

## **Digging Much Deeper—School Library Factors that Impact Achievement**

### **Authors:**

Joette Stefl-Mabry, PhD, University at Albany, SUNY

Michael Radlick, PhD, Institute for Research on Learning Technology Visions

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### **Abstract**

Building on prior structural equation models examining the effect of the presence or absence of a full-time certified school librarian on the academic achievement of all New York public schools outside of New York City (after controlling for student demographic and school characteristics), this study uses an outlier analysis technique to explore the differences in library resource and instructional strategies used by the top and bottom 5% (as well as the top and bottom 10%) of schools in the model. Among the library resource and strategies differences examined are: e-books, Internet PC's in the library, and regular classroom teachers accompanying their class to the library. Analyses show a number of statistically significant differences between the positive and negative outliers.

### **Purpose**

Evidence, albeit methodologically weak, has been consistently accumulated over the past two decades indicating that school libraries and librarians can be an important instructional resource impacting student academic achievement (American Association of School Librarians National Research Forum, 2014; Gildersleeves, 2012; Roman, Carran, & Fiore, 2010). However, few school library studies have used large-scale, representative data sets, along with sophisticated modeling techniques to control for a myriad of student demographics and school characteristics. This may be why so few school library studies have had the rigor to be included in peer-reviewed educational journals (Radlick & Stefl-Mabry, 2015; Stefl-Mabry, Radlick, Armbruster, & Keller, 2016). This study is a follow-on study to a series of more rigorous, large-scale structural equation models (SEM) examining all public schools in New York State (NYS) outside of New York City (NYC) (N=2,245) (Radlick & Stefl-Mabry, 2015). The SEM models include student demographic, school climate and prior academic performance. This study's purpose was to examine a sub-set of those schools identified in the model as the extreme outliers, that is the top performing and lowest performing 5% (and 10%), in terms of academic performance relative to a number of school library factors that were outside the models. Analyzing these differences in library resources and strategies was important to identify what specific aspects of school libraries might be most important in having an effect on student achievement. In addition to its overall lack of rigor, the research to-date examining the effect of school libraries on student academic performance has provided no clarity on which factors of a school library (e.g. staffing, activities, or resources) might actually impact student learning. Our exploratory research starts from our initial results that show a significant effect in schools with a full-time certified school librarian, after accounting for a range of student demographic, school characteristics

and prior achievement. After finding an effect, we set out to try to better understand what library programs, activities and resources might be linked with that impact. Based on this exploration we anticipate testing of more complex structural equation models with a range of other library resource and activity variables.

### **Theoretical Framework**

Educational researchers have shown that student achievement, especially in the areas of English and math, is impacted by complex clusters of variables, including those related to the classroom (instructional and self-efficacy related), capacities of the school (resources and climate) and socio developmental including parental/homevariables reflected in demographic characteristics (Creemers & Kyriakides, 2010; G. Marks, Cresswell, & Ainley, 2006; Walsh et al., 2014). Many teacher evaluation systems are using value-added models, while controlling for many of these variables in order to identify the specific teacher/classroom effect on student learning (Amrein- Beardsley, 2008, 2014; Amrein-Beardsley, Holloway-Libell, Cirell, Hays, & Chapman, 2015; Holloway- Libell & Amrein-Beardsley, 2015; Konstantopoulos, 2014; Ready, 2013). Debate continues over the extent to which student achievement is explained by student background and socio-demographic factors (Hoy, 2012; G. N. Marks, 2006, 2014; Perry & McConney, 2010). However, studies of school financing and school quality demonstrate that school-related resource factors beyond the classroom teacher clearly do impact student outcomes (Gottfried, 2012). While teachers, along with school libraries and school librarians (SLs), have been shown to have an effect on student achievement, this study looks beyond the classroom teacher and beyond the simple presence or absence of a school librarian, to explore differences in specific resources and strategies of school librarians in schools that help them “Beat the Odds” (be one of the top 5% positive outliers in the model) and those that are “Low Performing” (bottom 5% poor performers or negative outliers) with the intent of identifying what school library factors contribute to a difference in positive student achievement, after controlling for student demographics, school characteristics and prior achievement (Perez et al., 2007).

### **Data Sources**

This longitudinal, between-schools design, studied all New York State’s 2,245 public schools (which excluded schools in New York City) that had students in grades 3 through 8 during the 2012-13 school year. Of those 2,245 schools, there were 1,511 (67.3%) that had a full time or more school librarian, while there were 743 schools (32.7%) that did not in 2012-13. The student achievement outcome measures used in the study were the New York State Education Department’s (NYSED’s) annual state assessments transformed into the NYSED’s school performance index measure for ELA or Math. There were four SEM path models generated. The first two examined the New York State ELA and math Common Core Performance Indexes for 2012-13 and the second two examined the changes in both ELA and Math Performance Index in each building from school year 2011-12 to school year 2012-13) (Radlick & Stefl-Mabry, 2015). The researchers are working in

collaboration with New York State Education Department (NYSED). All data for this analysis were obtained from multiple NYSED sources in electronic format and imported into Stata (version 14.1), then merged by New York State building identifier code (Basic Educational Data System-BEDS code). All data related to library operation and resources were based on the annual school building survey conducted by NYSED which gathers extensive information on K-12 schools, including school libraries. These survey data are self-reported by building and district staff.

## Methods

Structural equation modeling includes a number of mathematical analytic techniques, including path analysis, confirmatory factor analysis (CFA) and partial least squares analysis. Path analysis was used for all the models, and all exogenous variables in the SEM models<sup>1</sup> were observed variables, that were posited to be temporally antecedent to the endogenous outcome variables that were used. Stata SEM was used to analyze the causal relationships in the different models as recommended by Jacob et al., (2014), Hoyle (2012) and Acock (2013). Continuous variables that were not normally distributed were transformed to normal using the best transformation (e.g. square, cubic, square- root, log etc.) based on review of output from the Stata data analysis.

The models used an observational (non-experimental), longitudinal, between-schools design, with school building-level aggregated data (and in a few cases district-level applied at the building level) in order to identify the effects of a school librarian on aggregate student ELA or math results. Four separate SEM models were analyzed, reflecting the four building-level endogenous outcome variables— ELA Performance Index for 2012-13, Math Performance Index for 2012-13, Change in ELA Performance Index from 2011-12 to 2012-13, and Change in Math Performance Index from 2011-12 to 2012-13, while controlling for the following covariates or factors:

- Gender (% girls in school)
- Minority status (%black and % Hispanic students combined)
- Students with disabilities status (% students classified with disabilities)
- Poverty (% students eligible for free or reduced lunch)
- Limited English proficiency status (% students who are limited English proficient)
- Building size (total student enrollment)
- District High Need/Resource Capacity (This is a NYS indicator created at the district-level and reflects districts above the 70<sup>th</sup> percentile statewide in terms of fiscal need/resource limitations, and is an indicator of lack of resources).
- Building Accountability Status (In Good Standing for AYP)
- Percentage of total discipline incidents per student in the building

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<sup>1</sup> Appendix: Figure 1

- (school climate)
- Presence or absence of a certified SLMS working full time or more.
- ELA Performance Index 2011-12
- Quadratic form of ELA Performance Index 2011-12
- Math Performance Index 2011-12
- Quadratic form of Math Performance Index 2011-12

The original research design hypothesized that the school librarian would have an effect on ELA scores but not math scores (Radlick & Stefl-Mabry, 2015), and that is what was found (e.g. the effect of a full-time school librarian was statistically significant in both the 2012-13 ELA Performance Index model and the Change in ELA Performance Index from 2011-12 to 2012-13 model). Based on the SEM ELA 2012-13 model results, the residual values were calculated for each school, and then sorted from highest to lowest (exceeding expectations to under-performing expectations). For this study we examined the 107 top 5% and 108 bottom 5% of schools based on their residual values (as well as the 217 top 10% and 216 bottom 10% of schools) with ELA 2012-13 performance index as the outcome measure.

After both groups of schools in the top and bottom 5% (and top and bottom 10%) were created based on residual values, a series of non-parametric (Chi-Square) and parametric comparisons (t-tests) were made between the top and bottom outlier groups relative to a number of library-related resources and strategies in order to explore possible school library variables that would be influential in subsequent modeling, including CFA). Library resources and strategies that were compared included: regular books and e-books, Internet-connected PCs in the library, collaboration with classroom teachers, access to student assessment information, and having classroom teachers accompany classes to the library. Based on the ELA 2012-13 Performance Index Model, we knew that the Full-Time Certified School Librarian variable accounted for under 4% of the variance in ELA scores, after accounting for the other variables. Obviously there are much more influential variables beyond the school librarian that might account for the fact that a school would exceed the mean (positive outlier). However our hope was to be able to tease out differences related to school library resources and programs that might be influencing student ELA scores.

## **Research Questions**

The following three research questions were formulated for this study:

1. Is there a statistically significant difference between the top and bottom outliers in terms of their use of different library resources such as books and e-books, or Internet PCs in the library?
2. Is there a statistically significant difference between the top and bottom outliers in terms of their use of staffing, hours of operation, professional development (PD) or patterns of operation (e.g. fixed, flexible and/or mixed scheduling)?
3. Is there a statistically significant difference between the top and

bottom outliers in terms of the strategies they might use in the library such as collaborative planning and with teachers, having the regular classroom teacher accompanying the class to the library, integration of information literacy curriculum, etc.,).

## **Results and Discussion**

Results are discussed in terms of the research questions formulated for this study.

**Research Question 1: Is there a statistically significant difference between the top and bottom outliers in terms of their use of different library resources such as books and e-books, or Internet PCs in the library?**

### **Library Resources—Books**

While there were no statistically significant difference between high and low performers (for either 5% or 10% group) in terms of number of books per student although as noted in the next section, there was a statistically significant higher number of e-books per student for both the top 5% and 10% groups as compared with the low performers.

This finding of no difference relative to number of books per student is not consistent with previous research documenting that students in well-resourced and funded schools perform better academically than students with poorly resourced libraries (Coker, 2015; Lance, 1994; Lance, Rodney, & Hamilton-Pennell, 2000a, 2005; Lance, Rodney, & Schwarz, 2010b; Mardis, 2007; Roberson, Schweinle, & Applin, 2003; Rodney, Lance, & Hamilton-Pennell, 2003; Smith, 2001; Tepe & Geitgey, 2005; Todd & Kuhlthau, 2005). Since the statistical model did account for school resource and student poverty, some of this difference may have been controlled out. In addition findings regarding resource usage needs additional investigation as little is known about who is using the resource, when the resources are being used and why, which all speak to the importance of context and purpose. These are issues of data and measurement.

### **Library Resources—e-books**

There was a statistically significant higher number of e-books per student for the top 5% and 10% group, a finding confirmed by recent research that provides evidence that the use of e-books increases student reading, vocabulary development and reading motivation (Larson, 2015; Sackstein, Spark, & Jenkins, 2015). However the results of our study, at this point, do not provide us with information about whether individuals are using e-books, groups of students are reading e-books simultaneously, and/or whether e-books are being used for classroom instruction. We also do not know where they are being used – whether in classrooms, labs, the school library and/or on students' personal devices. We do not know the purpose for which e-books are being used: class assignments, independent reading, recreational reading, curriculum enhancement, curriculum support, etc. Additionally, we do not know what types of e-books are being used (fiction, non-fiction, etc.). And although Hess (2014) demonstrated there was some increase in student achievement and motivation she also recommends that much more research needs

to be done regarding the use of e-books and student achievement. A key question is what is it about e-books themselves that has a salutary effect on student ELA achievement? The theoretical connections between the resource, its use and its effect have not been explained adequately.

### **Internet PCs**

In comparing both the top 5% and 10% groups with the bottom 5% and 10%, we found that there was a statistically significant higher number of Internet PCs per student in the school library for both the top 5% and 10% groups as compared with the low groups. While we were able to identify that the top performing groups had higher numbers of Internet connected PCs in their libraries, we do not know who was using the computers, when they were being utilized, nor do we know why the computers were being used. Further questions arise from this finding, such as are individual students, small groups, or full classes using the computers? What type of computer is being utilized: stand alones, laptops, netbooks, iPads etc.? What is the context in which they are being used? Are students who do not have access at home, or do not have personal devices using school library computers more frequently than other groups of students? Again the theoretical connections between the resource, its use and its effect are critically important to identify.

**Research Question 2: Is there a statistically significant difference between the top and bottom outliers in terms of their use of staffing, hours of operation, professional development or patterns of operation?**

### **Staffing**

There was no statistically significant difference between high and low performers (for either 5% or 10% group) in terms of the total library staff to student ratio. There was also no statistically significant difference between high and low performers (for either 5% or 10% group) in terms of the total professional library staff to student ratio.

These findings appear to contradict Dow et al., (2012) and others who report that schools maintaining higher staffing levels had students with higher proficiency rates (Baumbach, 2003; Lance, Hamilton-Pennell, Rodney, & Alaska State Library, 1999; Lance, Rodney, & Hamilton-Pennell, 2000b, 2001, 2003). However, it may well be that the majority of effect on student achievement is already reflected in the effect of the full- time certified librarian.

### **Hours of Operation**

There was a statistically significant higher number of hours that the library was staffed for the top 10% high performers, as compared with the 10% of low performers. This finding is supported by previous research (Kaaland & Seasholes, 2015; Kachel & Lance, 2013; Lance & Kachel, 2013; Small & Snyder, 2009; Small, Snyder, & Parker, 2009; Todd, 2012). Coker (2015) reports that students benefit from by “technology advanced and accessible school library facilities” (2015, p. 7). This finding too reveals that a deeper understanding of what occurs when the library is staffed and open is critical. Can teachers and students access the school library throughout the day? Can they access the computer 24/7 from home and/or personal devices? Are there instructional activities taking place in the library throughout the day and/or after school? Is the school library a space where the

school librarian, teachers and other members of the school community plan and collaborate? Is the library a place where students study/socialize? Do students view the library as a safe place?

### **Professional Development**

There was no statistically significant difference between high and low performers (for either 5% or 10% group) in terms of the various forms of professional development, except for professional development from the School Library System (SLS)<sup>2</sup>, where the high performing 10% group showed a higher percentage of engagement in professional development offered by the School Library Systems.

DuFour's (2014) research reveals that as adults' learning increases through engagement in professional learning communities, student academic achievement improves. Although our finding appears to support DuFour's finding, we acknowledge the need for further investigation into the types of professional development activities school librarians in the high performing 10% group participate in and also the discipline and subject areas that are targeted. We recognize that it is critically important to try and determine whether school librarians actively share the knowledge and skills they attain from participating in professional development activities with their school community. DuFour and Marzano (2011) explain how a professional learning community can help create a school culture that helps teachers work together to improve instructional practice and raise student achievement. Further research needs to be conducted to determine whether school librarians in the top 10% group are already a part of such a school culture and/or whether they are engaged in the creation of such cultures.

#### **Research Question 3: Is there a statistically significant difference between the top and bottom outliers in terms of the strategies they might use in the library such as collaboration or regular teacher accompanying the class to the library?**

A higher number of school librarians in the top 10% groups reported collaborating with teachers. This confirms Houston's (2008) finding that school librarians who engage in collaborative planning have a positive impact on student academic achievement. A statistically significant higher percentage of school librarians in the two top groups also reported that teachers accompany classes to the library. Numerous studies document the importance of teacher/librarian collaboration (Lance, Rodney, & Schwarz, 2010a; Mardis & Hoffman, 2007; Meyer, 2010; Montiel-Overall, 2005, 2007; Small & Snyder, 2009). However, collaboration is a complex process and the interactions between teachers and school librarians may extend beyond student academic success to increased content and/or pedagogical knowledge on the part of teachers and school librarians (DuFour, 2014), therefore this finding too, while statistically significant, identifies a need for continued and deeper investigation.

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<sup>2</sup> The School Library System (SLS) of New York State was established by Commissioner's Regulations in 1985, it is a state-aided program that creates and funds 41 School Library Systems based in the Big 5 cities and the Boards of Cooperative Educational Services (BOCES), which serve multiple districts in an area. The main functions of the program are outlined in Commissioner's Regulations 90.18, see: <http://www.slsa-nys.org/>

## Scholarly Significance

This study represents an on-going research project funded by the Institute of Museum and Library Services (IMLS) through a three-year research grant. While this study confirms the findings of many prior studies conducted in both the school library research and educational research arena, it also acknowledges the serious limitations of previous research, which have not completely captured the complexity of the factors contributing to a school librarians' effectiveness (Gildersleeves, 2012). In almost all the prior studies individual library related variables were examined separately relative to student achievement (Steffl-Mabry, Radlick, Armbruster, & Keller, 2016). Each variable, taken separately does not have its own, statistically significant effect on student achievement, but rather most library-related variables share common effects. A key aspect of this on-going research is to attempt to isolate the library-related variables that are making a difference. In addition to developing more robust statistical causal models, we are attempting to identify the mechanisms that produce higher or lower performing school librarians working in conjunction with classroom teachers. Over the last decade the effects of teachers on student performance have been reexamined using statistical models known as value-added models (VAMs), however educational researchers have recently reported that "...it is unclear that the value-added measures that inform the accountability system are adequate" (Amrein-Beardsley et al., 2015; Konstantopoulos, 2014) because VAM specifications are "almost never exactly correct and statistical models offer a macrolevel perspective that does not capture classroom dynamics and teacher behavior..." (Konstantopoulos, 2014, p. 16).

"There is an urgent need for concrete evidence now on exactly how school libraries and librarians do – or don't – add value to pupils' educational, social and developmental wellbeing" (Gildersleeves, 2012, p. 406). To capture school library and/or classroom dynamics and school librarian behavior we are trying to identify the complex school library factors that improve student learning. The intent of future investigations will be to apply more rigorous research designs and analytic techniques, (structural equation and causal modeling) to school library research. We recognize however that it is critical to identify the school context that maximize or minimize the school librarian's effects (e.g., staffing; scheduling; resources; school librarians interactions amongst students, teachers, and administrators; leadership; and school climate). Just as teacher effectiveness needs to be defined more explicitly (Amrein-Beardsley et al., 2015; Darling-Hammond, Amrein-Beardsley, Haertel, & Rothstein, 2012; Konstantopoulos, 2014), so too school librarian effectiveness needs to be explicitly defined as well.



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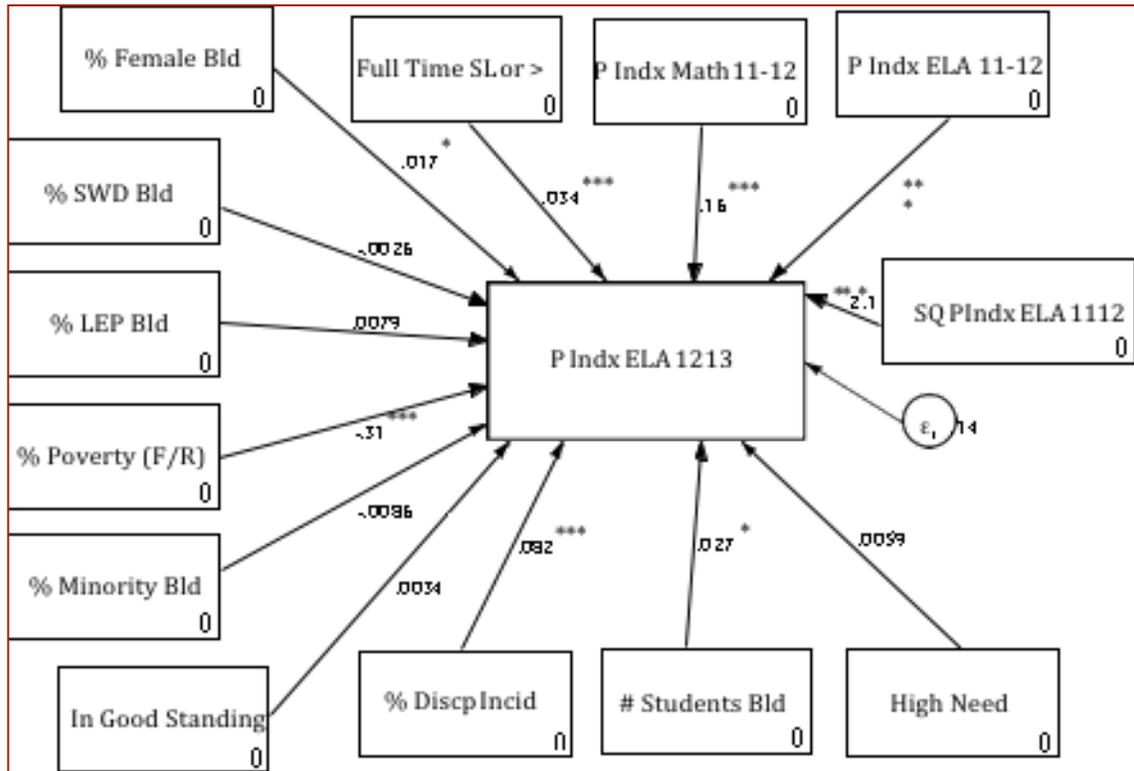
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**APPENDIX**

Figure 1: SEM Model 1--ELA Performance Index for 2012-13 (Standardized Path Coefficients)



Note that the relationships between the independent variables in the model are not shown in order to simplify the drawing. (\* p.<.05, \*\* P<.01 \*\*\*P<.001)