome occurred at the initial implementation of the Georgia law is investigated.

Unlike most previous initiatives focusing on early elementary grades, all Georgia grades are affected, and districts are required by the new law to be fully staffed by the fall of 2006, four months after passage of the legislation. The reserve supply of teachers is limited; recently only 20-25% of new teacher demand had been supplied by the state's teacher colleges. The No Child Left Behind Act of 2001 (NCLB) now requires all teachers to be fully certified ("highly qualified"); California's response to staffing prior to NCLB was to place uncertified teachers in classrooms, which is in Georgia only an option by formal request for exception to the state Board of Education.

This study assesses the impact of Georgia's CSR initiative on staffing and staffing needs. As of this writing, the 2007 Georgia legislature is considering an amendment to delay class size reduction for one or two years in response to school systems' many violations of the maximum class size limitations, and in light of the "temporary austerity reductions" which have reduced school funding below legislated levels for five years.

Methods and Analyses

All analyses were undertaken using tools available in SPSS14.

Analysis of future teacher staffing demands

Numerous curvilinear regression models were compared to twelve years' past state student enrollment. The best fit Gaussian model was used to project enrollment through the 2011-2012 (FY12) school year. The Gaussian regression function determined to best fit the data takes the form $b_1 * (1 - b_3 * exp(-b_2 * x **2))$ where x in this case is the year of enrollment being predicted beginning with the base year 1995 represented as year 1, continuing through FY12 as year 18. The SPSS nonlinear regression tool iterates the factors b_1, b_2 and b_3 to best fit the existing data. Teacher staffing demand was estimated by multiplying the student enrollment projections by the most recent five-year average gross student/teacher ratio. Separate linear projections provided future annual teacher attrition estimates. Impact of the class size limit legislation was estimated using the midpoint between of the legislated class size average and legislated class size limit for each of the various designated class sizes. The estimated impact of the legislation was treated as a constant rather than allowing it to impact the slope of the regressions. Similarly, the impact of substantial increased enrollment due to immigration from states affected by hurricane Katrina was treated as a constant.

The Gaussian regression model was applied to the current production proportions of the various sources of the state's newly hired teachers to determine demands on each source to meet future full year projected staffing attrition as well as growth to meet student enrollment.

Analysis of changes in class size.

Data collection for class size was available for the fall of the 2005-2006 (FY06) and 2006-2007 (FY07) school years. Earlier data were not available to determine trends in class size variation; comparison could only be made immediately before and after the change in legislation. Each school open for both years, excluding closed and newly opened schools, was classified as Elementary, Middle, High or Other. The Other category, representing 154 or 7.1% of the 2,159 schools, including charter, special education, alternative and regular schools combining levels, was excluded from the analysis. The state school free and reduced lunch dataset was used to determine the proportion of students in each school eligible for free or reduced lunch in FY07. Schools were placed in five categories of free/reduced lunch proportions: 0-20%, 21-40%, 41-60%, 61-80% and 81-100%. A repeated measures analysis of variance used average class size as the repeated measure, School Level (Level) and Free/Reduced Lunch (FRLunch) category as between subjects factors. Because special education class sizes were not changed by the legislation, and would confound the analysis because schools with higher proportions of free and reduced lunch eligible students also have higher incidence of special education classes, those classes were excluded from the analysis.

Analysis of the number of classes over designated class limits

Whether each class in each school exceeded the designated class size limit was also available in the annual datasets and was used in an Overlimit analysis. The proportion of Overlimit classes in each school for the same schools identified in the class size analysis was subjected to a repeated measures analysis of variance with the proportion of overlimit classes as the repeated measure and school Level and FRLLunch category as between subjects factors.

Analysis of age and experience of teachers hired for enrollment growth and to replace attrition.

The number of teachers hired in each school between the spring (May, FY06)) and fall (October) 2006 (FY07) Certified Personnel Information (CPI) collection dates corresponded to the period during which schools and districts were required to implement the class size limit legislation. The hiring patterns during this period were compared to the previous three comparable periods (Spring FY03-Fall FY06). Two separate repeated measures analyses of variance used four years of average newly hired teacher age by school and four years of average newly hired teacher experience respectively as the repeated measure and School Level (elementary, middle, high) and FRLunch categories as the between-subjects factors.

Analysis of teacher vacancies

The state teacher licensing agency (Georgia Professional Standards Commission, PSC) initiated the Vacancy Reporting System (VRS) in the fall of 2006 to monitor difficulties in hiring certified education personnel. These data were collected by district by teacher certification and the percentage of time for which a teacher is sought, or Full Time Equivalent (FTE). Because the system was initiated after the implementation of the legislation, effect of the class size law could not be determined. Instead, an analysis of school district by FRLunch tested whether there was a differential impact of that socioeconomic proxy on vacancies at the 30 day and 90 day collections. A repeated measures analysis of variance used the proportion of vacancies to total number of positions in a school from the 30 and 90 day vacancy reports as the repeated measure, and FRLunch categories at the district level as the between subjects factor.

Data sources

Certified Personnel Information (CPI) data for educator staffing and Full Time Equivalent (FTE) data for student enrollment are collected biannually for all educators and all students in the state. The CPI provides data such as the hiring school, gender and ethnicity, years experience, salary, certification level, subject taught, and percent time employed. The FTE provides student data including enrolling school, gender and ethnicity, grade level, retention status, and dropout and graduation data. The FTE Class Size Report documents the number of students in each class in each school in the state by course, which enables class size and class size limit evaluation. The Certified Staffing Vacancy Reporting System (VRS), a new data collection beginning with the 2006-2007 school year, enables the analysis of educator vacancies at four points during the school year by certificate field at each school in the state. These data will be used to report on differences in vacancies among schools serving different socioeconomic levels as well as population density and geography. These datasets will be utilized to evaluate the impact on staffing of CSR legislation.

Results

Prediction of future teacher staffing levels

Teacher staffing needs for the school years 2006-2007 (FY07) through 2011-2012 (FY12) were estimated from projections of student enrollment predicted on the basis of twelve years' previous enrollment. Fall 2004 enrollment attributed to migration from Gulf of Mexico states as a result of hurricane Katrina was reported at 10,332 students statewide. These students were removed from enrollment figures for regression model development, although they are included in Figure 1. The Gaussian model fit student enrollment relatively well (r^2=0.978). Shown at FY07 is the new enrollment for the fall count (October 2006), which was 11,890 students (0.72%) under prediction.

Projections of teacher staffing were derived by determining the most recent five-year average gross student-teacher ratio and projecting that ratio from Gaussian model student enrollment estimates. As shown in Figure 2, teacher staffing was projected at 115,250; reported staffing in the fall of 2006 was reported at 114,746.

Figure 1. Past and projected Georgia public school enrollment, FY95-FY12.

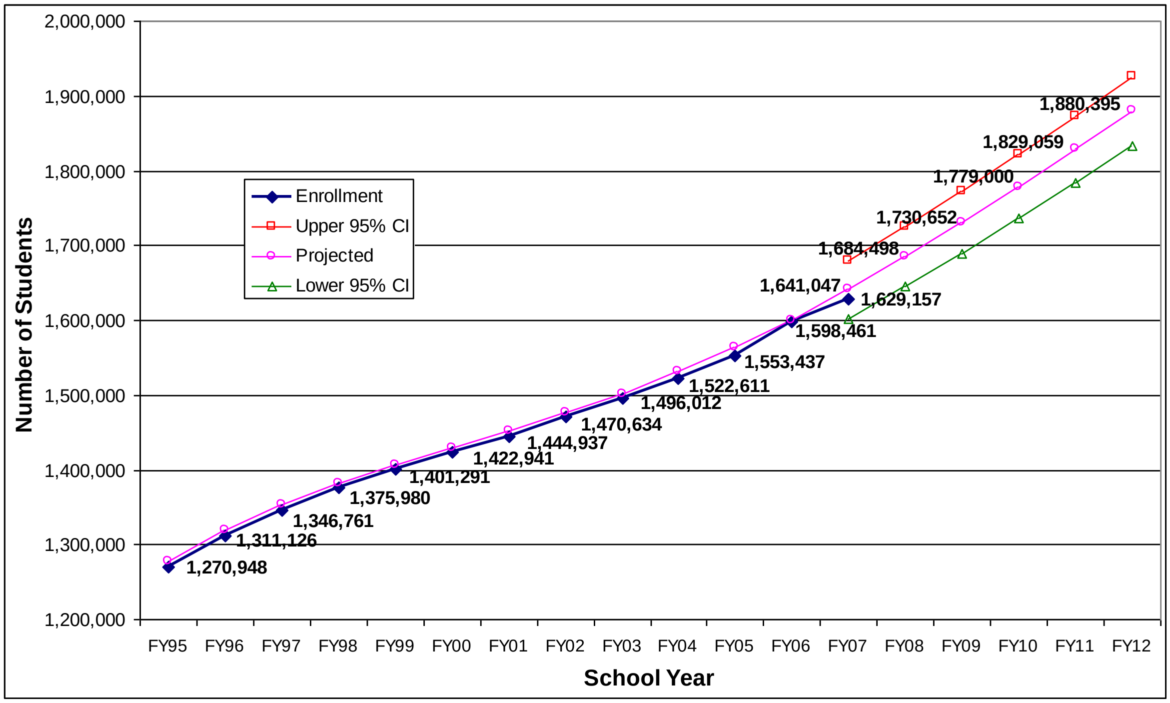
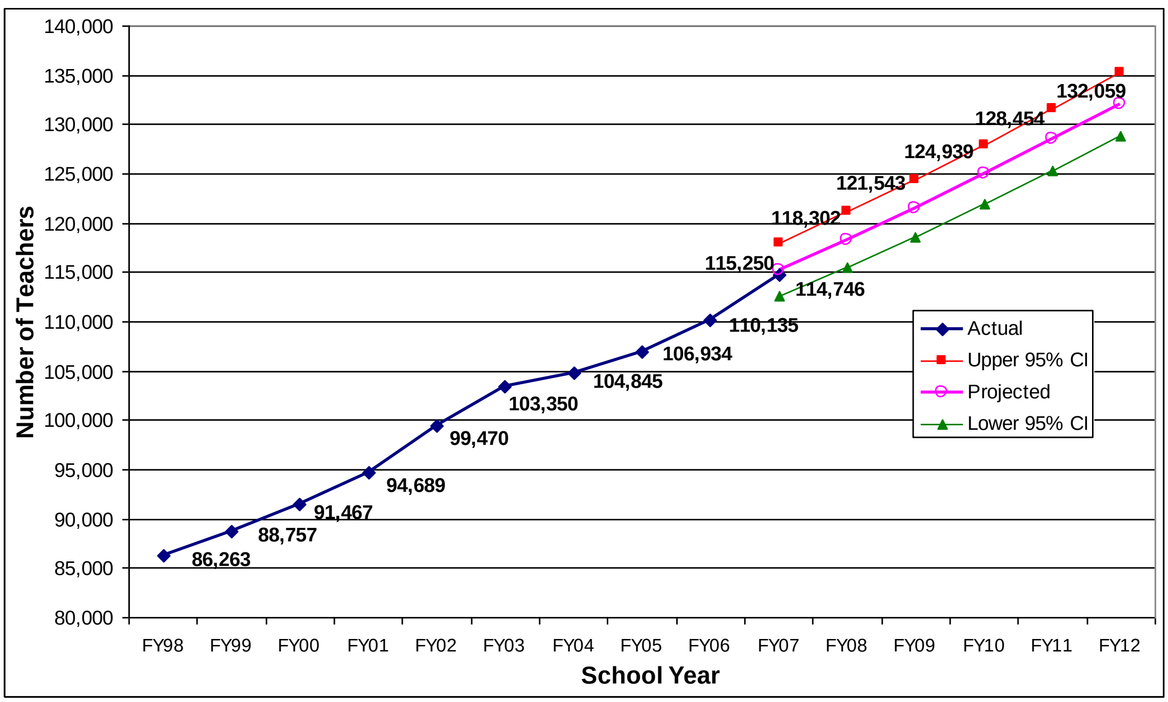
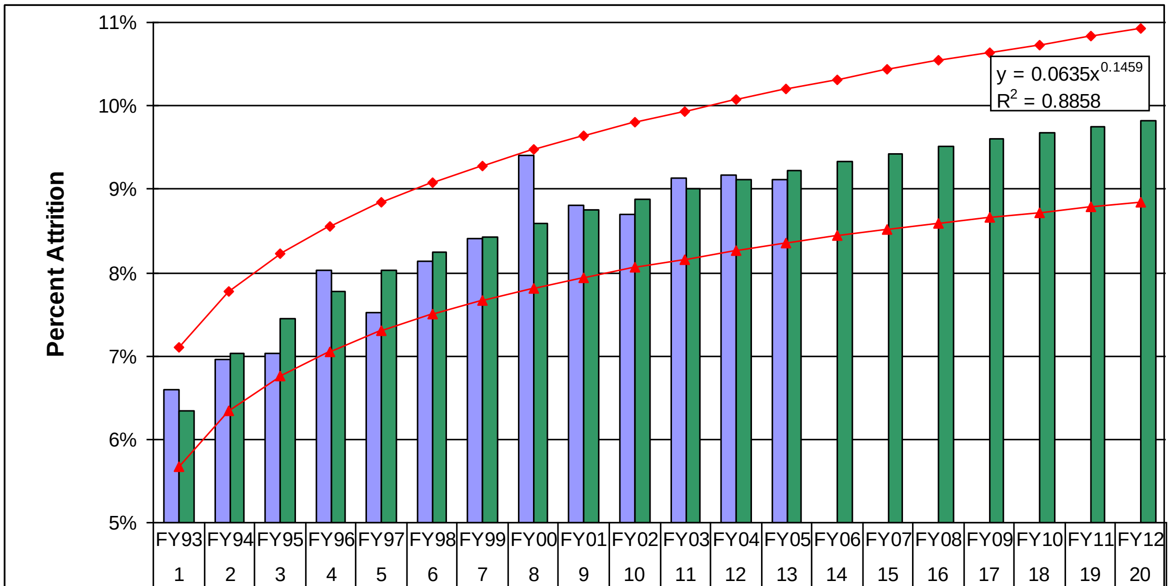


Figure 2. Past and projected Georgia public school teacher staffing, FY98-FY12



Projected teacher staffing includes both attrition replacement and enrollment increase demand. Figure 3 shows past and projected teacher attrition rates from FY93 to FY12. Attrition has been gradually rising since data were first available in 1993, when annual teacher attrition was well under seven percent. The most recent three years' attrition were above nine percent. The best fit regression model (r^2=.89) projects attrition to exceed 9.8% by FY12.

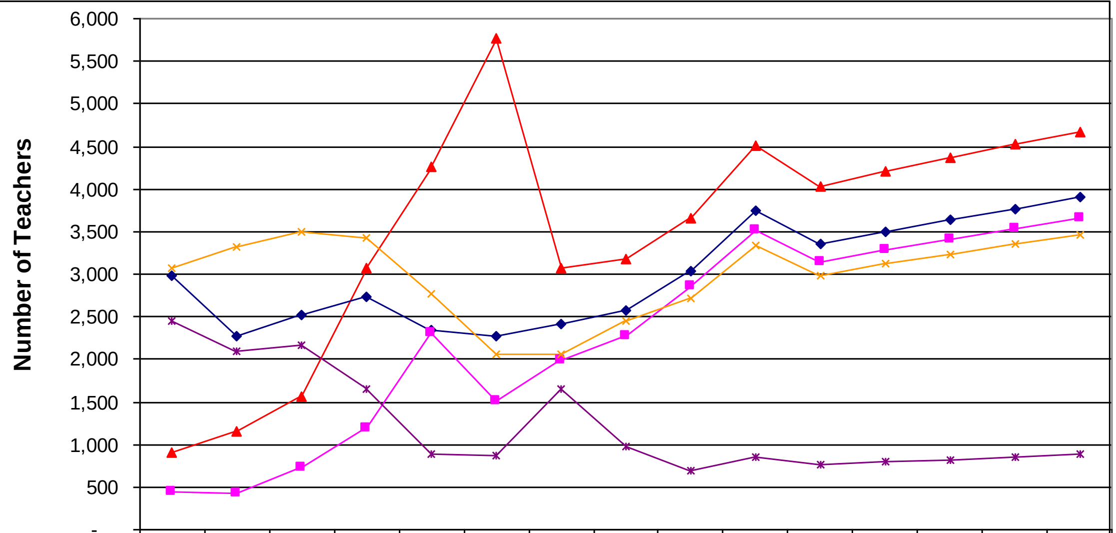
Figure 3. Past and projected statewide teacher attrition, FY93-FY12



	FY93	FY94	FY95	FY96	FY97	FY98	FY99	FY00	FY01	FY02	FY03	FY04	FY05	FY06	FY07	FY08	FY09	FY10	FY11	FY12
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Actual	6.59	6.95	7.03	8.03	7.51	8.13	8.41	9.40	8.80	8.70	9.13	9.16	9.12							
Prediction	6.35	7.02	7.45	7.77	8.03	8.25	8.43	8.60	8.75	8.88	9.01	9.12	9.23	9.33	9.42	9.51	9.60	9.68	9.76	9.83
UCL	7.11	7.78	8.22	8.56	8.84	9.07	9.28	9.47	9.64	9.80	9.94	10.07	10.20	10.32	10.43	10.54	10.64	10.74	10.83	10.92
LCL	5.67	6.34	6.76	7.06	7.30	7.49	7.66	7.81	7.94	8.06	8.16	8.26	8.35	8.44	8.52	8.59	8.66	8.73	8.79	8.85

Figure 4 shows past teacher supply and projected demand from each teacher supply source for Georgia, assuming that each source produces a share equivalent to the most recent year's proportions. Supply from each source in the past has been highly variable. A prior radical increase in staffing demand caused by policy changes in 2002 was fulfilled primarily by recruiting out-of-state teachers.

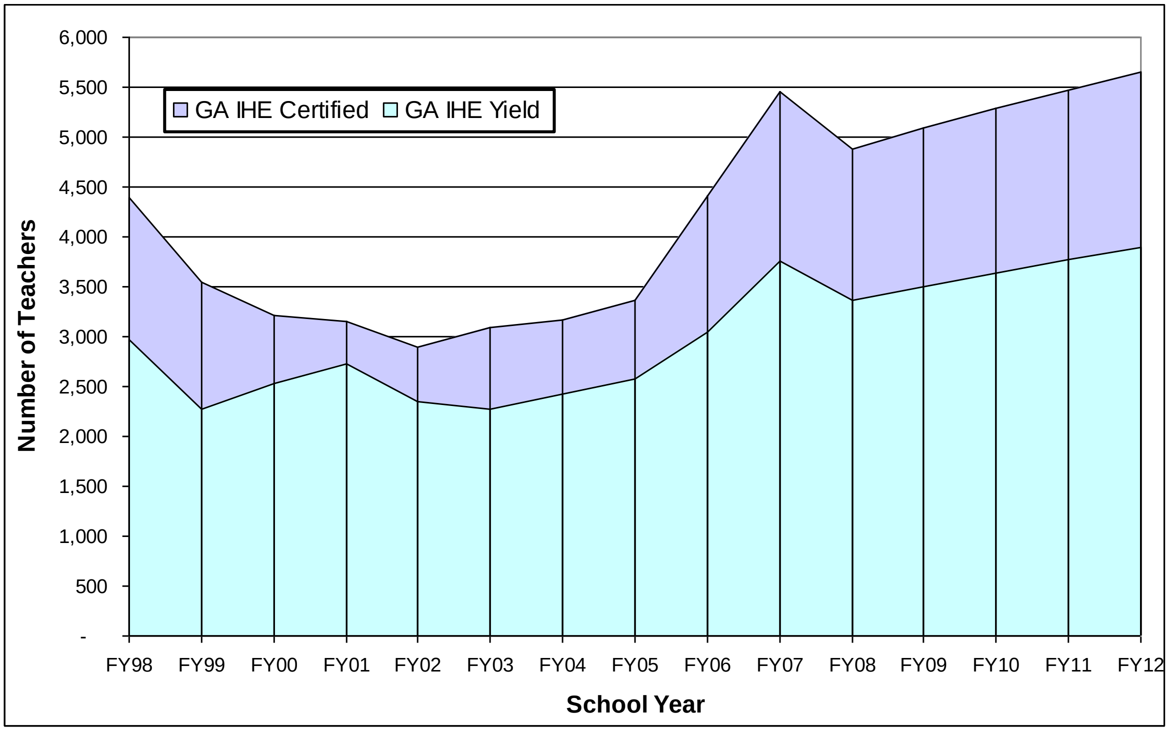
Figure 4. Past new teacher staffing, FY98-FY06 and projected production requirements from each supply source, FY07-FY12



	FY98	FY99	FY00	FY01	FY02	FY03	FY04	FY05	FY06	FY07	FY08	FY09	FY10	FY11	FY12
Out of State	901	1,150	1,567	3,072	4,252	5,771	3,068	3,170	3,659	4,505	4,035	4,204	4,368	4,525	4,677
GA IHE Yield	2,974	2,277	2,525	2,725	2,347	2,273	2,421	2,578	3,042	3,754	3,362	3,503	3,640	3,771	3,898
Alternative Prep	441	418	723	1,182	2,316	1,501	1,995	2,281	2,853	3,515	3,147	3,280	3,407	3,530	3,649
Returning	3,071	3,327	3,501	3,427	2,761	2,053	2,051	2,456	2,708	3,339	2,990	3,116	3,237	3,354	3,466
Other	2,450	2,092	2,157	1,655	890	878	1,650	971	687	847	758	790	821	850	879

The state's universities and colleges supply about one quarter of the new teachers required each year. Slightly fewer than 70% of the system's new teachers (not including those who return to earn advanced degrees) actually enter Georgia public school classrooms the following year. Figure 5 depicts this discrepancy and projects the number of teachers the universities may need to produce in order to yield a number of teachers to the classroom equivalent to the proportion they now supply.

Figure 5. Past and projected state traditional teacher production and yield, FY98-FY12



Class Size

The effect of the class size legislation on average class size at the school level was analyzed in a 2 x 3 x 5 repeated measures Anova using the repeated measure annual school average class size by school Level (elementary, middle and high) and the percentage of students eligible for free & reduced lunch in a school (FRLunch) categorized into five levels (0-20%, 21-40%, 41-60%, 61-80% and 81-100%).

Table 1 shows the average class sizes in FY06 and FY07 for schools at each FRLunch category by school Level. Table 2 shows the Anova table for this analysis.

Table 1. Descriptive statistics for Average Class Size by Level by FRLunch.

		School Year				
		FY06		FY07		
School Level	FRLunch	Class Size	SD	Class Size	SD	N
Elementary	0-20%	20.29	1.55	19.35	1.44	108
	21-40%	19.52	1.66	18.69	2.13	194
	41-60%	18.36	2.34	17.99	2.13	289
	61-80%	18.46	5.03	17.60	2.35	311
	81-100%	17.13	2.46	16.99	2.29	297
	Total	18.44	3.31	17.88	2.29	1,199
Middle	0-20%	19.48	2.50	18.68	2.18	34
	21-40%	19.51	2.48	19.21	2.54	67
	41-60%	19.29	2.25	18.33	2.17	111
	61-80%	18.76	2.72	18.01	2.52	128
	81-100%	18.22	2.62	17.55	3.55	76
	Total	18.98	2.56	18.26	2.68	416
High	0-20%	20.32	4.66	20.01	4.61	50
	21-40%	20.01	2.98	20.18	3.33	70
	41-60%	19.54	2.85	19.54	3.06	118
	61-80%	19.34	2.65	19.36	2.52	79
	81-100%	19.01	2.64	18.50	2.50	13
	Total	19.69	3.17	19.66	3.27	330

Table 2. Yearly Average Class Size by Level by FRLunch Anova

Tests of Within-Subjects Effects						
Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Class Size	113.148	1	113.148	35.556	0.000	0.018
Class Size * Level	23.018	2	11.509	3.617	0.027	0.004
Class Size * FRLunch	7.382	4	1.846	0.580	0.677	0.001
Class Size * Level * FRLunch	35.274	8	4.409	1.386	0.198	0.006
Error(Class Size)	6141.807	1930	3.182			
Tests of Between-Subjects Effects						
Intercept	696087.253	1	696087.253	56627.707	0.000	0.967
Level	419.872	2	209.936	17.079	0.000	0.017
FRLunch	656.686	4	164.171	13.356	0.000	0.027
Level * FRLunch	137.629	8	17.204	1.400	0.192	0.006
Error	23724.224	1930	12.292			

The interaction of Yearly Average Class Size and Level was significant at p=.027. The main effect of FRLunch was significant at p<.001. Table 3 shows the post-hoc analysis for FRLunch. The 0-20% and 21-40% groups and 41-60% and 61-80% groups were not significantly different. The difference between the 21-40% and 41-60% groups, and the difference between the 81-100% group and all others were significantly different. Class sizes are largest for schools with 0-40% free and reduced lunch, and smallest for schools with 81-100% free and reduced lunch.

Table 3. Tukey Honestly Significant Difference post hoc analysis of FRLunch

Tukey HSD					
(I) FRLunch	(I) Mean	(J) FRLunch	Mean Difference (I-J)	Std. Error	Sig.
0-20%	19.687	21-40%	0.412	0.225	0.355
		41-60%	1.155	0.209	**0.000**
		61-80%	1.459	0.209	**0.000**
		81-100%	2.498	0.219	**0.000**
21-40%	19.520	41-60%	0.743	0.174	**0.000**
		61-80%	1.047	0.174	**0.000**
		81-100%	2.086	0.186	**0.000**
41-60%	18.842	61-80%	0.303	0.154	0.281
		81-100%	1.343	0.167	**0.000**
61-80%	18.589	81-100%	1.040	0.167	**0.000**
81-100%	17.901				

Table 4 shows post-hoc 2x5 analyses of variance the elementary, middle and high school levels of the analysis. At the elementary school level, the Yearly Class Size x FRLunch interaction was significant (p=.005). At middle school, both Yearly Class Size (p<.001) and FRLunch (I=.002) main effects were significant, but high school showed no significant class size results.

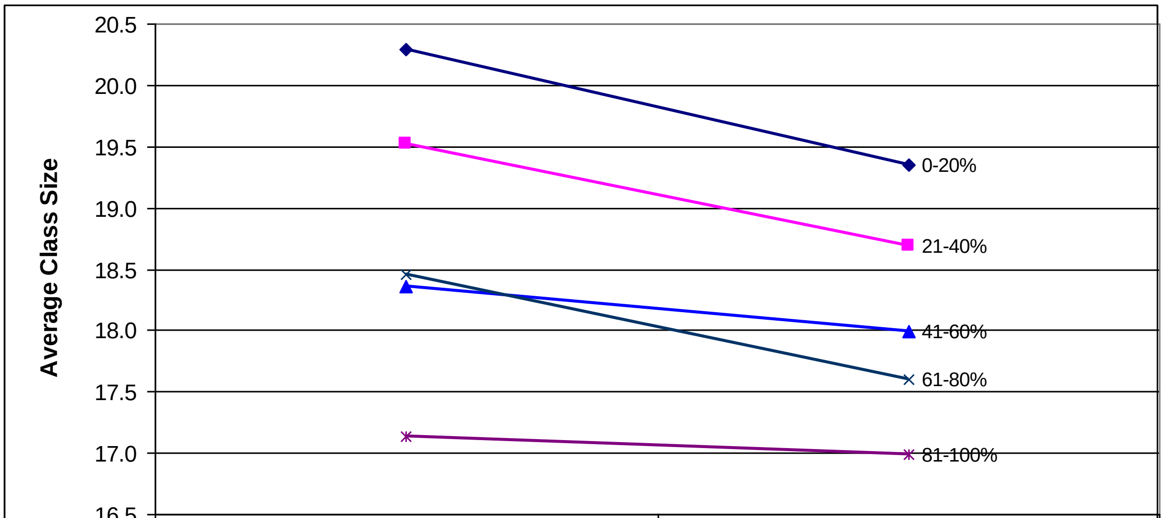
Table 4. Post-hoc Yearly Class Size by FRLunch Anova tables

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Elementary School						
Tests of Within-Subjects Effects						
Class Size	201.486	1	201.486	51.306	**0.000**	0.041
Class Size * FRLunch	58.835	4	14.709	3.745	**0.005**	0.012
Error(Class Size)	4689.031	1194	3.927			
Tests of Between-Subjects Effects						
Intercept	695113.347	1	695113.347	63994.407	**0.000**	0.982
FRLunch	1673.041	4	418.260	38.506	**0.000**	0.114
Error	12969.342	1194	10.862			
Middle School						
Tests of Within-Subjects Effects						
Class Size	81.134	1	81.134	36.817	**0.000**	0.082
Class Size * FRLunch	9.165	4	2.291	1.040	0.386	0.010
Error(Class Size)	905.727	411	2.204			
Tests of Between-Subjects Effects						
Intercept	235339.045	1	235339.045	21124.704	0.000	0.981
FRLunch	190.941	4	47.735	4.285	**0.002**	0.040
Error	4578.732	411	11.140			
High School						
Tests of Within-Subjects Effects						
Class Size	1.452	1	1.452	0.863	0.354	0.003
Class Size * FRLunch	5.000	4	1.250	0.743	0.564	0.009
Error(Class Size)	547.049	325	1.683			
Tests of Between-Subjects Effects						
Intercept	144863.316	1	144863.316	7622.965	0.000	0.959
FRLunch	91.221	4	22.805	1.200	0.311	0.015
Error	6176.150	325	19.004			

Figures 6, 7, and 8 show the elementary, middle and high school results. Elementary school post-hoc *F*-tests using ms error within showed that the 0-20%, 21-40% and 61-80% FRLunch schools significanty ($p<.001$) reduced class sizes between FY06 and FY07. The 41-60% and 81-100% schools did not significantly reduce class sizes.

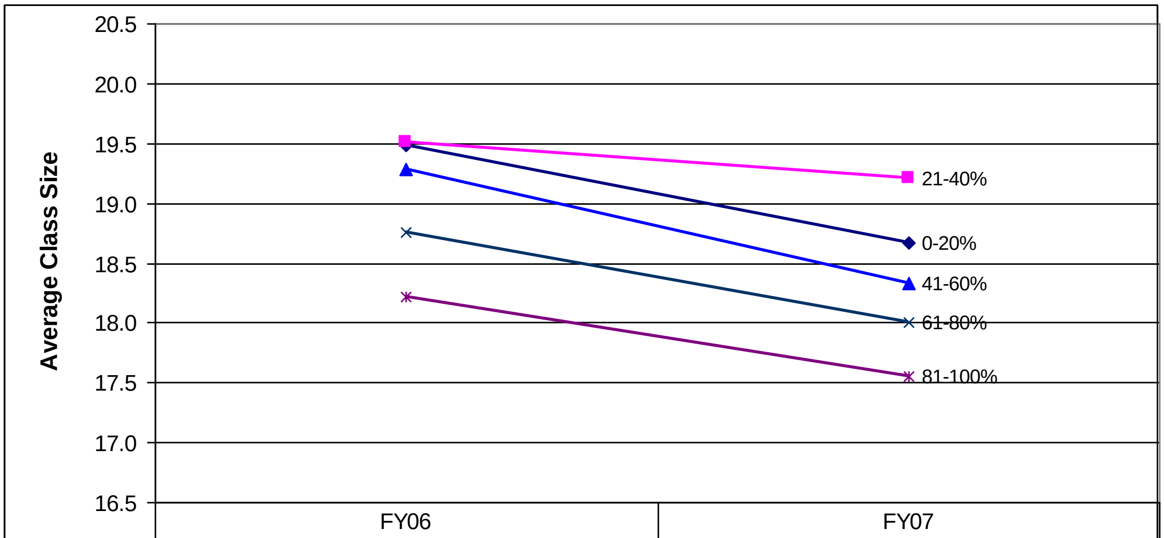
The middle school analysis revealed no interaction. The post-hoc Tukey HSD revealed only the 21-40% and 81-100% school groups were significantly different from one another ($p=.002$).

Figure 6. Elementary school Yearly Average Class Size by FRLunch



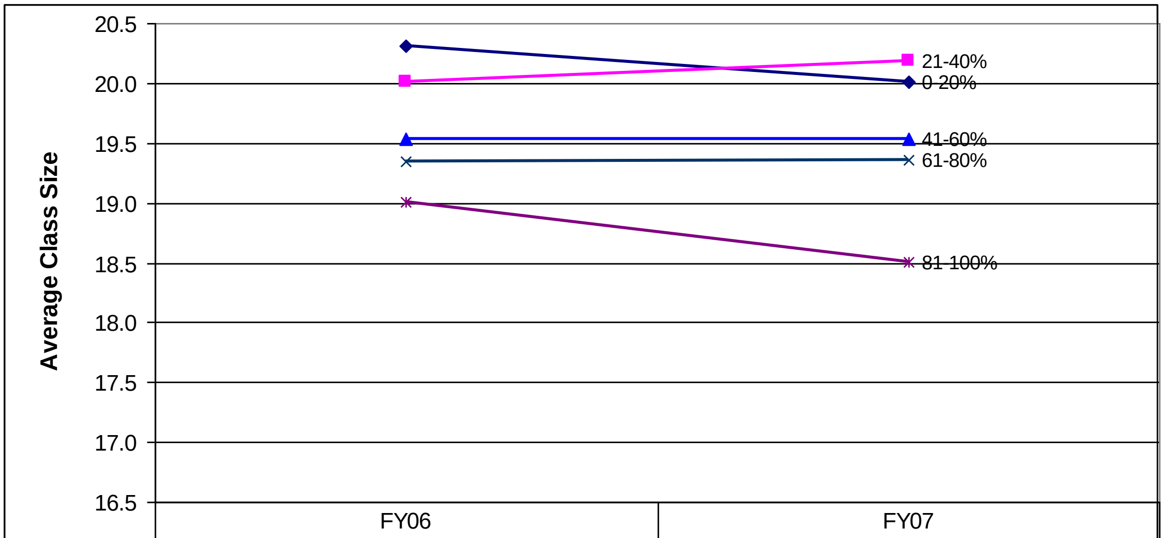
	FY06	FY07
0-20%	20.29	19.35
21-40%	19.52	18.69
41-60%	18.36	17.99
61-80%	18.46	17.60
81-100%	17.13	16.99

Figure 7. Middle school Yearly Average Class Size by FRLunch



	FY06	FY07
0-20%	19.48	18.68
21-40%	19.51	19.21
41-60%	19.29	18.33
61-80%	18.76	18.01
81-100%	18.22	17.55

Figure 8. High school Yearly Average Class Size by FRLunch



	FY06	FY07
0-20%	20.32	20.01
21-40%	20.01	20.18
41-60%	19.54	19.54
61-80%	19.34	19.36
81-100%	19.01	18.50

Classes over legislated size limit

The effect of the class size legislation at the school level on the incidence of classes exceeding the legislated size limits was analyzed in a 2 x 3 x 5 repeated measures Anova using the repeated measure annual average number of classes over the maximum allowed number of students (Overlimit) by school Level (elementary, middle and high) and the percentage of students eligible for free & reduced lunch in a school (FRLunch) categorized into five levels (0-20%, 21-40%, 41-60%, 61-80% and 81-100%).

Table 5 shows the mean number of classes over limit by free/reduced lunch category and school level.

Table 5. Descriptive statistics for OverLimit by Level by FRLunch.

		Average Number Classes Over Limit				
	Pct Free &	FY06		FY07		
	Reduced	Mean	SD	Mean	SD	N
Elementary	0-20%	0.54	1.69	0.26	0.96	108
	21-40%	0.36	1.92	0.48	3.23	194
	41-60%	0.23	1.14	0.76	3.46	289
	61-80%	0.50	1.90	0.92	2.96	311
	81-100%	0.68	2.97	1.39	4.43	297
	Total	0.46	2.07	0.87	3.45	1199
Middle	0-20%	1.44	4.05	1.82	4.03	34
	21-40%	0.97	2.90	1.45	3.59	67
	41-60%	0.64	2.82	0.70	2.51	111
	61-80%	1.05	3.82	1.50	5.40	128
	81-100%	1.58	3.64	6.13	17.31	76
	Total	1.06	3.43	2.15	8.47	416
High School	0-20%	2.78	6.28	1.50	3.55	50
	21-40%	1.77	4.68	1.93	7.16	70
	41-60%	2.06	6.50	1.13	3.31	118
	61-80%	2.44	6.81	1.89	5.50	79
	81-100%	0.08	0.28	0.08	0.28	13
	Total	2.12	6.07	1.49	4.89	330

Table 6 shows the Overlimit by Level by FRLunch Anova table. The three-way interaction was significant ($p<.001$).

Table 6. Annual OverLimit by Level by FRLunch Anova

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Tests of Within-Subjects Effects						
Overlimit	50.798	1	50.798	3.939	**0.047**	0.002
Overlimit * Level	188.737	2	94.368	7.317	**0.001**	0.008
Overlimit * FRLunch	162.712	4	40.678	3.154	**0.014**	0.006
Overlimit * Level * FRLunch	407.768	8	50.971	3.952	**0.000**	0.016
Error(Overlimit)	24890.112	1930	12.896			
Tests of Between-Subjects Effects						
Intercept	1649.229	1	1649.229	134.801	**0.000**	0.065
Level	391.649	2	195.825	16.006	**0.000**	0.016
FRLunch	72.083	4	18.021	1.473	0.208	0.003
Level * FRLunch	375.183	8	46.898	3.833	**0.000**	0.016
Error	23612.734	1930	12.235			

Post hoc 2 x 5 analyses for each Level of OverLimit by FRLunch were performed and are shown in Table 4. To adjust for the loss of power in this post-hoc approach, a significance level of $p<.10$ was accepted. At the elementary and middle school levels, both main effects and the interaction were significant. No differences were significant at the high school level.

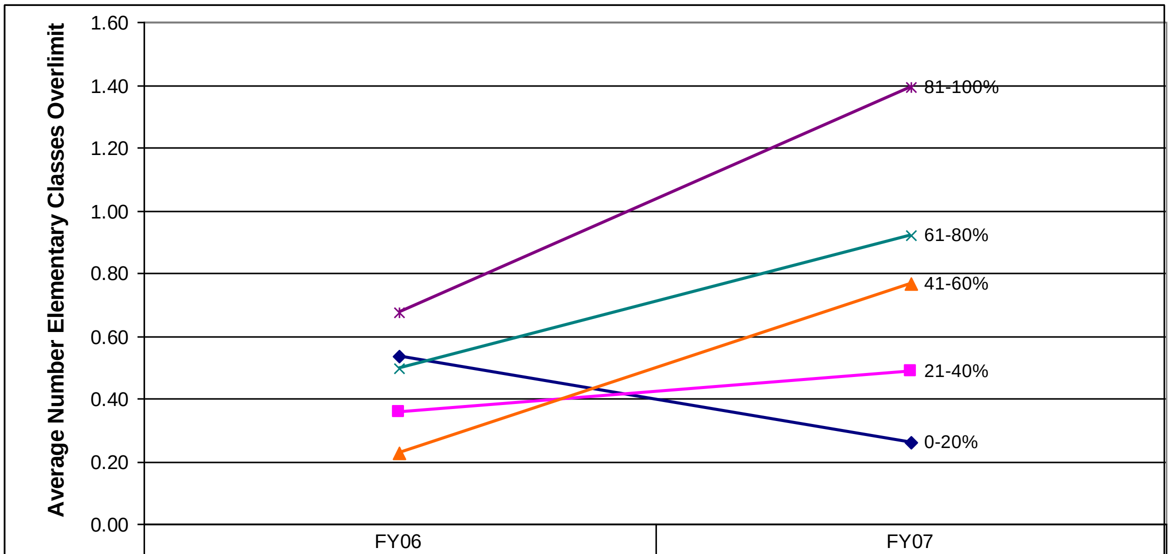
The interactions at the elementary and middle school levels might suggest that there are two groups at each level. At elementary, schools with 40% or fewer free and reduced lunch eligible students had no difficulty with the new law, while those with more than 40% FRLunch appear to have seen an increase in the number of classes over limit subsequent to the law’s implementation. At the middle school level, only those schools with more than 80% FRLunch appeared to have an increase in the incidence of overlimit classes, while there was no change for schools with lower percentages had no increase in difficulty meeting limits.

Table 7. Post-hoc repeated measures OverLimit by FRLunch Anovas

Source	Type III Sum of Squares	df	Mean Square	F	Significance	Partial Eta Squared
Elementary School						
Tests of Within-Subjects Effects						
Overlimit	47.79	1	47.79	8.36	**0.004**	0.007
Overlimit * FRLunch	49.27	4	12.32	2.15	**0.072**	0.007
Error(Overlimit)	6,829.05	1194	5.72			
Tests of Between-Subjects Effects						
Intercept	764.47	1	764.47	73.67	**0.000**	0.058
FRLunch	136.99	4	34.25	3.30	**0.011**	0.011
Error	12,389.93	1194	10.38			
Middle School						
Tests of Within-Subjects Effects						
Overlimit	236.49	1	236.49	7.35	**0.007**	0.018
Overlimit * FRLunch	561.17	4	140.29	4.36	**0.002**	0.041
Error(Overlimit)	13,229.91	411	32.19			
Tests of Between-Subjects Effects						
Intercept	2009.51	1	2,009.51	41.60	0.000	0.092
FRLunch	1012.48	4	253.12	5.24	**0.000**	0.049
Error	19,855.63	411	48.31			
High School						
Tests of Within-Subjects Effects						
Overlimit	25.78	1	25.78	1.73	0.189	0.005
Overlimit * FRLunch	40.43	4	10.11	0.68	0.606	0.008
Error(Overlimit)	4,831.15	325	14.87			
Tests of Between-Subjects Effects						
Intercept	925.27	1	925.27	20.07	0.000	0.058
FRLunch	120.16	4	30.04	0.65	0.626	0.008
Error	14,979.91	325	46.09			

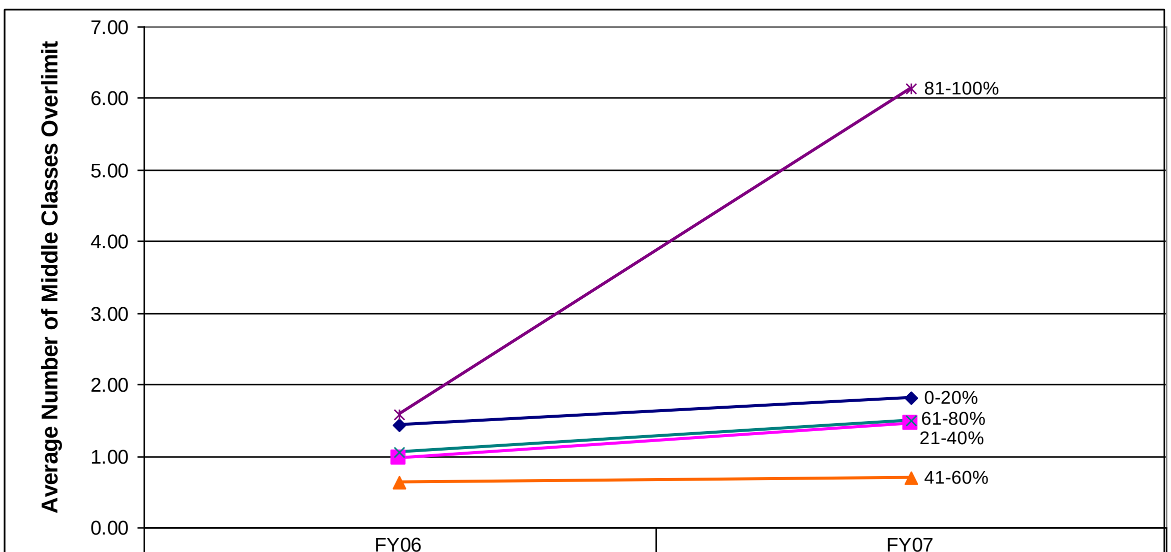
Figures 9, 10 and 11 portray the two-way interactions at each of the three school Levels.

Figure 9. Elementary school OverLimit by FRLunch interaction.



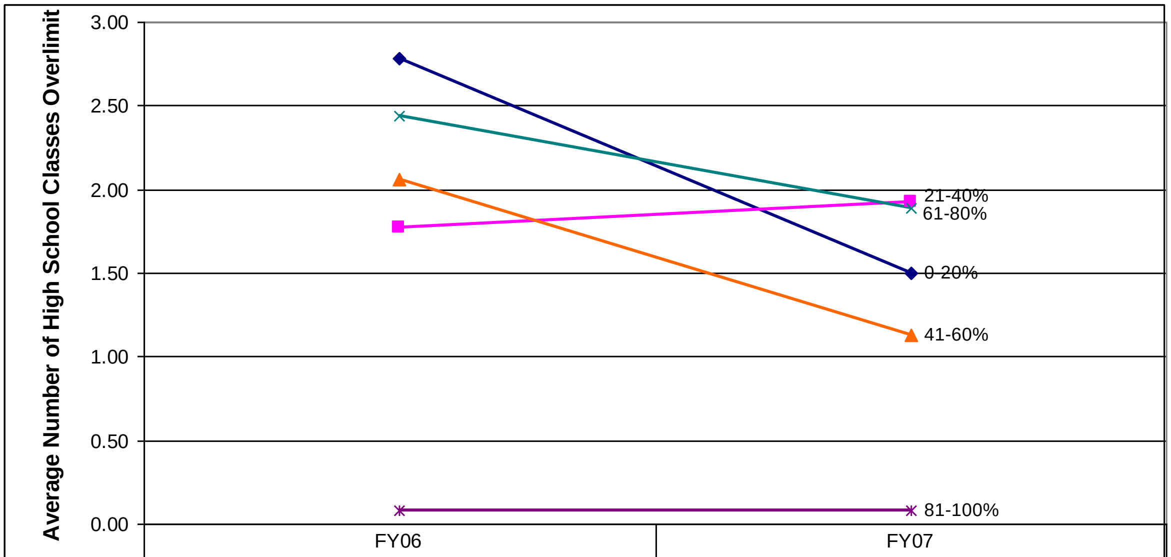
	FY06	FY07
0-20%	0.54	0.26
21-40%	0.36	0.48
41-60%	0.23	0.76
61-80%	0.50	0.92
81-100%	0.68	1.39

Figure 10. Middle school OverLimit by FRLunch interaction



	FY06	FY07
0-20%	1.44	1.82
21-40%	0.97	1.45
41-60%	0.64	0.70
61-80%	1.05	1.50
81-100%	1.58	6.13

Figure 11. High school OverLimit by FRLunch interaction.



	FY06	FY07
0-20%	2.78	1.50
21-40%	1.77	1.93
41-60%	2.06	1.13
61-80%	2.44	1.89
81-100%	0.08	0.08

Elementary and middle schools were categorized into “Low” and “High” FRLunch groups according to the above criteria and each level entered into a 2 x 2 repeated measures analysis of variance.

Tables 8 and 9 show the average number of classes over limit by free/reduced lunch category and school level and the Anova summary table for the elementary level. Figure 12 shows the interaction between Overlimit and FRLunch as categorized. The interaction indicates that the schools with higher free and reduced lunch proportions (more than 40%) had significantly more difficulty meeting the new class size requirements than did those schools with lower rates of FRLunch.

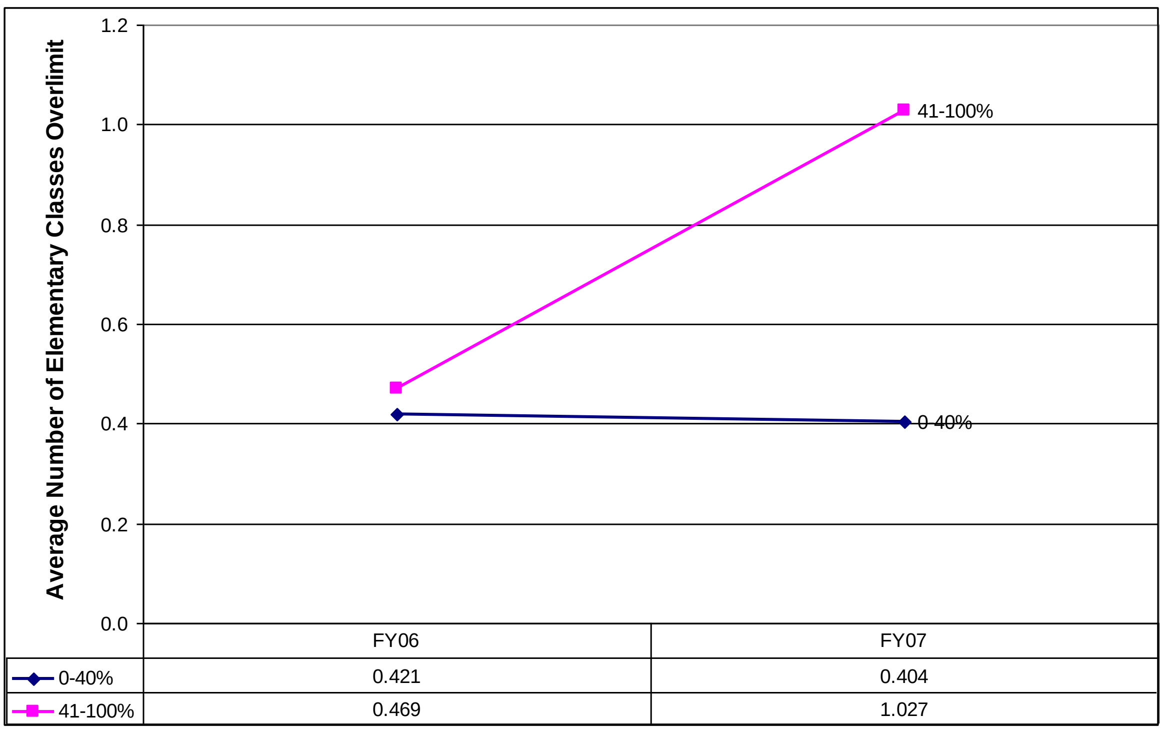
Table 8. Descriptive statistics for elementary school Overlimit by two-category FRLunch interaction

	Average Number of Classes Overlimit				
Pct Free & Reduced	FY06 Mean	FY06 SD	FY07 Mean	FY07 SD	N
0-40%	0.47	2.15	1.03	3.67	897
41-100%	0.42	1.84	0.40	2.65	302
Total	0.46	2.07	0.87	3.45	1,199

Table 9. Post-hoc elementary school Overlimit by two-category FRLunch Anova

Tests of Within-Subjects Effects						
Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Overlimit	33.05	1	33.05	5.78	0.016	0.005
Overlimit * FRLunch	37.22	1	37.22	6.51	0.011	0.005
Error(Overlimit)	6,841.11	1,197	5.72			
Tests of Between-Subjects Effects						
Intercept	608.35	1	608.35	58.37	0.000	0.046
FRLunch	50.95	1	50.95	4.89	0.027	0.004
Error	12,475.97	1,197	10.42			

Figure 12. Elementary school Overlimit by two category FRLunch interaction



Tables 10 and 11 show the mean number of classes over limit by free/reduced lunch category and school level and the Anova summary table for the middle school level. Figure 13 shows the interaction between Overlimit and FRLunch as categorized. The interaction indicates that the schools with more than 80% free and reduced lunch proportions had significantly more difficulty meeting the new class size requirements than did those schools with lower rates of FRLunch.

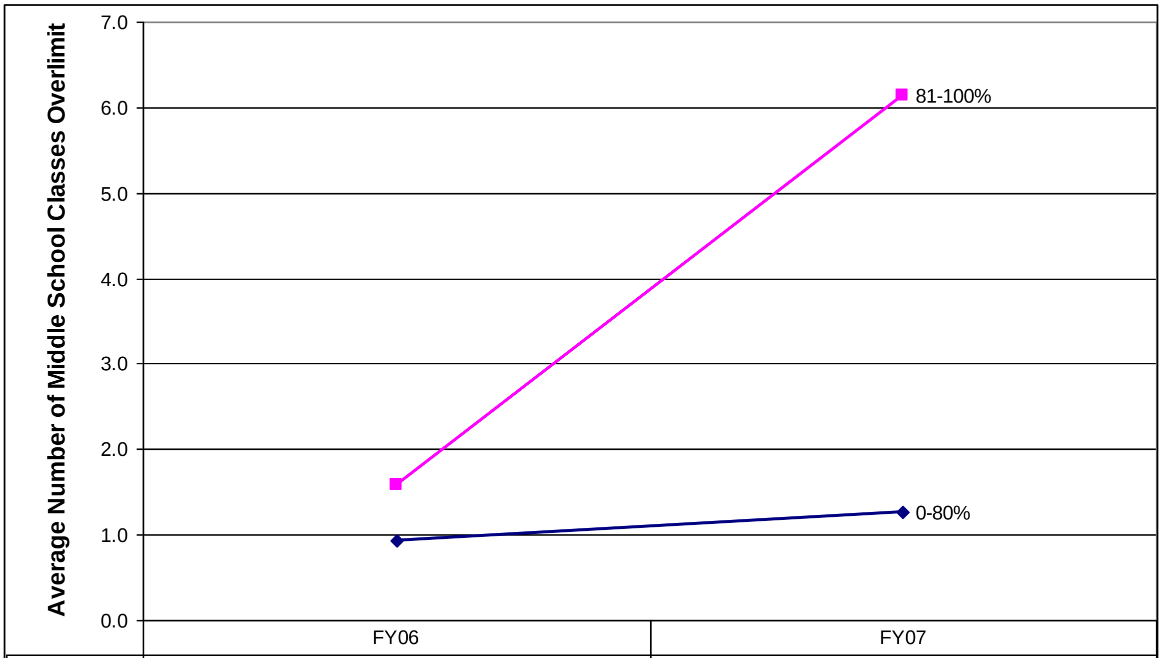
Table 10. Descriptive statistics for middle school Overlimit by two-category FRLunch interaction

Pct Free & Reduced	Average Number of Classes Overlimit				N
	FY06		FY07		
	Mean	SD	Mean	SD	
0-40%	1.58	3.64	6.13	17.31	76
41-100%	0.94	3.37	1.26	4.15	340
Total	1.06	3.43	2.15	8.47	416

Table 11. Post-hoc middle school Overlimit by two-category FRLunch Anova

Tests of Within-Subjects Effects						
Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Overlimit	738.46	1	738.46	23.10	0.000	0.053
Overlimit * FRLunch	555.48	1	555.48	17.37	0.000	0.040
Error(Overlimit)	13,235.60	414	31.97			
Tests of Between-Subjects Effects						
Intercept	3050.44	1	3050.44	63.38	0.000	0.133
FRLunch	943.09	1	943.09	19.60	0.000	0.045
Error	19,925.02	414	48.13			

Figure 13. Elementary school Overlimit by two category FRLunch interaction



	FY06	FY07
0-80%	0.938	1.262
81-100%	1.579	6.132

Teacher age and experience

The effect of the class size legislation on the average age and experience of newly hired teachers at the school level was analyzed in two separate 4 x 3 x 5 repeated measures Anovas using the repeated measure of four years school average new teacher age and experience by school Level (elementary, middle and high) and the percentage of students eligible for free & reduced lunch in a school (FRLunch) categorized into five levels (0-20%, 21-40%, 41-60%, 61-80% and 81-100%).

Teacher age

Table 12 shows the results of the repeated measures Anova for average Age at the school level for new teachers hired for the four years FY04-FY07. Age and Level were significant ($p<.001$). Table 13 shows the post-hoc Age contrasts and the post-hoc school Level tests. Figures 14 and 15 show the average new teacher ages over the past four years and the difference in ages among the three school levels, respectively.

It would appear that the class size legislation had no significant effect on the age of newly hired teachers. A significant ($p<.001$) rise in age occurred between the FY04 and FY05 years, but the post-hoc Helmert contrast showed no significant change in age subsequently. Newly hired elementary teachers are significantly ($p<.001$) younger than middle and high school new teachers, but middle and high school new teachers are not significantly different in age.

Table 12. New teacher age by Level by FRLunch Anova table

Tests of Within-Subjects Effects						
Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Tr Age	1194.849	3	398.283	11.041	**0.000**	0.008
Tr Age * Level	179.470	6	29.912	0.829	0.547	0.001
Tr Age * FRLunch	606.341	12	50.528	1.401	0.157	0.004
Tr Age * Level * FRLunch	904.841	24	37.702	1.045	0.402	0.006
Error(TrAge)	153131.468	4245	36.073			
Tests of Between-Subjects Effects						
Intercept	3814315.316	1	3814315.316	80806.953	0.000	0.983
Level	1887.158	2	943.579	19.990	**0.000**	0.027
FRLunch	130.994	4	32.748	0.694	0.596	0.002
Level * FRLunch	700.242	8	87.530	1.854	0.063	0.010
Error	66791.977	1415	47.203			

Table 13. Post Hoc new teacher age Helmert contrasts and school level Tukey Honestly Significant Difference tests

New Teacher Age						
Helmert Test of Within-Subjects Contrasts						
Source	TrAge	Type III Sum of Squares	df	Mean Square	F	Sig.
Tr Age	FY04 vs. Later	1466.304	1	1466.304	26.797	0.000
	FY05 vs. Later	67.869	1	67.869	1.271	0.260
	FY06 vs. FY07	99.750	1	99.750	1.579	0.209
Error(Tr Age)	FY04 vs. Later	77427.040	1415	54.719		
	FY05 vs. Later	75566.852	1415	53.404		
	FY06 vs. FY07	89366.572	1415	63.157		
School Level						
Tukey HSD						
(I) SchlLvl2	(J) SchlLvl2	Mean Difference (I-J)	Std. Error			Sig.
Elementary	Middle	-1.063	0.225			0.000
	High	-1.699	0.235			0.000
Middle	High	-0.636	0.278			0.058

Figure 14. Average new teacher age, FY04-FY07

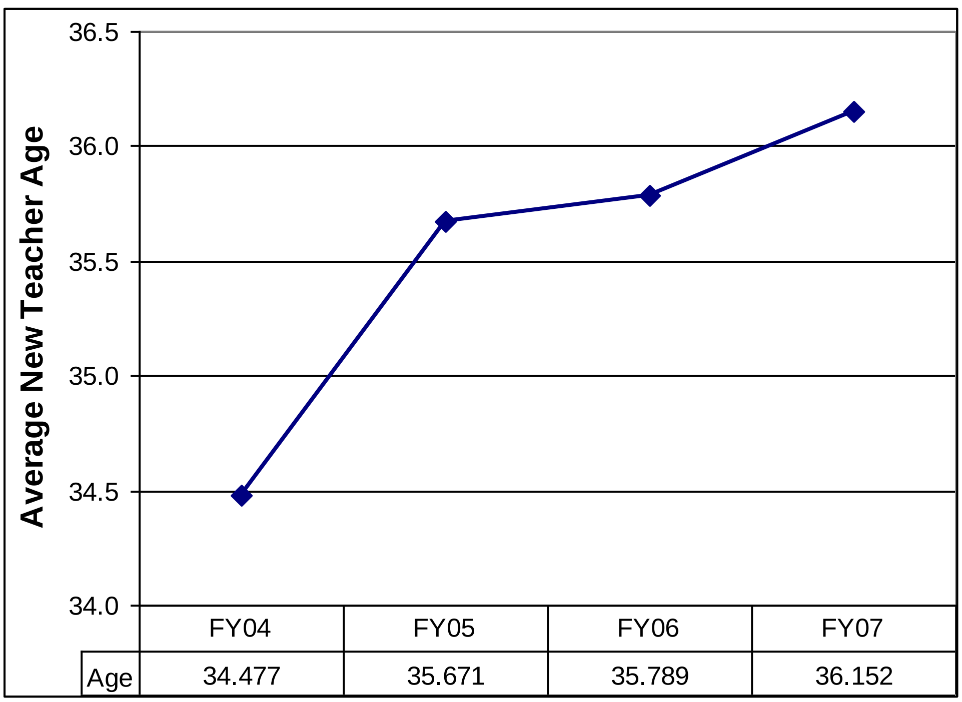
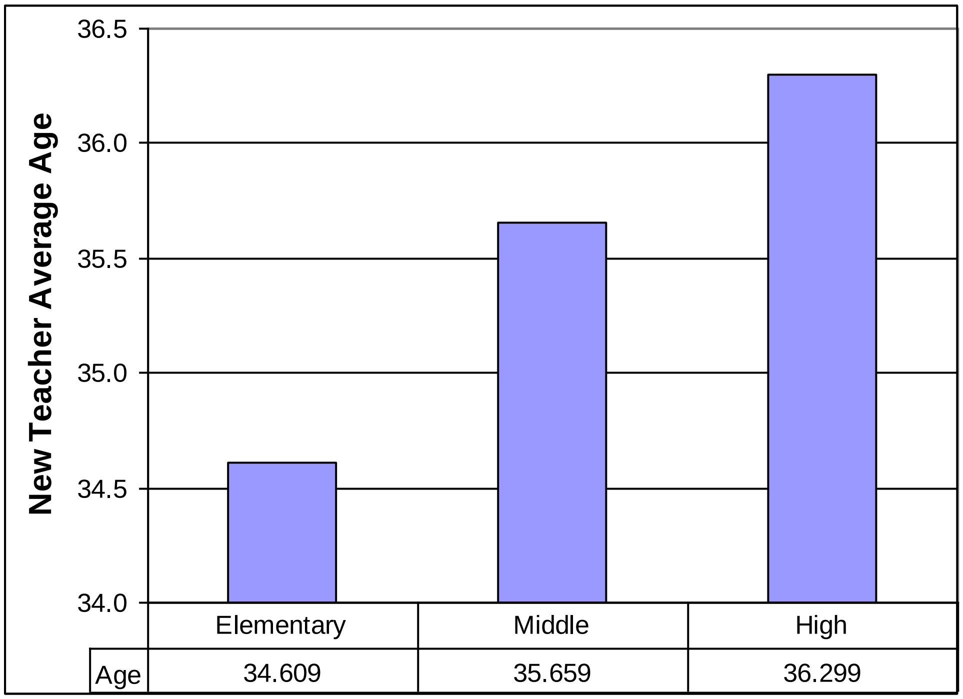


Figure 15. Average new teacher age by school level



New teacher experience

Table 14 shows the results of the repeated measures Anova for average Experience at the school level for new teachers hired for the four years FY04-FY07. School Level and Free & Reduced Lunch (FRLunch) were significant (p<.001). Table 15 shows the post-hoc Level and FRLunch tests. Figures 16, 17 and 18 show the average new teacher experience for each school year, at each School Level and at the different FRLunch levels, respectively.

It would appear that the class size legislation has so far had no significant effect on the level of experience of newly hired teachers. Independent of the legislation, the average experience of these teachers is not significantly different between elementary and middle schools, but those teachers have significantly less experience than those hired into high schools (Elementary: p=.034, Middle: p<.001). Also independent of the legislation, schools with higher proportions of students eligible for free and reduced lunch (61-80% and 81-100%) hired teachers with less experience than did schools with 21-40% or 41-60% eligible students. Schools with low percentages of free and reduced lunch eligible students appear also to have hired teachers with less experience.

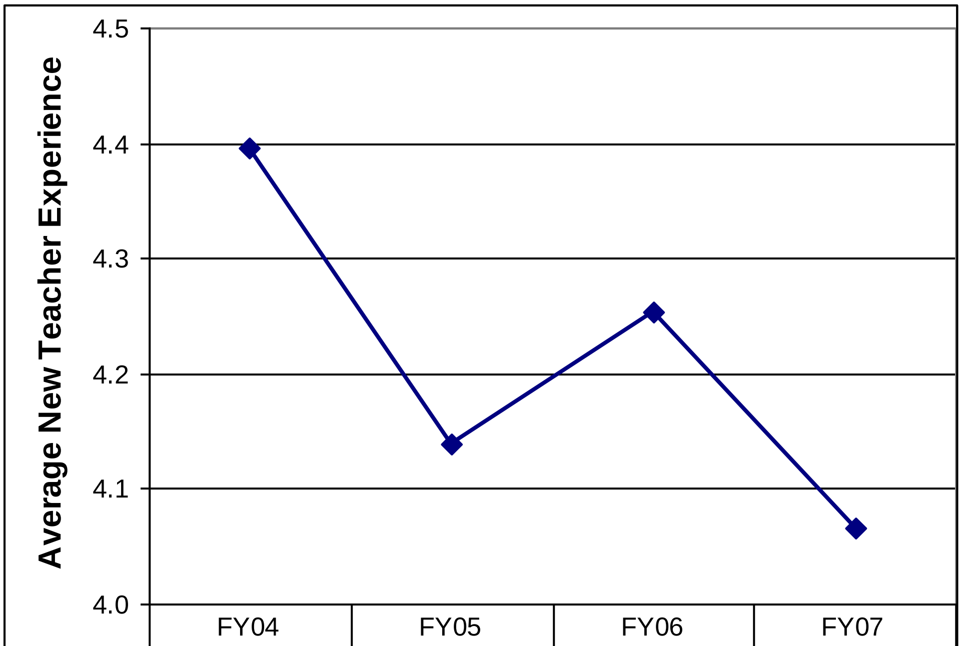
Table 14. New teacher experience by Level by FRLunch Anova table

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Tests of Within-Subjects Effects						
Tr Exp	46.784	3	15.595	0.868	0.457	0.001
Tr Exp * Level	85.859	6	14.310	0.796	0.573	0.001
Tr Exp * FRLunch	141.061	12	11.755	0.654	0.797	0.002
Tr Exp * Level * FRLunch	348.259	24	14.511	0.807	0.731	0.005
Error(Tr Exp)	76304.316	4245	17.975			
Tests of Between-Subjects Effects						
Intercept	53683.206	1	53683.206	2302.444	0.000	0.619
Level	287.471	2	143.735	6.165	**0.002**	0.009
FRLunch	294.615	4	73.654	3.159	**0.013**	0.009
Level * FRLunch	168.168	8	21.021	0.902	0.514	0.005
Error	32991.789	1415	23.316			

Table 15. Post Hoc School Level and FRLunch Tukey Honestly Significant Difference tests.

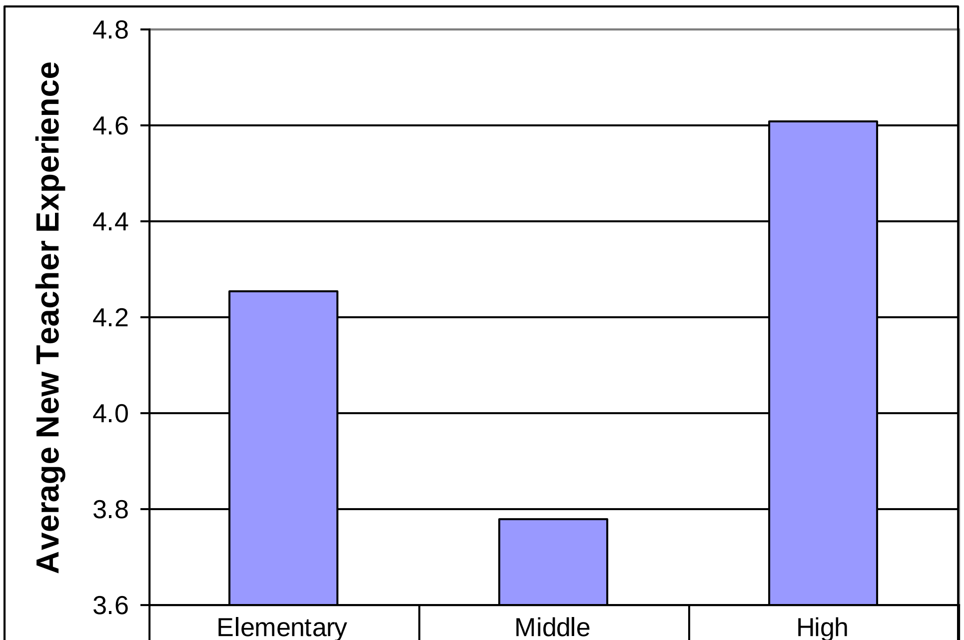
Tukey HSD				
(I) Level	(J) Level	Mean Difference (I-J)	Std. Error	Sig.
School Level				
Elementary	Middle	0.348	0.158	0.072
	High	-0.414	0.165	0.034
Middle	High	-0.761	0.195	0.000
FRLunch				
0-20%	21-40%	-0.294	0.249	0.763
	41-60%	-0.428	0.234	0.358
	61-80%	0.214	0.234	0.891
	81-100%	0.298	0.244	0.739
21-40%	41-60%	-0.134	0.197	0.961
	61-80%	0.508	0.196	0.073
	81-100%	0.592	0.209	**0.037**
41-60%	61-80%	0.642	0.177	**0.003**
	81-100%	0.726	0.190	**0.001**
61-80%	81-100%	0.084	0.190	0.992

Figure 16. Average new teacher experience, FY04-FY07



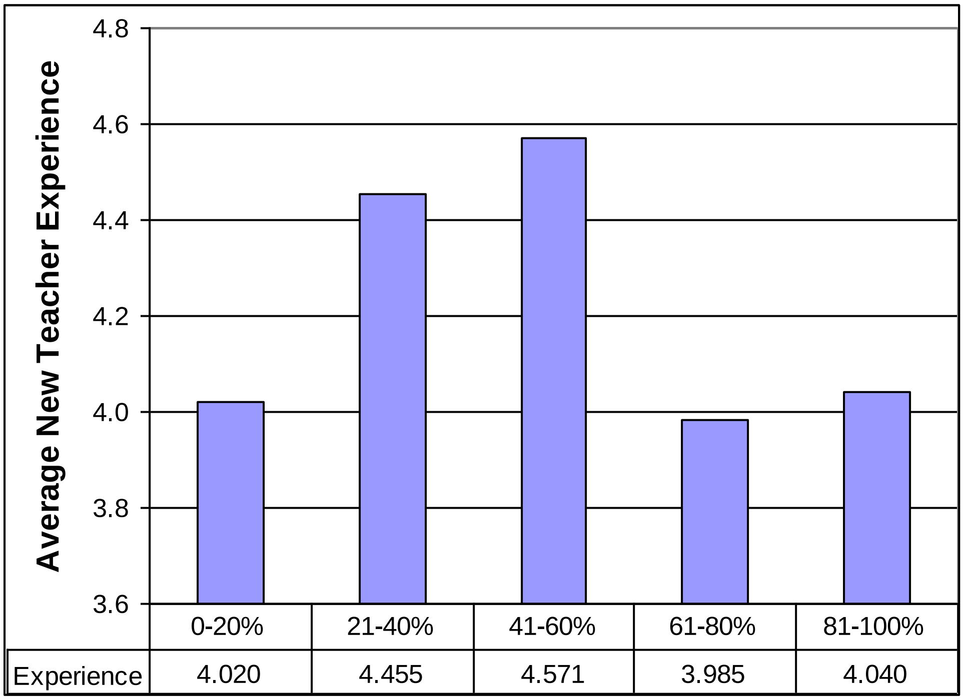
	FY04	FY05	FY06	FY07
Experience	4.396	4.140	4.254	4.067

Figure 17. Average new teacher experience at each school level



	Elementary	Middle	High
Experience	4.252	3.781	4.609

Figure 18. Average new teacher experience at each level of student free and reduced lunch eligibility



Teacher vacancies

The vacancy reporting system (VRS) was initiated by the state in the fall of 2006 at the beginning of the FY07 school year. The effect of class size legislation on the number of vacancies per school system cannot be determined from these data. It can be investigated, however, whether school districts with high proportions of students eligible for free or reduced lunch (FRLunch) experienced higher teacher vacancy rates than did those with lower rates.

Table 16 presents the data for the 30 and 90 day teacher vacancy rates grouped by four FRLunch categories. At this school district level of analysis there were six districts with FRLunch ratios 20% or below; these were included with the 21-40% group for this analysis. Table 17 shows the Anova table for this analysis.

Table 16. Descriptive statistics for FY07 teacher vacancy rates by FRLunch

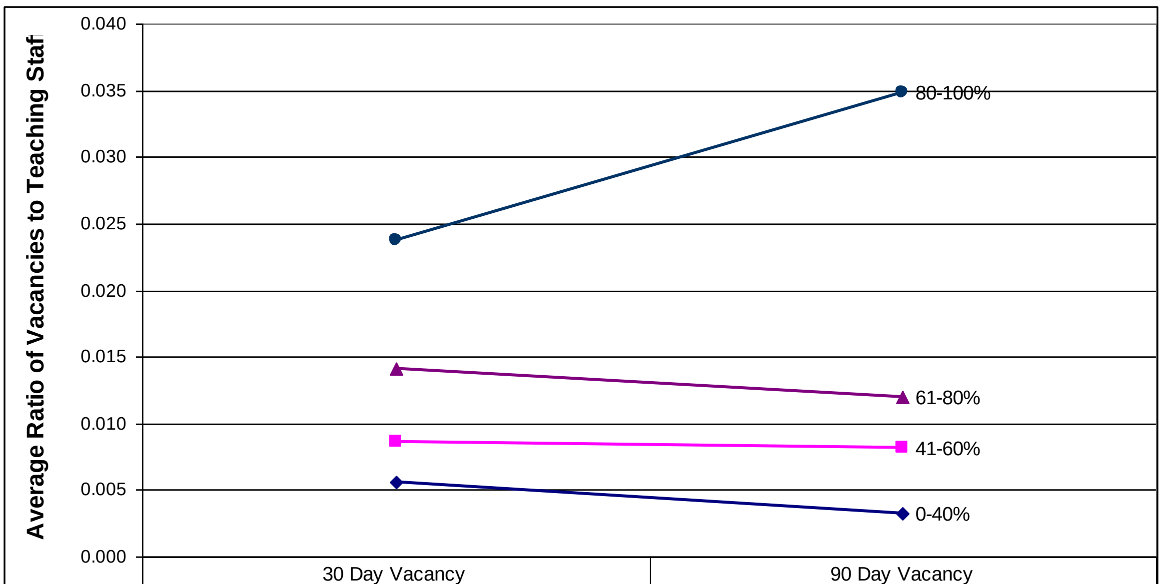
	30 Day Vacancy		90 Day Vacancy		
FRLunch	Mean	SD	Mean	SD	N
0-40%	0.006	0.008	0.003	0.004	27
41-60%	0.009	0.015	0.008	0.013	61
61-80%	0.014	0.027	0.012	0.021	75
80-100%	0.024	0.042	0.035	0.058	17
Total	0.012	0.024	0.012	0.025	180

Table 17. Vacancy by FRLunch Anova

Tests of Within-Subjects Effects						
Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Vacancy	0.000	1	0.000	1.958	0.163	0.011
Vacancy * FRLunch	0.001	3	0.000	5.486	**0.001**	0.086
Error(Vacancy)	0.014	176	0.000			
Tests of Between-Subjects Effects						
Intercept	0.049	1	0.049	47.414	0.000	0.212
FRLunch	0.015	3	0.005	4.863	**0.003**	0.077
Error	0.180	176	0.001			

Figure 19 displays the Vacancy by FRLunch interaction. School districts with 80% or fewer students eligible for free or reduced lunch appeared to have less difficulty filling vacancies for the school year, although they made no significant progress overall in reducing vacancies between thirty days after the beginning of their school year and the ninety day monitoring. The few systems with more than 80% FRLunch, however, had a significantly greater number of vacancies at the ninety day point than they did during the beginning of the school year.

Figure19. Vacancy by FRLunch interaction.



	30 Day Vacancy	90 Day Vacancy
0-40%	0.006	0.003
41-60%	0.009	0.008
61-80%	0.014	0.012
80-100%	0.024	0.035

Summary.

The Gaussian curvilinear regression model developed to predict future staffing underestimated actual fall staffing by 504, or 0.44% of actual staffing in the fall of the FY07 school year. The model was developed to predict the traditional total staffing measure taken in the spring of the FY07 year. The model will be adjusted each year to incorporate each new year's staffing data. Traditional determination of teacher attrition will not be calculated until the end of the school year; comparison to the attrition estimates cannot be yet known. Like many states, Georgia faces a predicted teacher shortage. Determining the persistence of vacancy rates as well as the ability of traditional and alternative preparation routes to fill those vacancies and new demand from rising attrition and persistent enrollment growth must await future data monitoring.

The class size legislation did significantly effect a reduction in average class sizes at the elementary and middle school levels, but the minimal changes in the legislation at the high school produced no significant change. Elementary schools at some levels of free and reduced lunch enrollment did not significantly reduce class sizes, specifically those with 41-60% and 81-100% eligible. At the middle schools all groups were generally successful in reducing class size, although those in the 21-40% would appear to have reduced sizes less than the others.

The effect of the legislation on the number of classes over legislated limits was complex, producing a three-way interaction of Overlimit, School Level and Free & Reduced Lunch. At the elementary school level, schools with 40% or fewer students eligible for free or reduced lunch had no significant difficulty with the law, but those with more than 40% eligible saw a significant increase in the average number of classes reported over the legislated limit. At the middle school, those schools with more than 80% of their students eligible for free or reduced lunch saw a significant increase in the incidence of overlimit classes. There were no differences among the various groupings of high schools.

Findings from the studies of the California CSR initiative would suggest that Georgia would find notable changes in the age and experience of newly hired teachers as the schools struggled to meet the urgent demands of finding enough teachers to fill the new classrooms required by the sudden requirements for decreased class size. Separate analyses of the average age and experience of newly hired teachers over the past four years did not sow a change in either as a function of the new law, although schools with more than 60% of their students eligible for free or reduced lunch did hire teachers with significantly less experience than schools with more than 20% to 60% eligible. Schools with 20% or fewer students eligible for free or reduced lunch – those that from previous research we would expect to have the most success hiring the teachers they need – hired teachers with an average experience no different from the schools with high percentages of free and reduced lunch eligible students.

The new teacher vacancy data, being a collection of data begun only after the implementation of the class size legislation, could not be brought to bear on the law's effect. Schools with more than 80% of their students eligible for free or reduced lunch had significantly more vacancies, and their situation worsened significantly from the 30 day to the 90 day into the school year monitoring. The situation for the schools with 80% or fewer free or reduced lunch eligible students showed no change in their vacancy levels between the 30 and 90 day monitorings. The 180 day collection in the spring of FY07 as well as continued monitoring will tell whether the high proportion free or reduced lunch schools continue to have a more difficult time putting certified teachers with their students.

This appears to be the first opportunity since the California initiative to report outcomes and consider implications of a statewide CSR. There were substantial differences between the California and Georgia initiatives, but the conditions appear similar enough to produce some of the same consequences in teacher staffing. It would appear that Georgia schools' effort in responding to the legislation, at least in the short term, was fairly successful. It is clear that schools with high proportions of low socioeconomic status students, as classified by the proxy measure of free and reduced lunch, have had more difficulty in responding to the law.

Although this first study was limited to the first year impact, the research effort will continue for multiple years to measure long-term impacts.

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