School Librarian Staffing Levels and Student Achievement as Represented in 2006-09 Kansas Annual Yearly Progress Data

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Abstract

To address the presence or absence of library media specialists in Kansas public schools, a study using Analysis of covariance (ANCOVA) was designed to investigate library media specialist (LMS), the label used for school libraries in Kansas licensed-personnel data, staffing levels and student achievement at the school level. Five subject areas (reading, mathematics, science, history/government, and writing) were examined over a four-year period (2006-09). The study examined approximately 2.5 million individual assessment results from 1,389 schools. Researchers found that where schools maintained higher and more stable staffing levels, the Annual Yearly Progress (AYP) data revealed higher school proficiency rates. Proficiency differences between no-LMS and full-time LMS conditions were small to moderate but critical with respect to meeting AYP targets. Effect sizes were consistent across grade spans and subject areas and also consistent with those found in other state impact studies. The researchers recommend future studies including addressing issues of causality with stratified random samples of students using propensity-score match techniques based on logistic regression and creating indices of contribution by weighting the ANCOVA-based proficiency differences.

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When state legislators reduce education finances, local school boards must trim their budgets, usually by reducing or even eliminating "non-classroom" programs and staff. School libraries and library media specialists (LMS), the label used for "school librarians" in the Kansas licensed-personnel data, are often seen as unnecessary frills that can be cut with little effect on student learning and achievement and with little political pushback from parents and other stakeholders. Is this an accurate perception?

To respond to this critical question, an empirical study was designed and conducted to investigate the effects of Kansas LMS staffing levels on four years (2006-09) of school proficiency rates on the Kansas state assessments in reading, math, science, history/government, and writing at the elementary, middle, and high school levels. The study tested the hypothesis that higher and more stable levels of LMS allocation will yield greater levels of proficiency and greater positive change in proficiency when controlling for differences in prior performance, school characteristics, and student demographics.

Literature Review

Background on Accountability

During the past five decades, United States (U.S.) education has focused on eliminating poverty through equal access to education and established high standards and accountability. Adequate Yearly Progress (AYP), which has become well-known to all educators, is a measurement defined by the No Child Left Behind Act of 2001 (NCLB, 2001) (P. L. 107-110) that allows the U. S. Department of Education to determine how every public school and school district in the county is academically performing according to results on state summative

assessments. The standard method of determining AYP has been a "status model" in which school performance is mainly evaluated in terms of the proportion of students meeting or exceeding proficiency levels on state reading and mathematics assessments. The U. S. Department of Education initiated the Growth Model Pilot Project in AYP determinations under the Elementary and Secondary Education Act (ESEA, 1965) (P. L. 89-10). Growth models measure how much students have gained from one year to the next using longitudinal records of individual student achievement in reading and mathematics within three or four years or by a specific grade level (usually grade eight or nine) as defined by the state's particular growth model. For the purpose of determining AYP, students who are not proficient but on-track can be counted the same as proficient students. Kansas is one many states to explore the use of a growth model for accountability.

Results from the 2010 Kansas Statewide Assessments (KSDE, October 12, 2010) show a 10-year, state-wide growth trend in reading and mathematics. Students performing in the top three performance levels on the reading assessment increased to 86.3 percent in 2010, up from 85.7 percent in 2009. On the mathematics assessment, students in the top three performance levels totaled 83.1 percent in 2010, up from 82.8 percent in 2009. Participation rates topped 99 percent in each subject area. This growth has occurred in a state, Kansas, which has long promoted library education and employment of state-licensed, school librarians. Further, Kansas educators, including school librarians, have for the past two decades used criterion-referenced assessments to indicate whether or not the test taker performed well or poorly, to compare the test taker's current and previous performance, and to continually revise and improve instruction. Kansas criterion-referenced assessments used to inform the instructional process with students include teacher-made classroom assessments; curriculum and test coordinator-made district level

assessments; and, standards-based assessments created by The Center for Educational Testing and Evaluation at The University of Kansas.

School Library Research

In recent years, educational studies have clearly established the efficacy of state-licensed school librarians and well-funded school libraries. A series of statewide impact studies reveal tight links between student performance on assessments and well-educated school librarians and school libraries with well-funded collections and active, information literacy instructional programs (Baughman 2000; Francis, Lance, & Lietzau 2010; Lance 2000; Lance & Hofshire 2011; Lance & Hofshire 2012; Lance, Wellborn, & Hamilton-Pennell 1993; Scholastic Research 2008). These findings should not be surprising given school librarians' advanced preparation for partnering with classroom, content teachers to provide instruction, monitor progress, and to make adjustments to instruction where necessary.

With expertise in identifying, collecting and organizing content, and best sources of knowledge including photographs, films, music and presentations by experts in many languages, school librarians provide effective learning experiences while partnering with reading and other core content area teachers and instructing students to use actual sources in real situations of information need (Loertscher & Woolls 2003; Zmuda 2006; Kuhlthau, Maniotes, and Caspari 2007; Long 2007; Moreillon 2007; Snyder and Roche 2008; Callison 2009; Moreillon, Hunt, and Ewing 2009; Everhart, et al. 2010a; Everhart et. a. 2010b). Using strategies that reflect constructivist learning theories, school librarians develop information literacy skills in their students. Beginning with student's natural curiosity, and addressing student's interests and background experiences, ability levels, motivation and learning styles, students are taught to relate ideas to previous knowledge and experience, look for patterns and underlying principles,

check evidence and relate it to conclusions, and cautiously and critically examine logic and argument. Students learn to publish and share their knowledge using the Internet, computers and other electronic communication devices.

School libraries as essential to students' development of information literacy skills has also been studied and documented in the research of Schultz-Jones and Ledbetter (2009, 2010). Through a series of studies, these researchers found that "science classrooms and school libraries can be assessed along common dimensions" (p. 15). This led to the assertion that "with a variety of opportunities and responsibilities for meeting the learning needs of students, school librarians can develop and nurture an optimal learning environment that makes a positive and measurable contribution to the educational process" (p. 18).

School librarians' ultimate goal is to partner with classroom teachers to prepare all students to share knowledge and to participate ethically and productively as members of a democratic society. School librarians' collaboration with classroom teachers is articulated in the school librarians' *Standards for 21st-Century Learners* (AASL 2007), which align with the *Common Core State Standards* (2010) and communicate the Common Core vision of educational excellence (Dow 2010). The necessity of school librarians is articulated in outcomes-based language in the *Crosswalk of the Common Core Standards and the Standards for the 21st-Century Learner* (AASL 2011), which outlines "crosswalks" where specialized knowledge and skills of school librarians and classroom teachers comes together as important co-contributors to student learning and achievement in the areas of English language arts; reading standards in history; reading standards literacy in science/technology; and, writing standards.

Method

We used Analysis of covariance (ANCOVA) to examine library media specialist (LMS), the label used for school librarian in the Kansas licensed personnel data, staffing levels and student achievement as

recorded in Kansas AYP data at the school level. Five subject areas (reading, math, science, social studies, and writing) were examined over a four-year period (2006-2009). Overall, the study examined more than 2.5 million individual assessment results from 1,389 schools. **Table 1** displays the student counts by subject areas. Schools, not students, served as the unit of analysis in this study. That is, individual student results were aggregated to the building level.

In each one-way ANCOVA, the independent variable consisted of LMS staffing levels, expressed as full-time equivalence (FTE) units. These were recoded into three levels: No LMS, part-time (P/T), and full-time (F/T). **Table 2** displays the distribution of the LMS staffing levels at each grade span indicating the largest percent (42.9) of full-time LMS were at the high school.

Kansas does not vertically articulate its content standards or vertically scale its assessment scores. Consequently, comparing scores or score differences across different grade spans or subject areas created the risk of error and misinterpretation, inasmuch as a five-point score difference in elementary reading, for instance, might mean something very different from a five-point score difference in high school mathematics. Therefore, proficiency rates were the focus.

Kansas uses student percent-correct scores to classify students into one of five performance categories: Academic Warning, Approaches Standard, Meets Standard, Exceeds Standard, and Exemplary. Different cut scores have been established to delineate these categories. The cut scores vary across grade levels, subject areas, and test-types (the general assessment, the modified assessment for moderately disabled special education students, and the alternate assessment for severely disabled special education students). For AYP purposes, students are considered proficient in a subject area if they are classified as Meets Standard or better. Students in the bottom levels are classified as non-proficient. A proficiency rate is simply the average of the number proficient over the total number of tested students.

Proceeding on the assumption that the proficiency level cut scores were set appropriately, it is evident that proficiency rates tend to be more comparable than percent-correct scores across different subject areas, grade levels, etc. However, they also tend to be more volatile than percent-correct scores from year to year. To increase temporal stability, the four years of proficiency data were converted into

two composite proficiency rates within each subject area. Reading Proficiency 1 (RP1), for example, was constructed as the mean of the 2006 and 2007 proficiency rates in reading. Reading Proficiency 2 (RP2) was a composite of the reading proficiency rates for 2008 and 2009. Similarly, MP1 and MP2 were the composite proficiency rates for mathematics, SP1 and SP2 were the rates for science, and so on.

The composite proficiency rates for 2008 and 2009 served as the dependent variable in each ANCOVA. The composite proficiency rates from 2006 and 2007 served as a covariate in the ANCOVA models to control for between-school differences in prior student achievement. In addition to prior achievement, the other covariates in the ANCOVA model included school size (the number of valid assessments results); percent of students receiving free or reduced lunch; percent of special education students taking the modified assessment; percent of special education students taking the alternate assessment; and, percent of English language learners (ELL).

To enable meaningful comparison of the results across different grade spans and subject areas, effect sizes were computed by dividing the observed difference in adjusted proficiency rates by the root mean squared error (RMSE) yielded by each ANCOVA. A second set of effect size indices was computed, based on 99% confidence intervals (CI) around each observed difference, between the lower limit of each No LMS condition and the upper limit of each Full-time LMS condition. These CI-related proficiency differences represent a sort of best-case scenario with respect to the impact of LMS staffing levels.

In addition, an analysis of covariance was re-run with a three-value summary version of each covariate as an independent variable, removing its interval-level counterpart from the covariate input list. Doing this enabled the researchers to graph the interaction between the LMS staffing level and each covariate. These secondary independent variables were constructed by collapsing the interval-level covariate into three approximately equal-sized groups at the 33rd and 67th percentile of each distribution - separately by grade span.

Results

The differences in proficiency rates displayed in **Table 3**, as well as the effect size magnitudes, indicate that schools with a LMS tend to outperform schools with no LMS. The finding is consistent across grade spans and subject areas. Also, the finding is consistent with other impact studies that provide data from which effect sizes can be computed for purposes of cross-study comparison (e.g., Massachusetts 2000; Colorado 2010).

The magnitudes of the observed and CI-related proficiency differences, as well as the effect sizes, would customarily be considered in the small to moderate range. However, a school's proximity to the AYP target is an important consideration in determining the practical significance of the proficiency differences. For example, consider elementary reading, where the CI-related proficiency difference was 4.7 points. Of the 158 schools whose 2008-2009 composite proficiency rate was below the 2009 AYP target of 79.7% proficient, 36 schools (23%) would likely have made AYP if they had a full-time LMS. Conversely, of the 575 schools whose composite proficiency rate was 79.7 or better, 26 schools (4.5%) would likely have missed AYP if they had not had a full-time LMS.

Initially, this study was designed to examine proficiency in terms only of the 2008-2009 composite LMS staffing levels. However, the researchers noticed in the raw data that FTE allocations at particular buildings often varied greatly across the four years. In more than a third of all Kansas schools, the variation involved rather erratic fluctuations. At more than 100 schools, the fluctuation involved no LMS in at least one year, a full-time LMS in at least one other year, and different levels of part-time LMS during the other two years. Observing such variation led the researchers to add the Trend variable to the study's design. **Table 4** provides an example of each trend type. **Table 5** shows the number and percent of schools by trend type and indicates that 901 (64.9%) schools had steady full-time, stable part-time or increase in LMS FTE. **Table 6** shows the overall distribution of the trends across the three grade spans. In turn, **Table 7** shows a typical pattern in overall distribution trends across three grade spans and all content areas, in this instance, proficiency by trend for elementary reading. This suggests that stability of the LMS staffing may matter almost as much as the level of the staffing. If so, changing the FTE every year or two may have a disruptive effect on student achievement

Post Hoc Analyses

To "drill down" to a deeper level of understanding the effects of LMS staffing and trend on school-level proficiency rates, a series of *post hoc* analyses were conducted. Specifically, the interaction between FTE or Trend with a summary (three-value) version of each interval-level covariate was examined. Consider elementary math, for example. **Table 8** reveals the relationship between LMS staffing across schools with varying levels of poverty, expressed in terms of the percent of students receiving free or reduced lunch subsidy. It shows that schools with a full-time LMS tend to outperform no-LMS schools regardless of their poverty levels. The relationship is generally consistent across other grade spans and subject areas.

Table 9 shows how the student-LMS ratio affects proficiency rates. Small elementary schools, those with fewer than 100 students with valid test scores, outperformed their larger counterparts by 7 to 10 proficiency points. Conversely, in large schools with more than 180 students with valid test scores, there was virtually no difference in proficiency regardless of LMS staffing, presumably, because the student-LMS ratio was too high for the LMS to function effectively. Because the pattern was consistent across all three grade spans and all five subject areas, this finding provides evidence to support an argument that larger schools would benefit greatly from allocating more than one full-time LMS to the library media center.

Summary

The results of the study's overall findings are summarized in **Table 10**, which displays a bar graph of the five middle school subject areas. It shows that having at least a part-time LMS (and, preferably, a full-time LMS) there are notably higher proficiency rates in all five subject areas than does having no LMS.

Discussion

This article reports the results of a four year, empirical investigation of school librarian employment (LMS staffing levels) as reported in Kansas licensed-personnel data and student achievement at the school level as reported in the Kansas QPA state assessment data in reading, math, science,

history/government, and writing at the elementary, middle, and high school levels. This study supports the assumption that when school librarians are "cut" or eliminated at a school building, there is likely to be a negative influence on student learning and achievement. While school librarians may be perceived by some as an expensive luxury, particularly when school budgets are cut, higher school proficiency rates where school librarians are employed may be something schools cannot afford to do without.

Through the lens of AYP data, this study creates a new "picture" of the presence or absence of school librarians. We found that where schools maintained higher and more stable staffing levels, the AYP data revealed higher school proficiency rates. The proficiency differences between the no-LMS and full-time LMS conditions were small to moderate in magnitude but nonetheless critical with respect to meeting annual AYP targets. The corresponding effect sizes were consistent not only across grade spans and subject areas but also with other state impact studies. In particularly, it should also be noted that across the years represented in this study, the differences in reading proficiency scores between those schools with no LMS and full-time LMS were in many cases enough of an increase with the full-time LMS to make the required Reading AYP target. This suggests that students in schools with at least one full-time school librarian may achieve higher reading proficiency. To strengthen the findings in this quantitative study design, qualitative descriptions of school librarians' participation in teaching reading in schools meeting reading AYP targets should follow-up to present a comprehensive "picture" of the influence of the school librarian.

An issue that requires an explanation is the matter of the impact of school size on student proficiency levels. For example, according to the data, small schools with full-time school librarians outperformed their larger counterparts with full-time school librarians in reading proficiency. Also, larger schools (most students) have highest percentage of full-time LMS. These matters raise the question of whether or not FTE of the school librarian or school size is most meaningful. We believe that both FTE and school size are likely to be relevant to understanding the influence of the school librarian on student proficiency levels. We know from observation that some of the larger schools employ more than one full-time LMS. However, these findings caused us to consider that hiring trends, which we also observe, may

be even more complicated than we initially thought would result from the presence or absence of school librarians. Erratic coming and going of state-licensed school librarians may be more disruptive to students' learning than we anticipated. A future study would be to investigate and describe the nature of students' learning experiences and the school community with erratic (unstable) employment of state-licensed school librarians.

Another issue that must be addressed is the matter of proficiency in school with high poverty. The data reveals that schools with high poverty have high percentage of No LMS (38%). According to the data, students in low poverty (<33% free and reduced lunch) with a full-time school librarian achieve approximately 7 points higher in math than those with no school librarian. Students in high poverty (<67 free and reduced lunch) with a full-time school librarian achieve approximately 13 points higher in math than those with no school librarian. In a case study (2006-09) of high poverty schools, our visits to building revealed that the school facilities were modern, aesthetically designed buildings that offered special programs such as ESOL, special education, and Title I at elementary level. School librarians were highly involved in partnering not only with classroom teachers but also with program specialists in teaching reading, math and other content areas; implementing before- and after-school programs; making available computer technology equipment and instruction; and supervising support staff. These observations, together with the data in this study, suggest that where there are highly qualified educators and available resources and instruction, students living in poverty can despite many challenges become academically proficient.

It also is important to note that since approximately 1995, Kansas veteran and new school librarians have used an established approach to collaboration with teachers that includes a common language and a five-step method, *The Handy 5* (Grover, Fox, & Lakin 2001; Blume, Fox, & Lakin 2007). This model correlates with the five steps in mathematic problem solving: the assignment; plan of action; doing the job; product evaluation; and, process evaluation. *The Handy 5* steps are applied to curriculum includes reading, writing, mathematics, social studies, science, the arts, and information literacy skills. Analysis of data from a sample of participant schools where teachers used *The Handy 5* yielded multiple

findings including "use of the model had an impact on low achieving students," (Grover et al, p. 88) and, "use of the model helped students learn higher order thinking skills, i.e., analysis, synthesis, and evaluation" (Grover et al, p. 88). This suggests that while mathematics teachers and school librarians might not be teaching in the same room, instructionally they "mirror" each other in their efforts to teach logic, reasoning, problem-solving and critical thinking.

It should be further understood that issues of causality, or the lack thereof, in this study can be addressed and remedied in a future study in two phases. First, we will approximate stratified random samples of students using propensity-score match techniques based on logistic regression. After aggregating the samples to the building level, researchers would create indices of contribution by weighting the ANCOVA-based proficiency differences by the ratio of R^2 values without covariates to the R^2 values with covariates. Such weighting will adjust the observed and CI-related proficiency differences in a manner that reveals the relative "contribution" to the variability in proficiency rates made by just the LMS staffing levels. In short, the propensity-score matching will combine with the contributory indices to identify the impact of the LMS staffing on student achievement in a more accurate and trustworthy manner.

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Table 1. Student Count by Subject Area and Year

Count							
			Year				
gradespan			2006	2007	2008	2009	Total
Elementary	Subj	Reading	106454	109043	109461	111931	436889
		Math	106475	109026	109501	111851	436853
		Science	0	0	36465	37058	73523
		Writing	0	35532	0	37017	72549
	Total		212929	253601	255427	297857	1019814
Middle School	Subj	Reading	110230	110741	108904	108298	438173
		Math	110293	110695	108866	108143	437997
		Science	0	0	35968	35968	71936
		H/G	0	0	71724	0	71724
		Writing	0	36167	0	36367	72534
	Total		220523	257603	325462	288776	1092364
HS	Subj	Reading	34421	35013	34823	35219	139476
		Math	37585	35932	35307	35248	144072
		Science	0	0	33035	32894	65929
		H/G	0	0	33063	0	33063
		Writing	0	34045	0	33914	67959
	Total		72006	104990	136228	137275	450499

Table 2. Distribution of Library Media Specialist Staffing Levels by Grade Span

Grade Span	LMS Staffing	Number of Schools	Percent of Schools
Elementary	No LMS	127	17.3
	P/T	344	46.9
	F/T	262	35.7
	Total	733	100.0
Middle	No LMS	83	20.8
	P/T	190	47.6
	F/T	126	31.6
	Total	399	100.0
HS	No LMS	36	14.0
	P/T	112	43.6
	F/T	109	42.4
	Total	257	100.0
Total	No LMS	246	17.7
	P/T	646	46.5
	F/T	497	35.8
	Total	1389	100.0

Table 3. Overall Proficiency Rates, Observed and CI-related Proficiency Differences, and Corresponding Effect Sizes

	N of Schools	Overall Proficiency Rate	LMS vs No-LMS Proficiency Difference (Observed)	Effect Size (Observed)	LMS vs No-LMS Proficiency Difference (99% CI)	Effect Size (99% CI)
Reading						
Elem.	796	85.9	2.6	.23	4.7	.42
Middle	435	85.7	3.0	.23	3.9	.30
HS	285	82.8	5.4	.26	10.9	.62
Math						
Elem.	796	86.3	4.2	.38	5.5	.50
Middle	435	80.1	3.9	.24	4.1	.37
HS	285	75.2	4.1	.17	8.8	.39
Science						
Elem.	692	92.3	2.1	.18	3.8	.34
Middle	397	86.0	2.8	.16	5.3	.31
HS	244	85.1	0.5	.04	5.4	.41
H/G						
Elem.	n/a	n/a	n/a	n/a	n/a	n/a
Middle	416	81.6	2.8	.16	5.3	.36
HS	271	80.9	1.6	.11	5.9	.41
Writing						
Elem.	638	72.4	2.0	.10	5.1	.27
Middle	421	74.6	2.5	.13	6.6	.36
HS	274	76.4	2.2	.15	6.4	.42
Kansas does not administer a history/government (H/G) assessment at the elementary level.						

Table 4. Library Media Special Trend Types

FTE 2006	FTE 2007	FTE 2008	FTE 2009	Trend
0	0	0	0	No LMS
1	.8	.5	0	Steady decrease
0	1	0	.8	Erratic
.2	.5	.7	.9	Steady Increase
.3	.3	.3	.3	Stable P/T
.6	.6	.6	.6	Stable P/T
1	1	1	1	Stable F/T

Table 5. Number and Percent of Schools by Trend Types

Trend	Number of Schools	Percent of Schools
No LMS	246	17.7
Steady decrease	121	8.7
Erratic	121	8.7
Steady Increase	143	10.3
Stable P/T	261	18.8
Steady F/T	497	35.8
Total	1389	100.0

Table 6. Overall Distribution Trends Across Three Grade Spans

Grade Span by Trend Crosstabulation

			FTE Allocation Trend (2006 through 2009)						
			No LMS	Steady decrease	Erratic	Steady Increase	Stable P/T	Steady F/T	Total
Grade Span	Elem	Count	127	65	67	82	130	262	733
		Row %	17.3%	8.9%	9.1%	11.2%	17.7%	35.7%	100.0%
	MS	Count	83	35	32	45	78	126	399
		Row %	20.8%	8.8%	8.0%	11.3%	19.5%	31.6%	100.0%
	HS	Count	36	21	22	16	53	109	257
		Row %	14.0%	8.2%	8.6%	6.2%	20.6%	42.4%	100.0%
Total		Count	246	121	121	143	261	497	1389
		Row %	17.7%	8.7%	8.7%	10.3%	18.8%	35.8%	100.0%

Table 7. Proficiency by Elementary Reading Trend

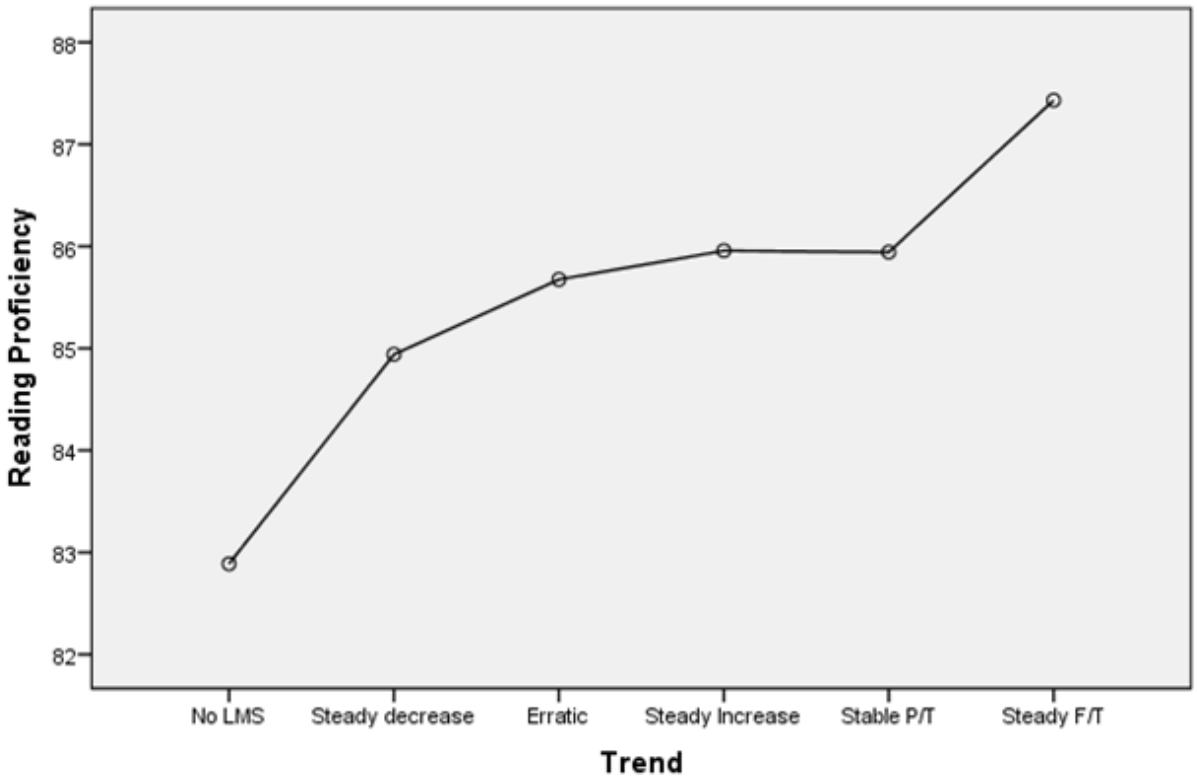

Table 8. Mathematics Proficiency Rate and Levels of Poverty (Free or Reduced Lunch Subsidy)

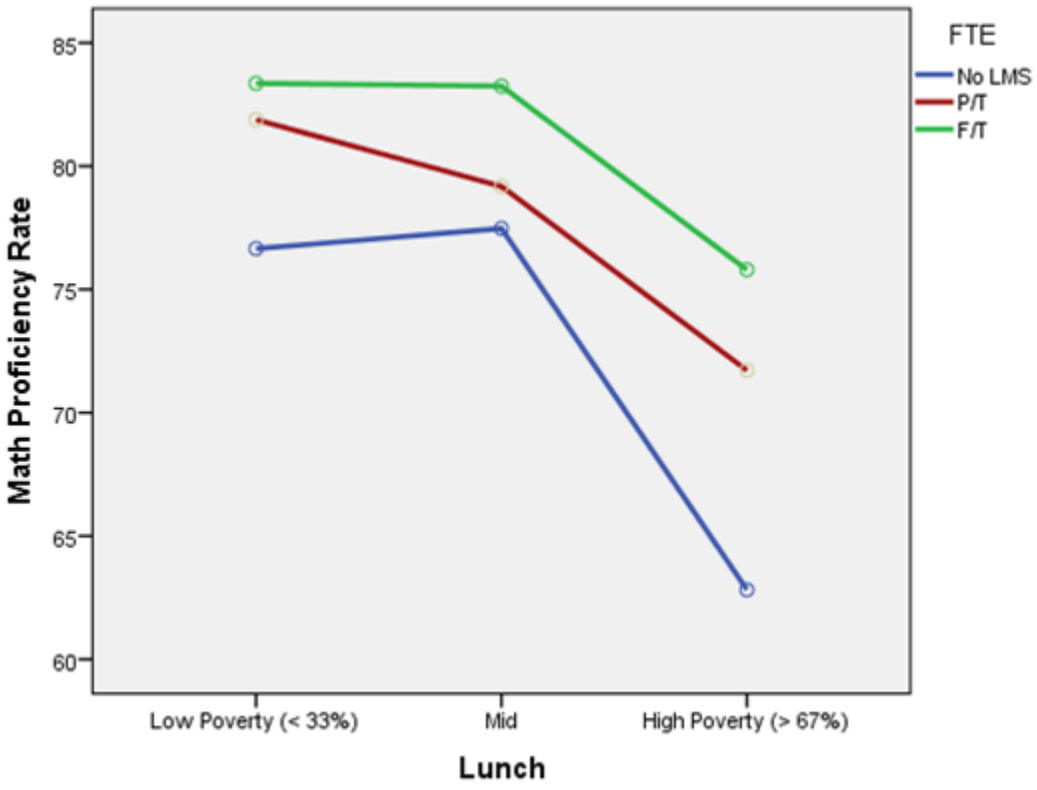

Table 9. Reading Proficiency Rate and School Size

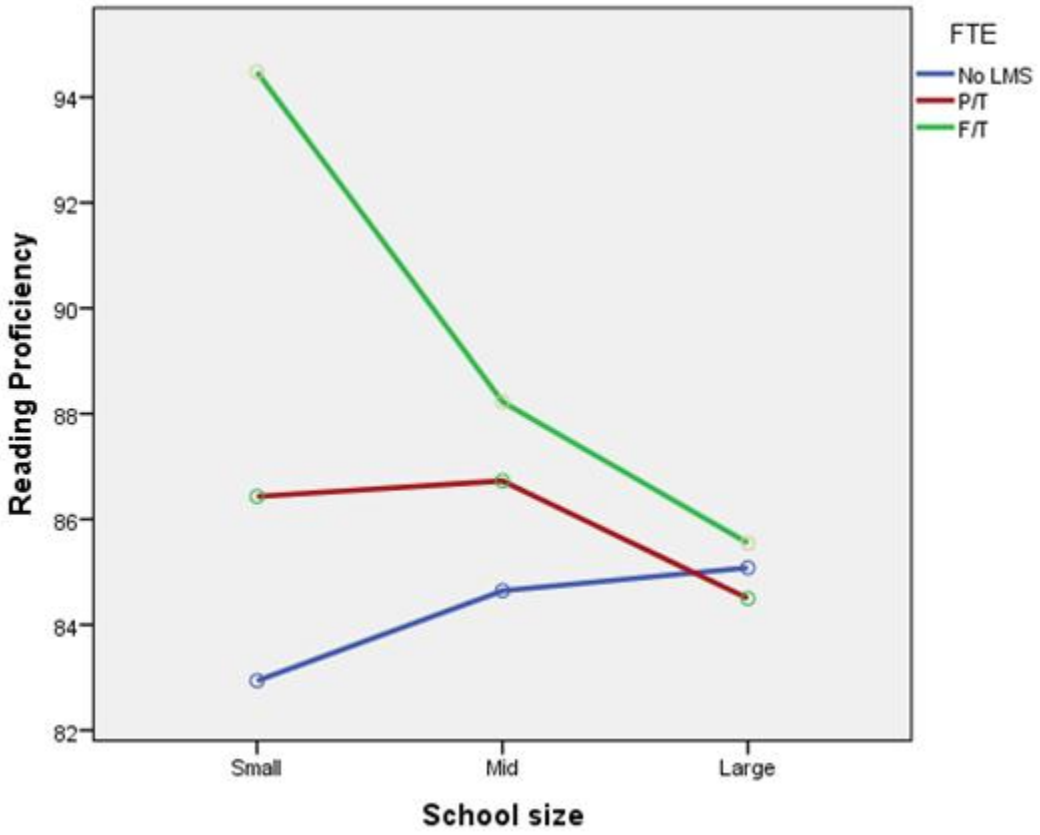

Table 10. Summary of Proficiency Rates by Five Middle School Subject Areas