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Impact of School Librarians on Elementary Student Achievement

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IMPACT OF SCHOOL LIBRARIANS ON

ELEMENTARY STUDENT ACHIEVEMENT

by

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ABSTRACT

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The purpose of this study was to determine if there is evidence that a full-time certified school librarian, trained and licensed based on state requirements, impacts fourth grade and fifth grade student scores on reading and/or mathematics end-of-year state achievement tests. Following over 30 years of school library impact studies, primarily correlational and qualitative studies, the school library field continues to have a lack of strong evidence of school librarian impact. This quasi-experimental matching design was conducted to determine if students who had full-time certified school librarians attained higher achievement scores than students who did not have full-time certified school librarians, through matching students based on age, gender, ethnicity, students with disabilities, English language learners, and economically disadvantaged status.

Independent samples *t*-test analyses using 14 databases of fourth and fifth grade students' reading and mathematics end of grade achievement tests found that students with full-time certified school librarian scored higher than students without full-time certified school librarians, with scores that were statistically significant at $p < .001$. The effect size ranged from Cohen's $d = .08$ to $d = .25$, all small effects. Additional analyses were conducted to determine if there was a difference between students in schools with a change in staffing of school librarians across a four year period. Students in 19 schools that had a full-time certified school librarian for two years

scored higher, without significance, on both reading and mathematics tests than the students in the same schools after losing the librarian. Students in 6 schools who did not have a librarian for two years scored lower, without significance, on mathematics achievement tests than the students in their school after the school gained a full-time certified school librarian, but scored higher (p = .035) on the reading achievement test than the students in the school after their school gained a full-time certified school librarian. Overall results provide evidence that full-time certified school librarians have an impact on both students' reading and mathematics achievement scores.

This dissertation is dedicated to my family
My three wonderful children who believed in me and supported me all the way
My loving husband, with an eagle eye for little mistakes
My NxtWave family that went through it with me
Thanks for the support!

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The opportunity provided by the NxtWave grant from IMLS provided the stimulus to start this path, and school library classes taught by world class professors opened the world of the American Association of School Librarians and academia. The experience of working with the CLASS II researchers allowed me to enrich my knowledge of research well beyond where I ever thought was possible. Thank you to all of you who helped me to get to this point. I look forward to seeing where this will take me.

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CHAPTER I

INTRODUCTION

The American Association of School Librarians (AASL) describes the effective school library as playing "a critical role in preparing learners for life in an information-rich society" (2019c, p. 1), that when led by a qualified school librarian, is "instrumental in fostering literacy and teaching inquiry skills to support lifelong learning" (AASL 2018b, p. 54). School librarians provide instruction and leadership in their schools through teaching inquiry skills, information evaluation, and multiple literacies (including print and digital) directly to students and indirectly through collaborating and providing professional development to teachers (AASL, 2016a). Unfortunately, according to Lance & Kachel (2018), more than the equivalent of 10,000 full-time school librarian positions have been lost between the 1999-2000 and 2015-2016 school years, a 19% decrease in positions (p. 19). This is despite several decades of studies reporting a correlation between various facets of school library programs and student achievement, such as Lance et al., (1992) and Lance et al., (2014a; 2014b). This dichotomy hints at the problems facing school librarians in many areas of the U.S. as school libraries are closed or without certified school librarians (Ballard, 2012; Moreno, 2017). These contracted correlational studies were published as reports and were not published in peer reviewed research journals, a process that would have allowed other experts in the field to scrutinize the methods and results (Kelly et al., 2014). In 2014, AASL and the school library field established a research agenda to move toward a causal approach to research, as correlational research does not isolate the effects of school librarians and "rule out plausible alternative explanations in a credible way" (AASL, 2014). There is a gap in the empirical quantitative school library research. I have searched in multiple large research databases, including EBSCO Education Source, JSTOR, Education

Resources Information Center (ERIC), Library Literature & Information Science Full Text, and What Works Clearinghouse, and was not able to find any rigorous empirical experimental or quasi-experimental school library research. Morris and Cahill (2017) analyzed the methodologies of all the articles published in *School Library Research* and *School Libraries Worldwide* between 2007 and 2017 and did not find any experimental or quasi-experimental studies in either journal. In light of this gap, this quasi-experimental research study was undertaken in an effort to provide stronger evidence of the possible impact school librarians have on student achievement, adding to the existing school library research.

Research Problem

The school library correlational study conducted by Gaver in 1960 showing that full-time certified school librarians in centralized school libraries affect student achievement is considered the early impact study in this field. Gaver examined three types of library configurations: Two of the schools had classroom libraries, two schools had a centralized school library but no librarian, and two schools had centralized libraries and a trained librarian. The study included factors such as the quality and quantity of books in the different types of libraries, the amount and types of reading materials students read, instruction in library skills, and the evaluation of educational gain on the *Iowa Test of Basic Skills* of the same students between fourth and sixth grade. The findings of this pilot study were significant, showing that centralized school libraries with qualified school librarians correlated with increased reading scores and greater academic gains between fourth and sixth grade than schools with centralized school libraries without qualified school librarians or schools with only classroom libraries, leading the funding agency to determine it was not necessary to continue further with an expanded study (Gaver, 1988).

Beginning with a study of Colorado school libraries' impact on student achievement conducted by Lance et al. in 1992, over two decades of correlational studies have been conducted on the impact of school librarians and school libraries on student achievement. These studies are collectively referred to as the School Library Impact Studies (AASL, 2014). The data collected for these studies were typically retrieved through school library staffing surveys and state achievement scores acquired from the state department of education, and used bivariate correlation, factor analysis, and multiple regression to determine correlations (Lance et al., 1992; Lance et al., 2000a, 2000b). The first impact studies examined staffing hours, full-time and certified school librarians, collection size, and expenditures, including the study conducted in North Carolina by Burgin et al., (2003). More recently, the studies have expanded to include surveys of administrators' and teachers' perceptions of school librarians' roles, flexible scheduling, collaboration, and provision of professional development by school librarians (Lance & Schwarz, 2012). Other researchers have also conducted studies including motivation factors (Small et al., 2009), student and faculty perspectives of how effective school libraries help students (Todd & Kuhlthau, 2005a, 2005b), and five-year graduation rates (Coker, 2015).

The first Colorado study used path analysis to identify potential predictors of school library impact on academic achievement. Findings show that the size of the library's staff and collection is the best predictor of academic achievement. Among other findings the instructional role of the school librarian "shapes the collection and, in turn, academic achievement" (Lance et al., 1992, p. 96). The second Colorado study's findings include Colorado Student Assessment Program reading scores increase when there are increases in school libraries, including staff hours, print volumes per students, library expenditures, collaboration between school librarians and teachers, and when the school library has flexible scheduling (Lance et al., 2000, 2000b.

The North Carolina impact study was conducted by Burgin et al. (2003) using Lance's survey and procedures along with the school achievement scores for all school levels. Using a survey instrument based on the survey Lance used in a Pennsylvania, Burgin et al. collected information on "staff activities; service hours; library usage; library technology; Internet access; operation expenditures; management, and school demographics" (Burgin et al., 2003, p. 28). The surveys were sent out in two waves to schools randomly chosen from the database of North Carolina schools. Out of the 954 surveys sent there were 216 returned. They were able to use 206 of the returned surveys in their analyses. The researchers determined the value of Pearson's correlation coefficient between the survey variables and student achievement, measured by the percentage of students who scored at or above level 3 on their end-of-year achievement tests. North Carolina currently uses a five level structure to rate achievement test scores, students with scores in level 3-5 are meeting or exceeding learning expectations (NC, DPI, 2018a), it is possible that the levels have been adjusted since Burgin's research was conducted. Among the results researchers found a statistically significant correlation between school library staff hours and student achievement, Pearson's $r = 0.272$, $p = .001$, $N = 152$, and the gap between the average high-performing schools and the average low-performing schools was statistically significant at $p = .000$. They also found a statistically significant correlation between total paid school library staff hours in a typical week and student achievement, Pearson's $r = 0.272$, $p = .001$, $N = 152$, and school libraries in the high performing schools had more paid school library staff hours than those in lower performing schools, with a gap of 18.6 weekly hours, $p = .003$. These correlation results extend to staff hours and student achievement for paid school library staff hours of "professionally-trained staff" (Burgin et al., 2003, p. 37) with a master's degree or higher, with a gap of 9.3 hours between high-performing schools and low-performing school, $p =$

.023, and for professional support staff with 6.8 hours, $p = .008$. Collection age had a statistically significant correlation between the copyright year of the collection and student achievement, Pearson's $r = 0.203$, $p = .007$, with the difference of 2.4 years newer copyright age of books in high-performing school and low-performing schools, $p = .018$ (Burgin et al., 2003). Regrettably, with few exceptions (Lance, 1994; Small et al., 2009), correlational School Library Impact Studies were not submitted to peer reviewed journals.

Despite this large collection of correlational studies, there are still areas of the United States where the number of full-time certified school librarians are declining (AASL, 2014, California Department of Education, 2017; Church, 2017; Ewbank, 2011; Moreno, 2017). Concurrent to this circumstance, the research focus of the *Causality: School Libraries and Student Success (CLASS) White Paper* reveals that AASL has started to support causal research designs to demonstrate the value of school librarians and their contributions to student learning (AASL, 2014).

Also, recently the Every Student Succeeds Act (ESSA) was signed into law (ESSA, 2015). ESSA guidance from the U.S. Department of Education calls for schools' use of evidence-based interventions to improve student success. Moderate evidence is described as "at least one well-designed and well-implemented quasi-experimental study on the intervention" (U.S. Department of Education, 2016, p. 8), which includes matching design propensity score analyses (What Works Clearinghouse, 2020, p. 30).

This study addresses the lack of strong or moderate evidence of school librarian impact as described in the *ESSA* definition of "Evidence-Based" (2015), *ESSA Guidance Using Evidence to Strengthen Education Investments* (U.S. Department of Education, 2016), and the *What Works Clearinghouse Standards Handbook* (2020). As the current research of the school library field is

primarily correlational or qualitative, this study adds to the moderate evidence in the field. This study of the impact of full-time certified school librarians on student achievement is a quasi-experimental study making causal inferences (U.S. Department of Education, 2016) that is an early study addressing the call from AASL for this type of study in school librarianship (AASL, 2014; Schultz-Jones et al., 2018).

Theoretical Framework

This research project evaluates the impact on student achievement by the presence or absence of a full-time certified school librarian in a school and is framed by the overlapping aspects of Senge's and Bronfenbrenner's systems theories, as well as Dewey's and Vygotsky's social development theories. A school is an organization made up of many elements, working together as a system, providing for the educational and social development of students. Katz and Kahn refer to organizations as "social systems that co-ordinate people's behavior by means of roles, norms and values" (Katz & Kahn 1966, p. 43). Senge et al. (2012) describe the school as "not an isolated entity but as an interconnected set of processes, linked by its nature both to the community around it and to the classroom and individual learning experiences within it" (p. 15). This interconnected set of processes includes the curriculum, teachers, learning specialists, administrators, and counselors, among others. Senge et al. define a system as "any perceived structure whose elements 'hang together' because they continually affect each other over time" (2012, p. 124). Systems include all organizations, school districts, classrooms, or educational practices (Senge et al., 2012).

Systems Theories

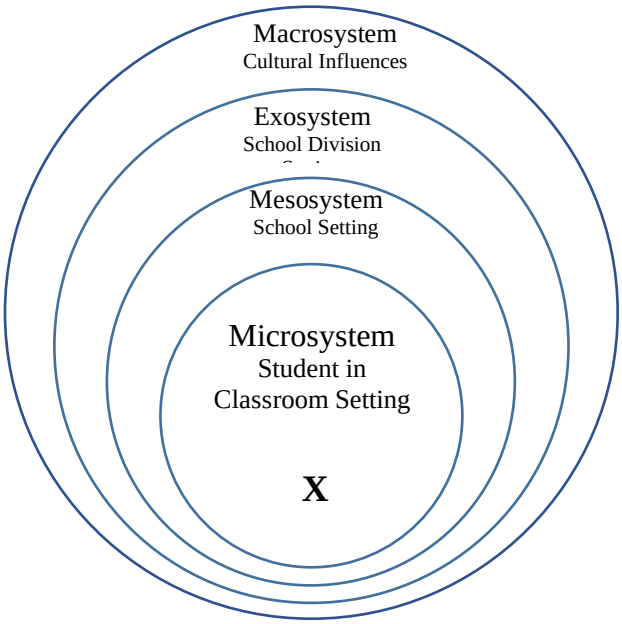
Bronfenbrenner's (1976, 1979) ecological systems theory proposed that a focal individual person develops in a nested ecological environment of interconnected systems in sequentially

larger settings, beginning with the microsystem and expanding through the mesosystem, exosystem, and macrosystem. The microsystem includes the focal individual who is in a setting of face-to-face interaction, and includes "a pattern of activities, roles, and interpersonal relations experienced by the developing person in a given setting with particular physical and material characteristics" (Bronfenbrenner, 1979, p. 22). A child's microsystems, including home, peer groups, and community groups, are where the child has close interaction with other children and adults. A school classroom or the school library is considered a microsystem in which the student is in face-to-face interaction with others. A mesosystem incorporates the intersection of two or more settings in which the individual student develops through interactions (Bronfenbrenner, 1976, 1979), in this case is the school. The third level, exosystem, is one in which the focal individual does not directly interact but includes actions and events that affect the settings in which the individual interacts (Bronfenbrenner, 1976, 1979). The school district level administration and school board exist in the exosystem. The macrosystem consists of the social interactions that form based on the culture in which an individual lives, including belief systems or ideology that influence the social interactions including the structure of social networks (Bronfenbrenner, 1976, 1979; Neal & Neal, 2013). The chronosystem is "the observation that patterns of social interactions between individuals change over time, and that such changes impact the focal individual both directly and by altering the configuration of ecological systems surrounding him/her" (Neal & Neal, 2013, p. 729).

Bronfenbrenner describes ecological systems theory as consisting of systems that are nested (Figure 1), "each inside the next, like a set of Russian dolls" (Bronfenbrenner, 1979, p. 3). Senge et al. (2012) also describe schools as nested systems.

Figure 1

Example representation of Bronfenbrenner's Nested Ecological System (1979)

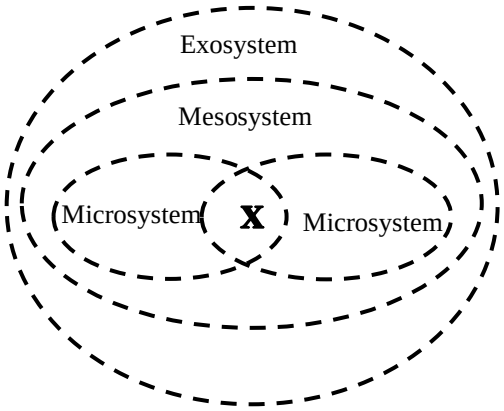


In interpreting Bronfenbrenner's ecological systems theory, Neal & Neal (2013) proposed that "the ecological environment is an overlapping arrangement of structures, each directly or indirectly connected to the others by the direct and indirect social interactions of their participants" (p. 727). From the Neal and Neal perspective, ecological systems theory can be perceived as intersecting non-nested ecological systems where "different microsystems can overlap when they involve distinct sets of individuals participating in different settings" (Neal & Neal, 2013, p. 728), with a setting consisting of "sets of people engaged in social interaction" (Neal & Neal, 2013, p. 733). Jaeger's close reading of Bronfenbrenner's description of the systems prompted her to state that "microsystems do not 'sit' within mesosystems: rather mesosystems exist as the overlap between two or more microsystems" (Jaeger, 2016, p 164), concurring with Neal & Neal. In this view, the mesosystem is an intersection of two or more

microsystems, allowing the consideration of the ecological environment from the perspective of different focal individuals (Neal & Neal, 2013). With the school as a mesosystem, the classroom and library settings are microsystems that intersect within the mesosystems (Figure 2).

Figure 2

Student position within networked ecological system



Social Development Theory

Early in the 20th century John Dewey recognized the social role of learning, stating that "the principle that development of experience comes about through interaction means that education is essentially a social process" (Dewey, 1938, p. 65). Dewey acknowledged learners' benefit from the use of experimentation and problem solving in learning as preparing them as future participating citizens in their community (Evans, 2000), as evidenced when he stated that "To learn to be human is to develop through the give-and-take of communication and effective sense of being an individually distinctive member of a community; one who understands and appreciates its beliefs, desires, and methods, and who contributes to a further conversion of

organic powers into human resources and values" (Dewey, 1927, p. 154). The school ecosystem is another community, focused on the learning of each individual in a social setting. Senge et al. maintain that "all learning is social as well as individual" (2012, p. 53), which echoes Vygotsky's view that the construction of knowledge relies on the learner's internalization of social and individual processes (Vygotsky, 1962, Vygotsky & Cole, 1978). Following Vygotsky's theories John-Steiner and Mahn further interpret the formation of new knowledge as a product of learners' sustained social and individual efforts interacting with what is known, as "internalization is simultaneously an individual and social process" that leads individuals to co-construct new knowledge (1996, p. 197). According to Green and Gredler (2002), Vygotsky and Cole found that school age children develop awareness and control of their cognitive learning through "deep connections among ideas and organizing the world according to logical relations (conceptual thinking and logical memory)" (1978, p. 57) in collaboration with the teacher's instruction.

This study uses the social development and systems theory lenses to look at the impact of full-time certified school librarians on students situated in elementary schools. Senge et al. identify schools as social systems, that along with school systems, function as formal organizations (2012, p. 19). Social development of students continues throughout the microsystems of the classroom and the school library. The knowledge gain through internalization of individual processes and social interaction with others continues internalization of new and expanded knowledge.

Elementary students spend the majority of their time with their classroom teacher and their classroom is their primary microsystem. This classroom microsystem exists in the larger school mesosystem which is made up of other microsystems in which individual students interact

in social settings with other students and teachers or other adults. The school library is one of the other microsystems (Figure 2), providing the opportunity for the school librarian to impact and extend student learning.

Purpose Statement

The purpose of this study was to determine if there is evidence that a full-time certified school librarian, trained and licensed based on state requirements, impacts fourth grade and fifth grade student achievement scores on English/language arts reading or mathematics end-of-year state achievement tests. I compared students who had a full-time certified school librarian and students who did not have a full-time certified school librarian through matching students based on age, gender, ethnicities, disability status, English language learners, and economically disadvantaged status. Fourth and fifth grade reading and mathematics scores for each year from the 2014-2015 to the 2017-2018 school year were analyzed. Students were matched starting with 2013-2014 school year on using students' third grade scores. Data for these years were chosen due to access to school library staffing data. Staffing data collection changed between 2013-2014 and 2014-2015 (NC DPI, 2020a). The following research questions provide the focus of my research approach.

Research Questions

RQ 1. To what extent does the presence of full-time certified school librarians in elementary schools impact students' end-of-year state achievement tests compared to students in elementary schools without full-time certified school librarians, based on the following grade level and subject area scores?

1-1. Fourth grade reading scores

1-2. Fifth grade reading scores

1-3. Fourth grade mathematics scores

1-4. Fifth grade mathematics scores

RQ 2. To what extent does a change in staffing between a full-time certified school librarian and no full-time certified school librarian in an elementary school impact students' scores on end-of-year state achievement tests, based on the following library staffing at the indicated grade levels and subject area scores?

2-1. School library staffed with a full-time certified school librarian for two years followed by a school library not staffed with a full-time certified school librarian for two years on fifth grade reading scores.

2-2. School library not staffed with a full-time certified school librarian for two years followed by staffed with a full-time certified school librarian for two years on fifth grade reading scores.

Significance of the Study

The recently published *National School Library Standards for Learners, School Librarians, and School Librarians* (AASL, 2018b) describes school librarians as acting in "interlinked, interdisciplinary, and cross-cutting roles as instructional leaders, program administrators, educators, collaborative partners and information specialists" (p. 12). Through these roles, school librarians work across all curricular areas, supporting student learning in every subject (AASL, 2019c). Through their instruction to develop and support the use of print and digital literacy skills, inquiry learning, as well as current and emerging technology tools, school librarians are "critical to teaching and learning in the school community" (AASL, 2016a, p. 1). Across the more than 34 studies of school librarian impact on achievement there is a consistent positive relationship on reading, writing, and language arts achievement tests in

schools with full-time certified school librarians (Lance & Kachel, 2018), with some studies also showing gains in math scores (Coker, 2015; Dow et al., 2012). Using school librarian staffing data from the National Center for Education Statistics and 4th-grade National Assessment of Education Progress reading scores, analysis showed that students in states that had gains in school librarians from the 2004-2005 school year to the 2008-2009 had significantly higher fourth-grade reading scores than states that lost school librarians across the same period (Lance & Hofschire, 2011, p. 29). While there are numerous studies supporting the notion that school librarians affect student outcome, the studies are at best correlational and cannot support an evidence-based claim that school librarians matter.

I remedy this lack of evidence by using rigorous methods to examine the relationship between school librarians and student outcomes. I hypothesize that students in schools with full-time certified school librarians show higher achievement scores in both reading and mathematics than students without full-time certified school librarians. I test this hypothesis using a propensity score matching design that is defined by the Every Student Succeeds Act (ESSA) as a rigorous research design (U.S. Department of Education, 2016). If the hypothesis is supported, this study provides the strongest evidence to date for the school library field to use as a point of advocacy for inclusion of full-time school librarians in public schools across the country. The findings of this study do not displace the correlational evidence already gathered but raise questions to be pursued in future research to isolate effective actions of school librarians.

Delimitations

Following are the boundaries of this study:

- Time of the study: School years 2013/2014 to 2017/2018
- Location: North Carolina public elementary schools

- RQ 1 - Fourth grade and fifth grade students in schools without a full-time certified school librarian matched with students in schools with a full-time certified school librarian according to the matching criteria established for this study
- RQ 2 – Fifth grade students in the same school for two years with a full-time certified school librarian, followed by a staffing change resulting in no full-time certified school librarian were matched with fifth grade students in the same school at the end of the second school year after the staffing change. Fifth grade students in the same school for two years without a full-time certified school librarian with a staffing change resulting in a full-time certified school librarian were matched with fifth grade students in the same school at the end of the second school year after the staffing change.

Assumptions

In this study, the assumption is made that school libraries are staffed with full-time certified school librarians, are school librarians who are following the AASL *National School Library Standards for Learners, School Librarians, and School Librarians* in lessons, interactions with students and teachers, and their roles as school librarians (2018b).

Definition of Terms

Case: Each line in a database including each separate piece of connected data points, similar to a row in an Excel database and the information in each column for that row. Each case in a database is based on a separate student.

Certified school librarian: Meets the North Carolina state requirements for certification as a media coordinator. The North Carolina Department of Public Instruction (NC DPI) requires completion of an approved media coordinator program at the Master's degree, which includes

teacher licensure and a passing score on the Praxis II Library Media Content Test (NC DPI, 2018b).

End-of-grade achievement test: The subject specific test developed to measure academic achievement for the state of North Carolina Standard Couse of Study used for state and federal student achievement measurement.

Full-time: Works as a school librarian in one elementary school for the entire school day, five days a week, for the entire school year.

Full-time certified school librarian: There is a school librarian with a school librarian teaching license which includes school librarian endorsement working in one school full-time.

No full-time certified school librarian: There is no school librarian, or there is a part time certified school librarian, or there is a staff member working in lieu of a school librarian without a school library teaching license.

Not full-time: Works less than full-time in one elementary school, including part-time or working at multiple schools.

Organization of the Remaining Chapters

Following this first chapter introducing this study will be four more chapters. Chapter II will review the related literature that provide background and informs this study. Chapter III will explain the research design and methodology that was used in conducting the study. Chapter IV will present the analysis of the data and findings. Chapter V will summarize the study, including conclusions and recommendations of the study. References are included at the end of this paper.

Summary

Following more than two decades of correlational studies suggesting that school librarians impact student achievement, the number of school librarians is continuing to decline

with more than the equivalent of 10,000 full-time school librarian positions lost between the 1999-2000 and 2015-2016 school years, a 19% decrease in positions (Lance & Kachel, 2018, p. 19). This study follows a theoretical framework lens of the overlapping aspects of Senge's and Bronfenbrenner's systems theories and Dewey's and Vygotsky's social development theories. The purpose of this study was to determine if there is evidence that a full-time certified school librarian, trained and licensed based on state requirements, impacts fourth grade and fifth grade student achievement scores on reading or mathematics end-of-year state achievement tests.

CHAPTER II

LITERATURE REVIEW

Research on the topic of teacher certification has established that students of teachers prepared in programs requiring education coursework and certification indicate strong correlations in reading and mathematics achievement (Darling-Hammond 2002). In a 2007 study comparing North Carolina elementary students' reading and math achievement test scores based on the type of teaching license their teacher held, Clotfelter et al. found that students of teachers with regular teacher certification outscored students of teachers with lateral entry or other provisional, temporary, or emergency licensure. Lateral entry licenses, issued for two years, are a path toward a regular license and require a bachelor's degree with a major in the area in which they will teach. Lateral entry teachers must enroll in a teacher education program and complete at least six semester hours of coursework each year. Teachers with lateral entry licenses had "statistically significant negative effect on student achievement" (2007, p. 678) and teachers with other types of provisional or emergency licenses had student achievement scores ranging from loss of -0.033 to -0.059 standard deviations for math and -0.017 to -0.024 standard deviations for reading compared to student achievement scores of teachers with regular licensure (Clotfelter et al., 2007, p. 678). In another study conducted in 2010, Clotfelter et al. looked at the impact of high school teachers' credentials, as well as other teacher characteristics. In comparison of achievement scores of students with teachers who received regular licensure, the achievement scores of students of lateral entry teachers were statistically significantly lower, with a coefficient of variance of -0.0569, $p < 0.01$, and teachers with other licensure a coefficient of -0.737, $p < 0.01$ (Clotfelter et al., 2010, p.665). The gains for student achievement scores of teachers who attained NBCT status added another statistically significant coefficient 0.0494

above the scores of teachers holding a regular license (Clotfelter et al., 2010). Certification in the subject taught also added a coefficient of 0.0703, and if the certification was in a subject related to the course there was an added coefficient of 0.0511. Cowan and Goldhaber (2016) compared Washington State elementary and middle school National Board Certified Teachers (NBCTs) and teachers without National Board Certification with similar teaching experiences and found that the NBCTs are 0.01-0.05 standard deviations more effective in teaching depending on the subject (reading or math) and school level (Cowan & Goldhaber, 2016). Through multiple correlational and other studies, researchers have been trying to determine if certified school librarians impact student learners (Lance & Kachel, 2018). Though there remains a gap in the literature, the lack of empirical experimental studies to provide causal evidence of the impact of certified school librarians on students' achievement (AASL, 2014), that needs to be closed.

Like classroom teachers, school librarians are state certified, and can also be certified as NBCTs, in the field of school librarianship. The school librarian has many roles in their position in the school, including being part of schools' teaching faculty. Though state departments of education establish the school librarian licensure requirements within their states (Jesseman et al., 2015), the AASL, as the national association of school librarians, promotes specific standards of preparation. In this chapter I will return to details about school librarian certification and roles that lead to school librarians' impact on student learning, but first I provide the frame of the interaction of the school librarian with students, learning, and in the school as a whole.

Theoretical Framework

This research is framed by Senge's and Bronfenbrenner's systems theories and Dewey's and Vygotsky's social theories. Senge et al. (2012) describe the school as "not an isolated entity but as an interconnected set of processes, linked by its nature both to the community around it

and to the classroom and individual learning experiences within it" (p. 15) The school library is another type of classroom within the organizational system of the school. This interconnected system includes the curriculum, teachers, learning specialists, administrators, and counselors. The school librarian is one of the many teachers in the school, as part of a system, which Senge et al. (2012), define as "any perceived structures whose elements 'hang together' because they continually affect each other over time" (p.124). One of the differences of school librarians from other teachers is that they are in a position that works with every student and staff member in the school.

Intersection of Bronfenbrenner's and Senge's Theories

Bronfenbrenner's (1976, 1979) ecological systems theory identifies that a focal individual person develops in a nested ecological environment of interconnected systems in sequentially larger settings, each of which encompass the previous systems. The first is the microsystem in which the individual is in, a setting of face-to-face interaction that includes "a pattern of activities, roles, and interpersonal relations experienced by the developing person in a given setting with particular physical and material characteristics" (Bronfenbrenner, 1979, p. 22). A child's microsystems, including home, peer groups, and community groups, are where the child has close interaction with other children and adults. A school classroom and school library are considered microsystems in which the student is an active agent in their development in different contexts. The next larger setting is the mesosystem incorporating the intersection of two or more microsystem settings in which the individual student develops, in this case the school. The school district administration and school board exist in the exosystem. The macrosystem is the community and consists of the social interactions that form based on the culture or subculture in which an individual lives, including the belief systems or ideology that influence social

interactions and the structure of social networks (Bronfenbrenner, 1976, 1979; Neal & Neal, 2013).

Bronfenbrenner describes ecological systems as systems that are nested sequentially like Russian dolls (Bronfenbrenner, 1976, 1979); Senge et al. also describe schools as nested systems (Senge et al., 2012). Jaeger's close reading of Bronfenbrenner's description of the systems prompted her to state that "microsystems do not 'sit' within mesosystems: rather mesosystems exist as the overlap between two or more microsystems" (Jaeger, 2016, p 164), which corresponds with the Neal and Neal (2013) interpretation of Bronfenbrenner's ecological system theory as overlapping systems, "each directly or indirectly connected to others by the direct and indirect social interactions of their participants" (p. 727). The Neal and Neal perspective also perceives ecological systems theory as intersecting non-nested ecological systems where "different microsystems can overlap when they involve distinct sets of individuals participating in different settings" (Neal & Neal, 2013, p. 728), with a setting consisting of "sets of people engaged in social interaction" (Neal & Neal, 2013, p. 733). In this view, the mesosystem can be an intersection of two microsystems, allowing the consideration of the ecological environment from the perspective of different focal individuals (Neal & Neal, p. 728). The focus of this research is the mesosystem, which indicates the school and the classroom and library settings that are microsystems intersecting within the school mesosystem.

Social Theories

Researchers throughout the 20th century recognized education and learning as social processes (Dewey, 1916/2004, 1938; Senge, 2012; Vygotsky & Cole, 1978). Dewey acknowledged learners' benefit from the use of experimentation and problem solving in learning as preparing them as future participating citizens in their community (Evans, 2000), as evidenced

when he stated that "To learn to be human is to develop through the give-and-take of communication and effective sense of being an individually distinctive member of a community; one who understands and appreciates its beliefs, desires, and methods, and who contributes to a further conversion of organic powers into human resources and values" (Dewey, 1927, p. 154). The school library is described in the *National School Library Standards* as "a unique and essential part of a learning community" and as "a third space for learning, a space between the classroom and home, important for on-site, personalized, and self-directed learning" (AASL, 2018b, p. 11). This third space is another way to describe the school library as one of three overlapping microsystems (home, classroom, and library), each a part of the learner's community, and each part of the education of the learner. Dewey believed "The young have to be brought within the traditions, outlook and interests which characterize a community by means of education: by unremitting instruction and by learning in connection with the phenomena of overt association" (Dewey, 1927, p. 154) where individuality is not consciously important, but instead "the more subtle characteristics of individuality, which make the person distinctive and stamp his personality in a more or less unconscious way upon everything that the person has to do with" (Dewey, 2008, p 172). This individuality allows for the uniqueness of each person's contribution to society, but according to Dewey "Only in social groups does a person have a chance to develop individuality" (Dewey, 2008, p. 176).

Senge and Vygotsky also identified that there is an individual aspect in learning as well. Following a Vygotskian framework, John-Steiner and Mahn determined that construction of new knowledge is produced through both social and individual efforts of interacting with the known to co-construct knowledge (John-Steiner & Mahn, 1996). Through learner's conceptual thinking creating connections between ideas and making logical relationships in collaboration with

teacher instruction, learners develop awareness and control of their cognitive learning according to Vygotsky's research (Green & Gredler, 2002). Children develop their learning both individually and in concert with others.

This study uses the social development and systems theory lenses to look at the impact of full-time certified school librarians on students situated in elementary schools. The school library, as a part of Dewey's community, is a place of learning, allowing learners to grow intellectually and socially. School librarians work in various roles to impact learning as part of the mesosystem of the school, encapsulating all of the microsystems of which the learner is a member. Senge et al. identify schools as social systems, that along with school systems, function as formal organizations (2012, p. 19). Depending on approaches to specific lessons, school librarians are using social theories as they teach, such as through collaborative partnerships, peer work, learner self-choice, and guided inquiry. Elementary students spend the majority of their time with their classroom teacher and their classroom is their primary microsystem. This classroom microsystem exists in the larger school mesosystem which is made up of other microsystems in which individual students interact in social settings with other students and teachers or other adults. The school library is one of the other microsystems (Figure 2), providing the opportunity for the school librarian to impact student learning.

School Librarian

Today's school librarian is shaped through the various standards applied to school librarianship (Church et al., 2012) which are constantly updated. School librarian preparation standards were developed by the American Library Association (ALA) and the AASL and were approved by the Council for the Accreditation of Educator Preparation (CAEP) (AASL, 2019a, p. 4). The *ALA/AASL/CAEP School Librarian Preparation Standards* apply to "all master's

programs that prepare candidates to develop and manage library and information services in a PreK-12 setting, regardless of degree name or professional title" (AASL, 2019a). Most critical to future school librarians are AASL's *National School Library Standards for Learners, School Librarians, and School Libraries,* which establish the shared foundations, domains, and the competencies that describe "the desired knowledge, skills, and dispositions of a learner" (AASL, 2018b, p. 19). The *National School Library Standards* continue to recognize the five roles of school librarians first introduced in *Empowering Learners: Guidelines for School Library Programs* (AASL, 2009): leader, instructional partner, information specialist, teacher, and program administrator, with the insight that multiples of these roles are regularly performed simultaneously as needed in daily practice (AASL, 2018b). Following is a more detailed description of each of these standards that shape the school librarians as experts and leaders in their field.

Preparation Standards

The *ALA/AASL/CAEP School Librarian Preparation Standards* (2019a) provide the structure for school library certification programs and influence the knowledge, interactions, and teaching of future school librarians when they start their careers. These standards include the learner and learning; planning for instruction; knowledge and application of content; organization and access; and leadership, advocacy, and professional responsibility (AASL, 2019a, p. 2). Within these standards are expectations for school librarian candidates to become effective educators in all areas covered in the standards, supporting learners and helping prepare them for their future through effective school libraries. Standard 1, The Learner and Learning, describes effective school librarians as aware of learners' development, including respect for learner diversity and learning differences, while providing learner-centered environments.

Standard 2, Planning for Instruction, refers to planning, delivering, and assessing instruction through collaboration with the learning community, use of a variety of instructional strategies while integrating ethical use of information, and assessing for learners' growth and areas that need more attention. Standard 3, Knowledge and Application of Content, focuses on future school librarians' knowledge in literature, digital and information literacies, current instructional technologies and how to engage learners to develop critical-thinking and inquiry to become successful learners. Standard 4, Organization and Access, develops the future school librarian's ability to develop, curate, organize and manage a school library collection that supports diverse needs and interests in a global society. Standard 5, Leadership, Advocacy, and Professional Responsibility supports future school librarians' engagement as leaders in their school and the profession through collaboration, advocacy, and professional networking to further support and promote their learners and the profession (AASL, 2019a). These standards support the future school librarians' roles as leaders, bringing diverse knowledge and skills to their learners and their schools.

The *ALA/AASL/CAEP School Librarian Preparation Standards (2019)* are required to be incorporated into curriculum, along with accreditation by CAEP, for school librarian programs that want to receive ALA/AASL National Recognition (ALA, 2019), though not all school librarian programs follow these standards as they are voluntary (but suggested) for school librarian programs, which are approved by their state. The position of AASL is "that, in addition to meeting state certification requirements, school librarians hold a master's degree or equivalent from a program that combines academic and professional preparation in library and information science, education, and technology" (AASL, 2016b, p. 1), though a master's degree is not required, as certification requirements are developed by individual states (Jesseman et al., 2015).

Growing from a century of school library standards, today's *National School Library Standards for Learners, School Librarians, and School Libraries* (AASL, 2018b) along with school curriculum standards (e.g. Common Core State Standards), form the foundation from which the school librarian works. The first school library standards were introduced by committees of the National Education Association (NEA) and the North Central Association of Colleges and Secondary Schools (1920) and the NEA and ALA (1925). These early standards were more focused on the school librarian's role with reading and circulating books (Committees on Post-War Planning of the American Library Association, Division of Libraries for Children and Young People and Its Section the AASL, 1945), but over the past fifty years the roles have increased and changed (AASL, 1960; ALA & NEA, 1969; AASL & Association for Educational Communication and Technology [AECT], 1975; AASL & AECT, 1988). Recent program standards have redefined the roles of the school librarian (AASL & AECT, 1998, AASL, 2007). Beginning with the 1998 school library standards, *Information Power: Building Partnerships for Learning*, introduced by AASL and the Association for Educational Communication and Technology (AECT), school librarians have identified their roles as collaborators, leaders, and technology integrators enacted through supporting a focus on student learning and teaching, information access, and program administration in the library program (AASL & AECT, 1998), later identifying as information specialists, instructional partners, teachers, program administrators, and leaders in library programs that incorporate physical and digital resources, including emerging technologies in *Empowering Learners: Guidelines for School Library Programs* (AASL, 2009).

The 2007 *Standards for the 21st-Century Learner* used an inquiry framework for standards that provided for students' development of skills, dispositions to use the skills,

understanding of their responsibilities in using information, and self-assessment strategies to monitor their own learning while developing literacy, technology, critical thinking, and information skills (AASL, 2007). This base is continued and reimagined in the updated *National School Library Standards*. These standards use a framework of six Shared Foundations (Inquire, Include, Collaborate, Curate, Explore, and Engage), each of which contain four learning domains that each incorporate three to five competencies expressing the desired student learning. School librarians can target learning competencies from a single foundation, across one of the domains (Think, Create, Share, Grow), or across multiple foundations and domains (AASL, 2018b) when they are working with students. School librarians continue to work through their five roles to provide engaging learning opportunities in a "caring and warm environment where students have a place to explore their passions and have their point of view honored" (Martin & Panter, 2015, p. 56). Through strong school library programs, students develop information literacy, critical thinking, inquiry, and ethical skills to promote academic achievement and preparation for their future with instruction and support from school librarians.

While the current standards continue to recognize the school librarian's roles as leaders, instructors, and collaborators in the school (AASL, 2018b), additionally, AASL has published numerous position statements elaborating on school librarians and school libraries (AASL, 2019b). *National School Library Standards for Learners, School Librarians, and School Libraries* describes school librarians as "master educators who provide leadership for a vision of learning centered on learner voice and choice" (AASL, 2018b, p. 44) through collaborative partnerships with teachers and directly with students one-on-one, in small groups, and whole classes in teachers' classrooms and in flexible library spaces. The *Definition of an Effective School Library* position statement states school librarians also support student learning with

physical and virtual collections that include emerging technologies as they provide deeper personalized learning opportunities (AASL, 2018a). The AASL position statement *Instructional Role of the School Librarian* refers to the school librarian's use of traditional and blended learning opportunities and their potential contact with every learner in the school in their "prominent role in instructing students, faculty, and administrators in a range of literacies, including information, digital, print, visual, and textual literacies" (2016a). Through these standards and position statements, school librarians assert their expertise to impact student learning.

School Librarian Impact Research

Correlational School Library Studies

Over the last 25 years, at least 34 statewide studies in 26 states, and an additional two studies in Canada, have been conducted that have shown positive correlations between high-quality school libraries and student achievement, including the impact of full-time certified school librarians on student achievement (Lance & Kachel, 2018). School libraries are situated within the organizational system of the school, working as one of an interconnected set of processes provided to educate students (Senge et al., 2012). School librarians work with all students in a school and are "uniquely situated as a hub between the outside world and the classroom, between multiple media forms and technologies, and between personal and formal learning" (Subramaniam et al., 2013).

Prior to the statewide studies, an early correlational school library study was conducted in a smaller environment, providing early evidence of the impact of school librarians on student achievement. Between January 1959 and June 1960, Mary Virginia Gaver conducted a study of six elementary schools to develop instruments to evaluate elementary school library services, and

to use the resulting scores and ratings to study the relationship between achievement tests and the three types of libraries provided in the studied schools (Gaver, 1961; Gaver, 1963). Gaver compared three types of libraries in schools by evaluating two schools each that had classroom libraries, only a centralized school library but no librarian, or schools with centralized libraries and a trained librarian. The scores from the *Iowa Test of Basic Skills* were used to compare the scores of students in these three conditions between when they were in fourth grade and in sixth grade to determine academic gain. Other factors such as the quality and quantity of books in the different types of libraries and the amount and types of reading materials a student read were evaluated as well. The most significant finding was an association of higher educational gain in schools that had school libraries and school librarians compared to schools with classroom libraries or a centralized school library without a librarian (Gaver, 1961, 1963). This study was to be the first phase in a larger study, but the results were viewed as so convincing that when Gaver pursued funding for the larger study she was refused, as the funder determined there was no need to conduct the larger study as she "had proved the point" (Gaver, 1988). This groundbreaking study is now recognized as the first correlational study showing a correlation between student achievement and the presence of a school librarian and a centralized library.

While there were other correlational studies (e.g. Didier, 1985) published between Gaver's (1961) study and the 1990s, the statewide studies began in 1992 when Lance, Wellborn, and Hamilton-Pennell released the first Colorado study, *The Impact of School Library Media Centers on Academic Achievement* (Lance et al., 1992).. This was the first of what are now many statewide studies known as the School Library Impact Studies (AASL, 2014). This study used regression analysis to establish a correlation between certain school library characteristics and

academic achievement, including the number of hours the school library was staffed, spending on the library, and the collection size (Lance et al., 1992).

Nearly a decade later, Lance et al., (2000a) conducted the second Colorado Study, incorporating additional characteristics of library media programs in the impact evaluation, including school librarians' specific leadership and collaboration activities, as well as student and teacher access to networked technology to access databases and the Internet. The design of this study and the first Colorado Study used surveys of school library centers to determine the characteristics that are included in the library program, as well as acquired data from the U.S. Census Bureau and building-level statistics, demographics, and achievement scores from the Colorado Department of Education. The data analysis in each of the Colorado Studies is described as bivariate correlation, factor analysis, and multiple regression (Lance et al., 1992; Lance et al., 2000a). The same data analysis procedures have been replicated in many other statewide studies, including various school librarian characteristics with similar results, including Rodney et al. (2003) and Lance & Schwarz (2012). Starting in 2000, studies were reporting results that showed the presence of certified school librarians in schools were correlated to student achievement (Lance et al., 2000a, 2000b; Quantitative Resources, LLC, 2004). Another study by Francis and Lance (2011) found that third, fourth, and fifth grade students in elementary schools with at least one full-time certified school librarian consistently had a higher number of students passing with proficient or advanced scores in reading than students in schools with lower library staffing level

Other Studies

Other studies pursued different approaches, such as the research by Todd and Kuhlthau (2005a) on how effective school librarians help students, measured by a 48 statement survey that

included an open-ended question allowing students to directly provide their thoughts. According to Todd and Kuhlthau, high percentages of students indicated that the school library plays a strong role in finding first facts for research (92%) and helping by providing an information base for assignments (94%), when students did not understand something (90%), search the Internet better (90%) among other topics generally included through instruction provided by school librarians (Todd & Kuhlthau, 2005a). When they surveyed the faculty using the same survey adjusted to the faculty point of view, the results were even more positive than with the students (Todd & Kuhlthau, 2005b).

In New York, a three-phase study of student achievement and motivation was conducted by (Small et al. (2009). The mixed-design study used surveys of school librarians and principals along with a quantitative evaluation, using techniques similar to Lance's studies, correlating student achievement between students with school librarians and without school librarians. In this mixed correlational and qualitative study, researchers found that students at schools with certified school librarians, on average, had higher fourth-grade reading scores than students at schools without certified school librarians. They also found that certified school librarians were more likely to select resources representing different points of view and that support the general curriculum, and the importance they place on teaching basic information literacy skills is correlated to their perception of their ability to motivate students to learn (Small & Snyder, 2009, Small et al., 2009, & Small et al, 2010).

The most recent statewide studies were conducted in South Carolina (Lance et al., 2014a, 2014b) and Washington (Coker, 2015). In South Carolina, researchers looked at reading scores for students in elementary, middle, and high schools. Students in schools with full-time certified school librarians and strong library programs with larger spending, collections, and technology

access, were more likely to meet standards for using literary text, using informational text, and conducting research, on achievement tests at an exemplary level, and less likely to not meet these standards (Lance et al., 2014a, 2014b) The Washington state study was focused separately on both certified school librarians in schools and quality school libraries which are "associated with more library resources, better hours, and more advanced library technologies" (Coker, 2015, p. 15), controlling for school size and student income level. The findings show that students in schools with certified school librarians and quality library programs have higher scores on reading and math tests at all tested grade levels (4, 6, 7, 8; 10 reading, year 1 and year 2 math) than students in schools without certified school librarians or quality library programs, with statistically significant scores in grade 4 and 10 reading; grade 4, 6, 7, 8, and year 1 high school math; and graduation rates (Coker, 2015).

Impact of Statewide Studies

These studies were all conducted with either correlational or qualitative research designs and do not provide moderate or strong research design as preferred by the U.S. Department of Education (2016), but have suggested that school librarians have an impact on student achievement. According to Lance and Kachel (2018), across the school library impact studies "the most substantial and consistent finding is a positive relationship between full-time, qualified school librarians and scores on standards-based language arts, reading, and writing tests, regardless of student demographics and school characteristics" (p. 16). These studies also found that "the benefits associated with good library programs are strongest for the most vulnerable and at-risk learners, including students of color, low-income students, and students with disabilities" (Lance & Kachel, 2018, p. 15). What school librarians do in their programs also matters. Across

multiple studies achievement scores tend to correlate higher in schools when school librarians are:

- Instructing students, both with classroom teachers and independently,
- Planning collaboratively with classroom teachers,
- Providing professional development to teachers,
- Meeting regularly with the principal,
- Serving on key school leadership committees,
- Facilitating the use of technology by students and teachers,
- Providing technology support to teachers, and
- Providing reading incentive programs (Lance & Kachel, 2018, p. 17).

These expectations allude to the roles of the school librarian. Current school librarians are leaders, instructional partners, information specialists, teachers, and program administrators in their schools as "qualified school librarians perform interlinked, interdisciplinary, and cross-roles" (AASL, 2018b, p. 12) in schools. They work with students and teachers throughout the school, in all subject areas. To understand how school librarians impact student learning, it is important to understand the role of school librarians. Researchers in the school library field, in partnership with AASL, are looking for ways to develop more definitive research as "existing correlational studies of library effects on student and teacher outcomes, although valuable in identifying possible effects and features of libraries and librarians that may cause them, are generally not able to rule out plausible alternative explanations in a credible way" (AASL, 2014, p. 9).

School Librarian Roles

Empowering Learners: Guidelines for School Library Programs describes leadership as an essential role of school librarians (AASL, 2009), and *National School Library Standards for Learners, School Librarians, and School Libraries* emphasizes that school librarians, as leaders, undertake an active role in the local and global community and an increased commitment to addressing the challenges and opportunities of the profession (AASL, 2018b). Leadership encompasses the four other school librarian roles of instructional partner, information specialist, teacher, and program administrator (AASL, 2009). Everhart and Johnston state "When school librarians take on leadership roles, they contribute to creating better learning opportunities for students through the librarians' collaborating with teachers, providing engaging instruction, and integrating technology" (2016, p. 1). With a leadership mind-set, school librarians lead from the middle through collaborative teaching to develop information literacy skills, integrate technology, promote reading, and provide professional development as they work to support the curriculum standards and increase student achievement (DiScala & Subramaniam, 2011; Everhart & Johnston, 2016). The desire to lead compels school librarians' commitment to making a difference in the school library, which is shown through efforts to build partnerships in the school and community to advocate for resources, staff, and budgets adequate to meet the school library's needs (Everhart & Johnston, 2016; Martin & Panter, 2015). While some school librarians continue in the traditional approach to leading through program leadership of school groups, some advocate for visionary school librarians to be "a guiding force in educational organizations" (Dotson & Jones, 2011, p. 80). Everhart and Johnston (2016) describe the resistance of some through an attitude of "a leadership task is not my job" (p. 20) and barriers enacted through unsupportive administrators and teachers. They also note that relationships,

communication, and confidence are concepts that support leadership potential through leading not only within the school, but sharing outside the school through advocacy, presenting at conferences, and collaboration with other school librarians (Everhart & Johnston, 2016). In enacting the leadership role, the school librarian may be working at any of the four levels of Bronfenbrenner's ecological system: working with students incorporating new technology in the school library microsystem, planning with teachers in a curriculum meeting to integrate information into classroom lesson in the school mesosystem, participating in a school division committee in the school division exosystem, or advocating for school librarian positions in the local or state community macrosystem.

As an instructional partner, the school librarian develops relationships within the school community, establishing collaborative partnerships that allow the school librarian to integrate information literacy, technology, critical-thinking, social and cultural skills and competencies throughout the school curriculum while supporting teachers' instruction and students' learning in both the school library microsystem as well as the classroom microsystem. Collaboration includes working with teachers in designing instruction, incorporating goals and objectives into learning experiences, and assessing students' knowledge and learning throughout lessons (AASL, 2018b; Dow & Thompson, 2017; Martin & Panter, 2015). Newmann and Wehlage (1995) found that schools with teachers taking collective responsibility for student learning were more successful in improving student achievement. As a member of the school mesosystem the school librarian also takes on the responsibility for student learning as an additional teacher collaborating to teach the school's curriculum. The school librarian's knowledge of the school-wide curriculum also situates the school librarian as an expert to incorporate horizontal (across subjects) and vertical (across grade-levels) integration of learning, helping students build on

prior knowledge and make connections across subjects, further supporting students' achievement (Purcell, 2010). It falls on the school librarian to foster a collaborative role, approaching teachers with ideas to initiate collaboration and appearing approachable to teachers who seek out collaboration (Immroth & Lukenbill, 2007). Benefits of collaboration are increased student achievement and providing teachers with new teaching tools and techniques (Mardis & Hoffman, 2007; Rawson et al., 2015; Vangrieken et al., 2015). Collaboration is also a form of advocacy. As a teacher learns more about the role of the school librarian in instruction, the teacher also learns the role of the school librarian in the school (Kimmel, 2011; Rawson et al., 2015). This helps position the school librarian as a partner in student learning (AASL, 2009).

As an information specialist, the school librarian is an expert in teaching students and teachers about effective processes for locating, evaluating, and using information through research and other inquiry pursuits (Boelens, 2007; Church, 2008; Dow & Thompson, 2017; Martin & Panter, 2015; Purcell, 2010). The role of the information specialist is important in today's world, where students are adept at social media but lacking in academic use of technology and need help in finding relevant information within the overwhelming amount available (Ausband, 2006). Information literacy skills are critical throughout a person's lifetime (Kovalik et al., 2013). Students expect to easily find results using Internet searches (Kuhlthau et al., 2008), and are able to locate information sources but struggle to evaluate their findings (Krueger & Donham, 2013). Students also need to be introduced to resources beyond Internet search engines and learn to use a variety of information resources that promote lifelong learning (Boelens, 2007; Neuman, 2012). Even teachers have similar issues with understanding information literacy and may find it difficult to help students evaluate the information they gather (Kovalik et al., 2013). As an information specialist, the school librarian provides

instruction to both students and teachers. School librarians are also well-positioned as experts in the ethical use of information, teaching students and teachers about plagiarism, fair use, and copyright as well as providing regular updates about new forms of information content and access that change frequently (AASL, 2018b; Dow & Thompson, 2017; Harris, 2011, Subramaniam et al., 2013). As information specialists school librarians support students' use of inquiry research using a process such as Kuhlthau's information search process which encourages students' individual interests through self-choice of topics, followed by actively working through "three realms of activity: physical, actual action taken; affective, feeling experienced; and cognitive, thoughts concerning both process and contents" (Kuhlthau, 1991, p. 362). Multiple researchers have described information literacy instruction and learners' information seeking as sociocultural contexts, supported by Vygotsky's theories (Alexandersson & Limberg, 2003; Gärdén et al., 2014; Lundh, 2008; Wang, 2007; and Wang et al., 2011). Dickinson (2006) points out the similarities between the information search process and Dewey's process of reflective thought: experience phase (problematic situation); disorganized stage (gathering facts); speculative stage (shaping data); reasoning (ideas and facts); actions (testing hypothesis). Dewey (1938) believed inquiry, experiences, and thinking were important in children's learning. School librarians include these when helping learners develop information literacy skills.

The interlinks between the school librarian's various roles become evident when looking at the school librarian's teacher role and how it cross-links with other roles (AASL, 2018b). The school librarian's role as teacher overlaps with the instructional partner role as evidenced in a systematic literature review conducted by Johnston and Green (2018). Following the framework of Neuman's (2003) seminal article reviewing school library research literature, Johnston and

Green (2018) undertook a systematic literature review of school library research published between the years 2004-2014, finding that 48% of the articles they reviewed studied school librarians' roles. The majority of these articles were of the instructional partner and teacher roles "due to the more-explicit connection between student learning and the roles of instructional partner and teacher" (Johnston & Green, 2018, p. 23). School librarians are trained educators and are knowledgeable about effective teaching practices and incorporate information literacy, technology, and ethics through the use of inquiry and critical-thinking (Martin & Panter, 2015; Purcell, 2010; Subramaniam et al., 2013). School librarians should be involved in curriculum development, working collaboratively with classroom teachers, and providing instruction in information literacy (Church, 2008). The school librarian's teacher and instructional partner roles also intersect with the information role while using instructional design knowledge. School librarians transform "find and record" assignments to engaging inquiry projects that require students to integrate information literacy skills as they locate, analyze, and synthesize information to inform others (Purcell, 2010). They work to inspire students' interest in topics, develop their critical thinking, and add to students' current knowledge while also learning about new and unique concepts. One of the established parts of the school librarian's teacher role is that as reading advocate: supporting readers' development of reading for understanding, interest, and exploration through access to a variety of books in all formats; recommending new books; and keeping current on student interests to meet their needs through further collection development (AASL, 2018b). School librarians use reading strategies as they teach students to be information literate. According to Messenger "Being literate goes beyond the ability to read at grade level. It is the ability to process information to analyze, synthesize, and draw conclusions"

(2015, p. 22) which connects the two roles of school librarians as teachers and information specialists. As Neuman (2012) states,

> Learning in today's information-rich environments requires our learners to have far more complex and sophisticated skills than pointing and clicking or copying and gathering. It requires them to be information experts who can extract meaning from a variety of presentation formats and who can create those formats themselves. And because it is school librarians and media specialists who are the schools' premier information experts, they are the ones to help students develop this expertise (p. 25)

Through efforts to teach information literacy classes, the school librarian crosses roles as information specialist, teacher, and instructional partner whether teaching in the school library microsystem or the school classroom microsystem.

The school librarian as a program administrator is another important aspect of their position. The library program stems from a mission statement and a strategic plan, which informs the rest of what the school librarian does in collection development; establishment and revision of policies and procedures; arrangement of the physical and virtual library facilities; and development of instructional and interest programming for students. As knowledgeable specialists, school librarians prepare purchasing requests for collection development, technology, and resources for school administrators' approval. As the program administrator, the school librarian also communicates with other school librarians in the district, region, state, and national level to stay current and resolve issues that arise (AASL, 2018b). In the role of program administrator, school librarians must be knowledgeable about all members of their learning community and ensure that resources and technology meet the needs of all students and teachers (Purcell, 2010; Subramaniam et al., 2013). School librarians' program administration

responsibilities go beyond collection development and include complete knowledge of the school's curriculum in order to support learners' needs through the school library program.

In the new *National School Library Standards for Learners, School Librarians, and School Libraries*, these five roles are embedded in the learning domains Think, Create, Share, and Grow, which were retained from the 2007 standards. In the 2018 standards, "when school librarians enact a role, it is not the role that directly affects the learner; rather, it is the school librarian's expression of the role within a learning domain that affects the learner" (AASL, 2018b, p. 16). When a school librarian collaborates as an instructional partner with a teacher, different aspects of lessons will engage learners in thinking, creating, sharing and growing. Other of the school librarian's roles may also be included in the same lessons, such as information specialist. The roles of the school librarian are not stand-alone, they cross over invisibly.

The field of school librarianship has been researched going back to at least 1960 with Gaver's (1961) early study. Throughout the profession there is a deep understanding of the roles of school librarians in the school ecosystem as shown through the research of the last decade, particularly in the roles of teachers and instructional partners as found by Johnston and Green (2018) and articles that appear in the practitioner journals such as *Knowledge Quest*, *School Library Connection*, and *School Library Journal.* The school librarian goes beyond teaching and providing resources in the school library microsystem, to working with students and teachers in their classrooms, incorporating the school mesosystem into their field of influence. Even with all of this knowledge, the question of the school librarian's impact is still open. More research is required to isolate effective actions of school librarians that impact student learning.

Today's School Librarians

Over the past several decades there have been studies showing a correlation between the

presence of certified school librarians, the roles they bring to their jobs, and the achievement of students on end-of year state-mandated standardized tests (Coker, 2015; Francis & Lance, 2011; Lance et al., 2000a, 2000b; Lance et al., 2014a, 2014b; Quantitative Resources, LLC, 2004). The North Carolina School Department of Public Instruction requires completion of an approved program for a media coordinator at the Master's degree level or above. Completion of the program includes a teacher license and a passing score on the Praxis II Library Media Content Test (NC DPI, 2018b). School librarians that are not certified do not have the benefit of the intense training and knowledge provided by these programs. Even certified classroom teachers are missing valuable knowledge that school librarians possess.

Teachers and School Librarians

The roles of teachers, though similar, differ from those of school librarians. These differences become evident through a study of the dispositions of teachers as they transition to becoming school librarians. Mardis (2007a) followed the experiences of a small group of classroom teachers through their school librarian practicum, gathering data from journals, questionnaires, and researcher observations. The transition that occurs, changing the participant from a teacher to a school librarian as the practicum is experienced, highlights differences of the professional expectations and actions of teachers and school librarians, underscoring the differences in the microsystems in which classroom teachers and school librarians work.

When they began their practicum, the teachers displayed "self-identities as strong classroom teachers" (Mardis, 2007a, p. 225). They expressed pride in their knowledge of curriculum, classroom management, lesson planning, and their ability to be flexible and multitask, expecting their school library role would be very similar to their classroom practice, perceiving the school library as a larger classroom. As they began the process of collection

development they were confronted with evidence that the role of information specialist was different from their experiences gained as classroom teachers, evident through their new experiences of weeding the collection and selecting materials for acquisition with consideration of a budget and school needs. Working with students brought a shift in how these developing school librarians reframed their interactions to the information specialist perspective as they realized students did not perceive them as teachers, but as "information professionals with unique knowledge" (Mardis, 2007a, p. 229). Taking on the role of program administrator was another transition as they assumed opportunities in management and a larger role in working with staff throughout the school as "leadership opportunities not only pushed limits of experience, they also changed thinking to be focused on the entire school" (Mardis, 2007a, p. 230). In a follow up study of five program graduates, the researcher found that the preservice experience allowed graduates to transfer their training and skills successfully to new school library and educational settings (Mardis, 2013).

While much like a classroom teacher, the school librarian has a responsibility to teaching the students in the school. All students in the school are the school librarian's learners. Everyone within the school shares responsibility for the learners, including administrators, counselors, clerical staff, custodians, and cafeteria staff in their own ways in the system of the school. However, the learner is positioned primarily in the classroom, and regularly in the school library. The question becomes, does the work of the certified school librarian have an impact on students' achievement along with that of the classroom teacher?

Research and Causality

After decades of research into school library characteristics and the actions of school librarians, these positive correlational studies are the research used by the school library field to

advocate for school libraries (Mardis, 2007b). Unfortunately, these correlational studies are not able to isolate the effects of school libraries in the way that experimental or specific quasi-experimental designs would (AASL, 2014) while providing stronger evidence as described by the U.S. Department of Education (2016). Correlational research uses regression modeling to compare statistical relationships between two variables when it is not possible to manipulate the independent variable. An experimental design uses randomized control of the independent variable and is considered the most rigorous strong research design in part because of the high degree of control of extraneous and confounding variables (McMillan & Schumacher, 2010). A quasi-experimental design using a time-series or matching design is considered to be "one of the stronger nonrandomized experimental designs" (AASL, 2014, p. 9) minimizing confounding effects with the independent variable. Mardis advocates that future research "should lend depth and sophistication to the relationships suggested by correlation" as "Correlational studies do not offer readers causal relationships: Researchers' interpretations of the results of these studies are often subjective and not absolute" (Mardis, 2007b, p. 25).

In 2014 AASL convened the *Causality: School Libraries and Student Success (CLASS)* forum, a national meeting of 50 school library scholars including emerging researchers, education researchers, and consultants (AASL, 2014). The charge of the CLASS Forum was to develop a research agenda for AASL. This forum was guided by Dr. Thomas Cook, "one of the most influential methodologists in education research" (AASL, 2014, p. 5) and a five-member expert panel. The discussions included the difficulties involved with determining the school librarian impact. The school librarian and the school library are intertwined and it is difficult to separate the direct effect of school librarians' interaction with student learning and the indirect interaction through collaborating with teachers and other parts of their roles. Methodologies were

discussed to determine ways to design strong causal studies that would strengthen researchers' claims about school librarian and school libraries impacts on student learning. As it is not feasible to randomly assign school librarians to schools, or students to school librarians, it would be difficult to use an experimental research design (AASL, 2014). Quasi-experimental research designs, including time-series and matching designs were discussed as appropriate possibilities, as well as adding qualitative methods to determine how and why the intervention worked (AASL, 2014).

In late 2015, AASL initiated the grant funded first phase of the research plan based on the recommendations made at the CLASS Forum. A CLASS II research team made up of research teams at three universities began a research synthesis analysis of causal educational research to answer the question "What causal relationships between school-based malleable factors and student learning are present in published research?" (Schultz-Jones et al., 2018). Early results led to a limited series of three field studies focused on "effective practices that a school librarian could lead or conduct individually" (Schultz-Jones et al., 2018) which were conducted during the 2017-2018 school year. Soulen et al. (2018) studied the effects of school librarians acting as mentors to a treatment group of first year teachers to help them build resilience, reduce burnout, and ensure retention to the teaching profession, in comparison with a control group who received mentoring from peer teachers as was customary in the school division. Results showed that resilience over time was dependent on the age of the participant and the treatment group received statistically significant more mentoring and collaboration which was valued by the new teachers who in interviews also credited the mentoring relationships to their perceptions toward resilience, burnout, and retention. Gerrity et al. (2018) compared students who received shorter, more frequent information literacy instruction, those receiving a longer single session of

information literacy instruction, or students who were not exposed to any information literacy instruction. Results showed both long instruction and multiple short instruction outperformed the control group, with the multiple short instruction easier to schedule and deliver without any loss of learning benefit. Smith and Tyler-Wood (2019) used a matched sample research design to compare students receiving STEM learning experiences through the use of a transmedia book with related activities to a control group of students receiving traditional instruction, with learning measured by attitudes toward STEM, reading fluency and comprehension, and STEM knowledge. Results showed that the elementary and high school students enjoyed the units, with the high school participants showing increased, but not significant, science scores and the elementary students showed increased, but not significant, scores in both science and math. The CLASS II research team completed their research and has produced multiple articles reporting the information gleaned from their metasynthesis with suggestions for future research in the school library field (Kimmel et al., 2019; Mardis et al., 2018; Schultz-Jones et al., 2018).

Summary

Certified school librarians have had extensive training through graduate programs based on rigorous standards (AASL, 2018b) and library preparation programs and guidelines (AASL, 2019a). They are prepared to collaborate with teachers in educating students in all subject areas, preparing them to inquire, think critically, gain and share knowledge (AASL, 2009). My assumption for this study is that full-time certified school librarians' behaviors, dispositions, and knowledge practices are based on these standards. School library studies have extensively provided evidence of the correlation between a full-time certified school librarian and student achievement on standardized end-of-year state-mandated tests, which, with the exceptions of research by Todd & Kuhlthau (2005a, 2005b) and the studies led by Small (Small & Snyder,

2009; Small et al., 2009; Small et al., 2010), were never submitted for peer review. The research gap in empirical quantitative school library research providing causal evidence still remains. Through this study I plan to begin to fill that gap. The purpose of this study is to determine if there is evidence that full-time certified school librarian, trained and licensed based on state requirements, impact fourth grade and fifth grade student achievement scores on reading, or mathematics end-of-year state achievement tests. I compared students who had a full-time certified school librarian and students who did not have a full-time certified school librarian through matching students based on age, gender, ethnicities, disability status, English language learners, and economically disadvantaged status. The questions answered through this research were "To what extent did the presence of full-time certified school librarians in elementary schools impact students' end-of-year state achievement tests compare to students in elementary schools without full-time certified school librarians?" and "To what extent did a change in staffing between full-time certified school librarian and no full-time certified school librarian in an elementary school impact students' scores on end-of-year state achievement tests?"

CHAPTER III
METHODOLOGY

In this chapter I present the methodology for this quantitative study. First, I explain the research design. The population and sample selection with sampling procedures follow. Next, the validity and reliability of the data used are explained. Data collection procedures will then be shared, followed by the data analysis procedures. The final element is a description of the limitations of this study.

Purpose Statement

The purpose of this study is to use a rigorous design to determine if full-time certified school librarians impact fourth grade and fifth grade student achievement scores on reading or mathematics end-of-grade state achievement tests. The existing research on the impact of school librarians on achievement has been mostly limited to correlation and qualitative research. There is a notable gap of rigorous scientifically based research in the school library field, defined in No Child Left Behind (NCLB) as research that "employs systematic, empirical methods that draw on observation or experiment" (2002) using an experimental design with random-assignment or a quasi-experimental design using within-condition or across-condition controls (NCLB, 2002). The guidelines provided under NCLB have been continued under the Every Student Succeeds Act (ESSA) and call for research on interventions "supported by higher levels of evidence, specifically *strong evidence* or *moderate evidence*" (U.S. Department of Education, 2016, p. 4) because these research methods confirm the interventions to be effective. ESSA guidelines describe research using an experimental study to provide strong evidence, and research using a quasi-experimental study as providing moderate evidence (Department of Education, 2016, p. 12). The Department of Education "considers a quasi-experimental study to be 'well-designed and well-implemented' if it meets *WWC Evidence Standards with reservations* or is of the

equivalent quality for making *causal-inferences"* (2016, p. 8-9*).* In this research project, I will be using a rigorous quasi-experimental design to provide evidence on the impact of school librarians on student achievement. Does the presence of a full-time certified school librarian in an elementary school impact student achievement in comparison to an elementary school with less than a full-time school librarian working in their school library? Less than a full-time school librarian could be a part-time certified school librarian, a person without school librarian certification providing book check out, or no librarian at all. The following research questions provide the focus of my research.

Research Questions

RQ 1. To what extent does the presence of full-time certified school librarians in elementary schools impact students' end-of-year state achievement tests compared to similar students in elementary schools without full-time certified school librarians, based on the following grade level and subject area scores?

1-1. Fourth grade reading scores

1-2. Fifth grade reading scores

1-3. Fourth grade mathematics scores

1-4. Fifth grade mathematics scores

The analysis will be repeated for each of several school years. Thus, each grade level and each subject are specific to the students tested each year. The fourth-grade students were matched on multiple characteristics including their third-grade scores. Fifth-grade students in each year's analysis were also matched on multiple characteristics, including their third-grade scores.

RQ 2. To what extent does a change in staffing between a full-time certified school librarian and no full-time certified school librarian in an elementary school impact students' scores on end-of-year state achievement tests, based on the following library staffing at the indicated grade levels and subject area scores?

2-1. School library staffed with a full-time certified school librarian for two years followed by a school library not staffed with a full-time certified school librarian f or two years on fifth grade reading scores.

2-3. School library not staffed with a full-time certified school librarian for two years followed by staffed with a full-time certified school librarian for two years on fifth grade reading scores.

The students are compared to students within the same school thus the achievement of fifth graders in the school in 2016 is compared with the achievement of fifth graders in the same school in 2018. Each of these fifth graders were matched on multiple characteristics, including teachers and their third-grade scores.

Research Design

This study used a quasi-experimental matched pair design using propensity score matching. The matched pair design allows estimation of causal effects in a nonrandomized study (Rubin, 1974). Matching pairs of students, one student in the control group matched to a student in the comparison group, imitates an experimental study when it is not possible to randomly assign subjects to control and treatment groups (Pribesh & Gregory, 2018, p. 147). Matched sampling is used to reduce bias in nonexperimental studies in which random assignment is absent (Rubin, 1973a). Bias can still be present even with matched criterion variables as "even the most suitable control population will still differ from the experimental population in certain properties

that are known or suspected to have some correlation with the criterion variables" (Cochran, 1953, p. 684). Nearest neighbor matching using propensity scores was used to match a subject in the treatment group to the control group subject "with the smallest distance" (Stuart, 2010, p. 9) from the treatment subject in terms of matching criterion (Rosenbaum & Rubin, 1985; Rubin, 1973a,1973b; Stuart, 2010). Guo & Fraser describe nearest neighbor matching as

> *Pi* and P_j are the propensity scores for treated and control participants, respectively: I_1 is the set of treated participants; and I_0 is the set of control participants. A neighborhood C(P_i) contains as a control participant *j*(i.e., $j \in I_0$) as a match for treated participant *i* (i.e., $i \in I_{1=)}$ if the absolute difference of propensity scores is the smallest among all possible pairs of propensity scores between *i* and *j*, as $C(P_i) = \min ||P_i=P_j||, j \in I_0$ . . . If for each *i* there is only a single *j* found to fall into $C(P_i)$, then the matching is nearest neighbor pair matching or 1–to1 matching (2015, p. 146-147).

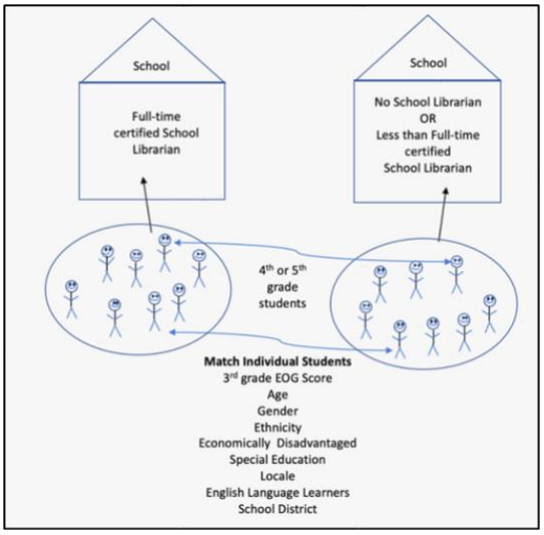
Cochran (1953) describes the matching procedure as taking the data with each treatment student and matching to a control student in the adjoining data cell with the same values for each of the covariates. Basically, the software compares students' matching value with the closest match of scores. This matching design is considered a propensity score analysis, as the matching characteristics for each subject (student) are analyzed and a score is calculated. The scores are compared and the closest matches between treatment and control subjects are matched within a prespecified tolerance, referred to as a caliper (Guo & Fraser, 2015). Rosenbaum and Rubin (1985) suggested a caliper size of 0.25 of a standard deviation of the sample estimated propensity scores, which is what I used in my study. All cases outside the tolerance remain unmatched and are removed.

Research Question 1

To answer the first research question, impact of full-time certified school librarians, students at schools with full-time certified school librarians were matched based on the criterion variables (covariates) of 3rd grade reading or mathematics scores, age, gender, ethnicities, disability status, English language learners, and economically disadvantaged status, geographic locale (rural, town, suburb, urban), and school district to students at schools without full-time school librarians with similar demographics (see Figure 3).

Figure 3

Research Question 1, Matching Staffing Based on Student Demographics



Matching Research Question 1

To conduct the matching I used SPSS Software with an added Fuzzy extension and Integration Plug-in for Python and Integration Plug in for R, using nearest neighbor matching with a caliper of 0.25. I started by merging a dataset containing school librarians staffing to the

dataset with the test scores through the SPSS Data/Merge Files/Add Variables function. Then I used the data merge process to merge the dataset with the third grade demographics to the dataset with the third grade test scores. Finally, I merged the third grade dataset with the demographics and third grade scores to the first dataset. For instance, the 2017- 2018 fifth grade reading test dataset was merged with the 2017-2018 Digital Learning & Media Inventory (DLMI) dataset containing the school library staffing. Then I merged the 2015-2016 third grade demographic dataset to the 2015-2016 reading test dataset, as the third grade scores are one of the matching points, along with the demographics. I now had a dataset including the 2017-2018 reading test scores, the 2017-2018 school library staffing, and the 2015-2016 scores and demographics. Any cases (rows in the datasets) that were missing data were removed, otherwise the software would not run the matching analysis. Using the finalized dataset I used SPSS Data/Propensity Score Matching, entering the independent variable, each of the matching variables, the match tolerance of 0.25 (to limit the matches than no more than one-quarter of a standard deviation), gave names to the variables that would be created by the matching analysis, then used Options to name the variable of eligible cases "Count" and set sampling as Without replacement, Give priority to exact matches, and Maximize execution performance. At this point I ran the matching analysis. Three variables were added to the output dataset. The Count variable shows which cases are not matched and they are removed. The Propensity variable shows the propensity score, and the Match ID variable identifies the student number of the matching student for each case. This completes the matching. The resulting dataset is analyzed with SPSS Analyze/Compare Means/Independent-Samples *t* Test, determining if mean scores of students with full-time certified school librarians are higher or lower than students without full-time certified school

librarians. This was repeated for both reading and mathematics achievement tests from 2014-2015 to 2017-2018 fourth grade and 2015-2016 to 2017-2018 for fifth grade.

Research Question 2

This second research question differs from the first question, with the intent to determine if a change in library staffing, losing or adding a full-time certified school librarian, within a school would have an impact on student achievement, rather than the first question which focuses on comparing all schools each year separately. For the second research question data are used over a continuous four-year period to determine the impact of a change in staffing of school librarians at a school, students in the fifth grade were matched in the same school, two years later (after the staffing change), with a student in fifth grade as the original students in order to determine if the loss or addition of full-time certified school librarians impacted students' EOG reading scores. Matching was made based on the criterion variables (covariates) of 3rd grade reading or mathematics scores, school, teacher, age, gender, ethnicities, disability status, English language learners, economically disadvantaged status, geographic locale (rural, town, suburb, urban), and school district (see Figure 4).

Figure 4

Research Question 2, Matching Two Years After Change in Staffing

Loss of a full-time certified school librarian Match Student A to Student B, compare the 5th grade EOG scores of student A and B.					
Study Year	1	2	3	4	5
RQ 2-1	FTC-SL Staffing	Yes	Yes	No	No
	Demographics with 3rd grade EOG score	Student A in 4th grade	Student A 5th grade EOG score		
			Demographics with 3rd grade EOG score	Student B in 4th grade	Student B 5th grade EOG score
Addition of a full-time certified school librarian Match Student C to Student D, compare the 5th grade EOG scores of student C and D.					
RQ 2-2	FTC-SL Staffing	No	No	Yes	Yes
	Demographics with 3rd grade EOG score	Student C in 4th grade	Student C 5th grade EOG score		
			Demographics with 3rd grade EOG score	Student D in 4th grade	Student D 5th grade EOG score
RQ = Research Question FTC-SL = Full-Time Certified School Librarian Yes = School Staffing with a FTC-SL No = School Staffing without a FTC-SL The dark line indicates a staffing change in full-time certified school librarian					

Matching Research Question 2

The matching for Research Question 2 was similar to Research Question 1. The 2015-2016 fifth grade reading achievement test dataset was merged with the school library staffing dataset, then the 2013-2014 third grade reading achievement test was merged with the third grade demographics dataset. The combined 2013-2014 third grade combined dataset was merged with the 2015-2016 fifth grade combined dataset. The students in schools that do not have full-time certified school librarians are removed and added to a new database. This is repeated with the 2017-2018 reading dataset merged with the school library staffing, then the third grade

combined dataset with 2015-2016 third grade reading achievement was merged with the third grade demographics dataset. The combined 2015-2016 third grade dataset is merged with the 2017-2018 combined dataset. The students in schools with full-time certified school librarians are added to a new database. The final 2015-2016 combined dataset was merged with the final 2017-2018 dataset. All cases missing data are removed, and the remaining dataset was matched as described above. This process was repeated with the mathematics achievement test in schools that gained full-time certified school librarians in 2017-2018. This same procedure was followed for the same years, but the students in school that had full-time certified school librarians in the 2015-2016 combined dataset were added to a new dataset that was then merged with the students without full-time certified school librarians in 2017-2018 for both the reading and mathematics achievement tests. The matching procedure of each dataset proceeded as described above in Matching Research Question 1. The resulting output matched datasets were then analyzed with Independent-Samples *t*-Tests.

Quasi-Experimental Design

As suggested by the U.S. Department of Education guidance (2016), this study was designed as rigorous quasi-experimental research measuring an existing intervention comprised of the provision of school librarians in public schools and the impact on student achievement through comparison of students in schools with and without full-time certified school librarians. A quasi-experimental design using a time-series design or a matching design, which is used in this study, is considered to be "one of the stronger nonrandomized experimental designs" (AASL, 2014, p. 9). This study is considered to be evidence-based, providing moderate evidence as defined by ESSA in 2015, stating that "moderate evidence from at least one well-designed and well-implemented quasi-experimental study" provides supporting evidence of successful

interventions (ESSA, 2015). The guidelines provided by the U.S. Department of Education "considers a quasi-experimental study to be 'well-designed and well-implemented' if it meets WWC Evidence Standards with reservations or is of the equivalent quality for making causal inferences (U.S. Department of Education, 2016, p. 8-9). Moderate evidence must show a positive, statistically significant student outcome, using a large and multi-site sample with overlaps of the types of students and geographical setting (U.S. Department of Education, 2016, p. 9). This study met all of these parameters as discussed below and in the next chapter.

Population and Sample

In 1994, five North Carolina counties filed a lawsuit against the state of North Carolina, arguing that the their school districts were not able to provide an equal education or their counties' children because they did not have enough money even though they taxed their residents higher than the state average (Public School Forum of North Carolina, 2020).The case of Leandro v. State of North Carolina went to the North Carolina Supreme Court, resulting in a 1997 ruling that the North Carolina constitution requires "opportunity for a sound basic education for in our public schools" (NC General Court of Justice, 2020, p. 6). In 2004 the court found the State of North Carolina was still out of compliance with the constitutional requirement and issued a Liability Judgment on the State, requiring them to provide well-qualified teachers and principals, as well as access to sufficient resources to allow equity of opportunity allowing all learners, including at-risk learners, access to obtain a sound basic education (NC General Court of Justice, 2020a, p. 8). In 2018 the judge appointed an independent consultant to evaluate the public schools and report their recommendations to bring the State into compliance, as equity had still not been attained. In January 2020 the judge responded to the findings with a requirement for the State to provide a plan to address the issues identified in the independent

report within 60 days (NC General Court of Justice, 2020). As the state of North Carolina has struggled to establish equity in their schools, it may be possible for North Carolina public schools to use the data from this study as further evidence of inequity in school librarian staffing.

Data for this study was obtained from North Carolina because their Department of Public Instruction (DPI) has consistently collected data from all public schools, which includes multiple aspects of the school library staffing and resources; data not readily available in other states. The updated survey, Digital Learning & Media Inventory (NC DPI, 2020a), has been formatted to support research analyses. Duke University hosts the North Carolina Educational Research Center, the repository for all NC DPI data, which is made available to researchers with appropriate studies. North Carolina schools include urban and rural areas, a range of economic levels of family income, ethnicities, and English language students. This diversity may reflect populations in other areas of the country, allowing possible generalization in other parts of the country.

This study used a total population sampling design (Lund Research Ltd, 2012), drawing data from all public elementary schools in the state of North Carolina, based on school library staffing. Analysis of data over a continuous five-year period determined which public elementary schools met the requirements of this study. Most schools in this state have full-time certified school librarians (77% of schools), leaving the sample for question one dependent on the number of elementary schools serving grades three through five identified without full-time school librarians (23% of schools). The 2018 DLMI survey shows 1,905 schools with full-time certified school librarians (68 schools had two or more librarians, 17 of those second school librarians were part time) and 572 schools without full-time certified school librarians (including 82 part-time certified school librarians) out of a total of 2,477 schools (NC DPI, 2020a). These numbers

change annually. For question two, the sample used all elementary schools serving grades three through five with a change in library staffing of a full-time certified school librarian between the second and third year of data. I found 19 schools which had a school librarian from 2014-2016 and were without a full-time certified school librarian in 2016-2018. There were six schools which were without a full-time certified school librarian during the 2014-2016 school years and gained a full-time certified school librarian for the 2016-2018 school years. School library staffing at each school was determined through analysis of annual school surveys conducted from the 2014-2015 school year to the 2017-2018 school year by the North Carolina Department of Public Instruction (DPI).

Once schools with and without full-time certified school librarians were identified individual fourth grade and fifth grade students from the treatment group (schools with full-time certified school librarians) were matched to individual students from the control group (schools without full-time certified school librarians). Matching was based on EOG achievement test scores from their previous school year as well as demographics including, gender, age, ethnicities, disability status, English language learners, economically disadvantaged status, geographic locale, and next nearest neighbor sampling using the school division.

Instrumentation

The North Carolina DPI used the Annual Media & Technology Report (AMTR) survey to collect information on school media and technology programs in each school and school district from 2008 to 2015. There were 105 questions at the school level and 106 questions at the district level. The school questions included four school librarian staffing questions, determining full-time, part-time, and certification for school librarians in the school, and whether the school had a media assistant. There were 24 questions concerning the school library facility and

resources. The AMTR was a digital report, with mandatory reporting to the state. Items varied and included yes/no, text, numerical, and drop-down options as required (NC DPI, 2020a).

In 2016, the North Carolina DPI changed their survey program to follow the needs of their updated Digital Learning Plan. This new survey, Digital Learning and Media Inventory (DLMI) includes 92 questions broken up between 44 district questions, with 48 school questions. Of the school questions, four are school library staffing questions and six are school library facility and resource questions. The DLMI format is similar to the AMTR, but includes validation pages for users to check that all items are complete NC DPI, 2020a)

The End-of-Grade (EOG) Assessments of English Language Arts/Reading, Edition 4 and EOG Assessments of Mathematics, Edition 4 were subjected to a formal development process following the June 2010 North Carolina adoption of the North Carolina Standard Course of Study (Mbella et al., 2016a, 2016b). During the 2010-2011 school year items were developed for the assessments by trained item writers including North Carolina teachers, curriculum specialists, and university content specialists, following 19 steps for item creation and approval. The final approval was made by the North Carolina DPI Test and Measurement Specialist, who reviewed the item for overall quality, and approved requests to the curriculum specialist review for possible edits, returned the item as requested by curriculum and instruction staff, or deleted the item. This rigorous test construction process helped to establish validity of the items as each item was reviewed by various experts throughout the process, establishing inter-reviewer agreement (Mbella et al., 2016a, 2016b). The reading and mathematics assessments were field tested in the 2011-2012 school year and were first administered in the 2012-2013 school year (Mbella et al., 2016a, 2016b).

Validity of the EOG assessments was established by an outside researcher using the surveys of enacted curriculum (SEC) approach, with results expressed on a scale with a range from 0 to 1.0, with 1.0 representing perfect alignment and 0 representing misalignment. The threshold for alignment is 0.5 or above (Smithson, 2015). Table 1 depicts the summaries of the alignment measures for the North Carolina English/language arts and reading end-of-grade achievement tests. The balance of representation (BR) value shows the balance of the content referenced in the curriculum standards and the portion of the assessment that targets standards-based content. All of the grades are well-aligned in BR. Topic coverage (TC), also known as categorical concurrence, measures the alignment of what is in the standards to what is on the test, so that students are not being tested on information that was not in the curriculum standards. The TC for English/Language arts and reading are well-aligned across the grade levels. The performance expectations (PE) measures the alignment of knowledge and skills, what students should know and be able to do. The PE is well-aligned for all grades. The overall alignment index (OAI) column addresses the OAI measures, which combines BR, TC, and PE into an overall measure of alignment. The scores for all grades are well-aligned (Smithson, 2015).

Table 1

Validity of English/Language Arts and Reading EOG Tests

Grade	OAI	BR	TC	PE
3	0.58	0.59	0.65	0.86
4	0.47	0.71	0.64	0.59
5	0.52	0.70	0.64	0.67

Note. OAI = Overall Alignment Index; BR = Balance of Representation Index; TC = Topic Coverage Index; PE = Performance Expectations Index.

The mathematics summaries of alignment measures are show in Table 2. The BR and TC scores shows well-aligned measures. The PE scores for 4th and 5th grade are well-aligned, with slightly lower 3rd grade alignment which also lowered the OAI score for 3rd grade. The 4th and 5th grade OAI are again well aligned. The weak performance expectations measure may result from "a shift in question format to assess more challenging performance expectations to address in a standardized multiple-choice assessment format" (Smithson, 2015, p. 14).

Reliability of the EOG assessments were measured by calculating internal consistency coefficients using Cronbach Coefficient alpha reliability. For the grade 4 English language arts/reading reliabilities the alpha = 0.89 on Form A, 0.90 on Form B, and 0.89 on Form C. Grade 5 English language arts/reading reliabilities report Coefficient alpha = 0.90 on Form A, 0.88 on Form B, and 0.89 on Form C. On the EOG grade 4 mathematics reliabilities the Coefficient alpha = 0.92 on all three forms. The grade 5 EOG mathematics reliabilities report Coefficient alpha = 0.91 on Form A, 0.92 on Form B., and 0.91 on Form C. These coefficients show that each of these assessments are internally consistent and will provide reliable results.

Table 2

Validity of Mathematics EOG Tests

Grade	OAI	BR	TC	PE
3	0.40	0.57	0.68	0.41
4	0.59	0.81	0.67	0.72
5	0.54	0.78	0.64	0.72

Note. OAI = Overall Alignment Index; BR = Balance of Representation Index; TC = Topic Coverage Index; PE = Performance Expectations Index

Data Collection Procedures

The first step of data collection for this study was to obtain human subjects research approval from my university's Institutional Review Board. The approval letter is attached in (Appendix A). In order to protect the privacy of the students, several steps were taken to provide security of the data used for this analysis. First, the North Carolina Education Research Data Center (NCERDC) de-identified all student information on all of the data files that they provided for the research. Old Dominion University's Information Technology Services (ITS) department established access to the databases for me on a secure server housed in ODU' s data center. Physical access is limited to data center staff with secure card entry. I was provided virtual access through a VPN connection using multi-factor authentication. All access and analysis of the data was conducted on the virtual server. Access to the virtual server beyond ITS was limited to me, my dissertation chair, and my dissertation statistical analysis advisor who is also on my dissertation committee. The server contained the databases provided by NCERDC, SPSS version 25 software and Microsoft Office software. There was no other software or access on the server. I was provided access to survey data collected in the AMTR and DLMI surveys which show staffing at each school in the state to determine which schools have full-time certified school librarians and which schools do not have full-time certified school librarians for each of the school years from the 2013-2014 school year to the 2017-2018 school year from the North Carolina DPI. The names of the schools were removed from the data to further provide privacy and security for students' information, and any other information that may identify the school was not included in my dissertation. The student demographics and end-of grade reading and mathematics scores for grades three through five from the same time period were obtained from the North Carolina Education Research Data Center. For both research questions, third grade

data and demographics was used to match students. Fourth grade scores and fifth grade scores were used to compare student pairs. For the second research question, fifth grade scores were used to match student pairs. All data was either returned to NCDERDC or destroyed as established on the security agreement provided to NCERDC.

Data Analysis

For the first research question, I analyzed the staffing survey databases to determine school library staffing, identifying which schools have full-time certified school librarians and which schools do not have full-time certified school librarians or do not have school librarians. I recoded certified school librarians working less than full-time to 0, because these are not full-time certified school librarians. During all analyses, school librarians met one of two staffing criteria: full-time certified school librarian (coded 1) or not full-time school librarians (coded 0).

Using each year's testing database required preparation to remove data that I did not need. The databases included all testing data from grade 3 through 12, and all subjects tested. I removed all grades I was not using, keeping only tests from grades 3 through 5, then removed any tests at this grade level that were not the subjects I was using, keeping the reading and mathematics tests, including the alternate tests for reading and mathematics. All non-standard public schools, such as charter schools and academies, were removed from the data. Also, any cases that were missing data were removed from the datasets because the software would not process the analysis with empty cells. All duplicate cases were removed, so no student was duplicated in the data. This data process took a very large dataset (the 2018 testing dataset originated at 2,888,019 items) to a much smaller, but still large number (the 2018 data included fifth grade 112,825 reading scores) of cases prior to conducting an analysis (see Table 3). All third-grade datasets were required for matching and were not analyzed separately.

Table 3

Number of cases by year and subject

School Year	2014	2015	2016	2017	2018
All Tests 3-12	2,691,037	2,751,470	2,826,094	2,883,524	2,888,019
Total Reading & Math tests by grade					
3	216,377	224,950	232,354	251,438	233,146
4	200,422	222,004	232,237	260,086	247,887
5	215,615	206,333	226,437	251,353	245,870
Total Grades 3-5	632,414	653,287	691,028	762,877	726,903
Total Cases by Test					
Reading 3rd	106,496	110,446	112,944	112,763	111,577
Reading 4th	98,776	108,222	109,812	112,694	113,235
Reading 5th	106,233	100,702	107,323	109,362	112,849
Math 3rd	107,749	110,968	113,534	113,471	111,561
Math 4th	99,605	108,708	110,306	113,373	113,206
Math 5th	107,155	101,154	107,847	110,002	112,825
Alternate Reading 3rd	1,063	1,212	1,214	1,264	1,247
Alternate Reading 4th	1,015	1,106	1,230	1,273	1,244
Alternate Reading 5th	1,112	1,121	1,159	1,287	1,297
Alternate Math 3rd	1,064	1,212	1,215	1,226	1,244
Alternate Math 4th	1,016	1,107	1,230	1,242	1,244
Alternate Math 5th	1,113	1,122	1,160	1,262	1,295
Total Cases	623,397	647,080	668,974	679,219	682,824

In order to conduct a matching analysis, the data for the specific grade and subject test was merged with the third-grade matching subject test, as the matching was based on the third-grade scores and demographics. This attached each student's third grade scores and demographics to their case. If there was no matching third-grade data for a student, that case was removed from the database, as there was no data to create the match. Students in schools that did

not have full-time certified school librarians were matched to students in schools with full-time certified school librarians based on third grade English/language arts or mathematics scores and demographics of gender, age, ethnicities, disability status, English language learners, economically disadvantaged status, geographic locale (rural, town, suburb, city), and school district (see Figure 3). Very few of the nearest neighbor matches are exact matches, though all matches are made within a caliper of 0.25 of a standard deviation of the sample estimated propensity scores. Out of the 32 analyses, only seven included exact matches between one exact match and three exact matches, all others were close matches within the 0.25 caliper. The fifth grade reading test in spring 2016 had one exact match, the fifth grade mathematics tests in spring 2017 had one exact match and spring 2018 had two exact matches. The fourth grade reading test in spring 2018 had three exact matches, and the fourth grade mathematics in spring 2016 and spring 2017 each had one exact match. From the second research question, the mathematics dataset that gained a full-time school librarian had two exact matches. Each of the matching variables create points toward the propensity matching score. Two of the eight variables, have four possibilities as the software will only process binary yes/no variables, leaving ethnicity split into four ethnicities (Asian, black, Hispanic, an white), and locale into four subsets (rural, town, suburbs, and city). That results in 14 separate points for each case as they are matched.

The first research question used eight datasets for each school year. In the first two datasets, one set for fifth grade students' reading EOG achievement, and the other set for their mathematics achievement, where scores are the dependent variable, and library staffing with or without a full-time certified school librarian the independent variable. In the second this was repeated using fourth grade students' achievement scores in reading and mathematics. North Carolina schools also use alternate tests for reading and mathematics for some students. The

alternate tests are given to students with significant cognitive disabilities, whose instruction is based on the North Carolina Extended Content Standards. These students require "extensive and repeated individualized instruction and support to make meaningful gains" (NC DPI, 2019). I chose to include the alternate testing scores in my study of school librarian impact, because school librarians work with all students in the school and have an opportunity to impact all students. These alternate tests at fourth and fifth grade account for the other four datasets. Analysis was conducted for fourth grade reading and mathematics achievement for each school year between 2014-2015 through 2017-2018, with each analyzed separately. The fifth-grade achievement tests were analyzed for each school year from 2015-2016 through 2017-2018. There was no matching third grade data available for 2012-2013 to create the matched data for the 2014-2015 fifth grade students, no analysis was possible and fifth grade was excluded in 2014-2015.

For the second research question, the dependent variable was the difference between reading scores of fifth grade students immediately before the library staffing change and the scores two years after the change. The independent variable was one of two conditions. I split the list of schools with staffing changes, one list for schools that did not have a full-time certified school librarian over a two-year period, then added a full-time certified school librarian over the next two-year period, this included six schools. The second list contained the schools staffing change that had a full-time certified school librarian over a two-year period, then lost the full-time certified school librarian over the next two years, including 19 schools. Again, all non-standard public schools and cases with missing data or duplicates were removed from the datasets. I analyzed the survey data to determine changes in library staffing after two consecutive years of the first treatment, followed by two consecutive years with the change in staffing.

Students in fifth grade before the change were matched to fifth grade students in the same school two years after the change. The first group of datasets were students in 6 schools without a full-time certified school librarian for two years, immediately followed by two years with a full-time certified school librarian. The second group of datasets were students in nineteen schools with a full-time certified school librarian for two years, immediately followed by two years without a full-time certified school librarian.

I began statistical analysis with a *t*-test comparison of achievement scores of treatment subjects (students with full-time certified school librarians) to those of the matched control subjects (students without full-time certified school librarians). Since there was a statistically significant difference between the treatment and control groups in each of the EOG reading and mathematics *t*-test analyses responding to the first research question, an analysis of covariance (ANCOVA) was administered for each of the analyses from all but those from the 2013-2014 school year. There was no available covariate data available. The achievement tests from 2014-2015 to 2017-2018 were included in one-way ANCOVA analyses, testing covariates of the number of book titles in school libraries, the average copyright ages of resources (including fiction and non-fiction items) in the catalogs of the school libraries, and the average weekly circulations in the school libraries, to determine if other factors contribute to the results (Greenberg, 1953).

Limitations

There are several limitations to this study. There is an expectation that North Carolina public schools have full-time certified school librarians in their schools. Unfortunately, the data from this study does not include analyses of exactly what school librarians do that makes the difference. Certified school librarians have received training to make them effective educators

and leaders through the various roles of the school librarian, and preparation to make them experts in information literacy. The *National School Library Standards for Learners, School librarian, and School Libraries* were developed to provide the foundation from which the school librarian works (2018b). A key assumption is that these school librarians lead from the middle (AASL & AECT, 1998, p. 53) through collaborative teaching, integrating technology, and professional development (DiScala & Subramaniam, 2011) with knowledge of the school-wide curriculum, incorporating horizontal (across subjects) and vertical (across grade-levels) integration of learning.

Schools in Charlotte have been allowed to substitute reading and other specialists for school librarians' positions (Helms, 2015). The staffing surveys do not reveal changes that happen mid-year such as a full-time certified school librarian leaving their position mid-year. School librarians nearing retirement may not be as current on school library practices promoted in the standards as newer school librarians. More information would be required to determine if any of these factors affect the results.

Students change schools, and the students may have changed to a different staffing model between when they were in third grade and the grade of the analysis, so the matching might not actually reflect comparison of students with different staffing. Students who have changed schools may have experienced both having a full-time certified school librarian and not having a full-time certified school librarian when moving between schools during third and fourth or fifth grade, which may affect the quality of the match.

Matching itself may also provide limitations, as the majority of the matches were not exact, leaving some level of variation in the matched pairs, though variation should be small because of the caliper restricting the size of differences. The loss of many cases due to lack of

matches may also cause missed opportunity for the cases that are at the extremes of the distributions to provide evidence. Despite the matching based on multiple demographics and data, there may also be other confounding variables unidentified.

Summary

This study was undertaken to determine whether full-time certified school librarians have an impact on student achievement. This research design used matching of individual students that had a full-time certified school librarian and students that did not have a full-time certified school librarian, followed by analysis comparing the achievement scores to see if the presence of a full-time certified school librarian impacted student achievement. Survey data on all public schools in North Carolina was used to identify the school librarian staffing. The impact of school librarians was measured through EOG scores on the fourth and fifth grade reading and mathematics assessments. The next chapter will provide the results of the data analysis.

CHAPTER IV

RESULTS

As stated in Chapter I, this study was conducted to determine if the presence in an elementary school of a full-time certified school librarian impacts student achievement on English Language arts and/or mathematics achievement tests. The actual test for English language arts is the EOG reading test, which is aligned with the English language arts standards (NC DPI, 2020b). This chapter is organized in order of the two research questions posed in Chapter I. Research question one will be presented by test, rather than the order of the sub-questions to allow a full discussion of subject. They will be shown in order of reading, mathematics, alternative reading, and alternative mathematics. Within each, fifth grade will be reported first, then fourth grade. The reporting of the second research question will begin with the results of the analyses of the schools that gained full-time school librarians, followed by the analyses of the schools that lost full-time certified school librarians. Finally, will be reporting of the one-way ANCOVA analyses of the statistically significant EOG reading and mathematics tests to determine if covariates were influencing the students' scores as related to whether there was a full-time certified school librarian or not.

Matching

Matching of students was conducted using SPSS version 25 with the Fuzzy add-on using nearest neighbor matching with a caliper of 0.25. The number of schools included changes for various reasons, such as opening of new schools and closing of other schools each year. The numbers of schools in the analyses here may change due to the data requirements that caused the removal of cases from an individual analysis, including no third-grade data to add to specific cases in the primary database being matched. For the 2017-2018 reading test there were 75,117

cases available from 1,300 schools for matching that were entered into the software. These cases included 64,010 students who had a full-time certified school librarian in their school, and 11,107 students in schools without a full-time certified school librarian. This means that there could only be 11,107 pairs of students matched, leaving 52,903 cases that were not matched and dropped out of database that was used in the independent samples *t*-test analysis.

Table 4

Propensity Score Matching, 5th Grade Reading Tests

	2016	2017	2018
Schools	1,216	1,204	1,228
Schools FTCSL	1,002	1,018	1,002
Schools No FTCSL	214	196	226
Cases Available	69,616	72,500	75,117
FTCSL cases	59,311	62,979	64,010
No FTCSL cases	10,305	9,521	11,107
No Match cases	49,006	53,477	52,903
Matched Pairs	10,305	9,502	11,107
Cases for Analysis	20,610	19,004	22,214

Note. FTCSL = Full-Time Certified School Librarian

Table 4 is an example of the data counts for the fifth grade reading test (see also Appendix C). The numbers are similar on the fourth grade reading tests and the fourth and fifth grade mathematics tests. The number of schools ranged from 1,103 on the 2015 fourth grade reading test to 1,302 schools on the 2018 fourth grade mathematics test. The alternate reading and mathematics test were much smaller, with a range of 103 schools on the 2015 fourth grade reading test to 200 on the 2016 fourth grade reading test. The cases used in matching pairs

ranged from 69,616 on the 2016 fifth grade reading test to 90,357 cases on the 2018 fourth grade mathematics test. The alternate reading and mathematics test cases ranged from 499 on the 2016 fifth grade alternate mathematics tests and 723 cases on the 2018 fourth grade alternate reading test. The numbers of school librarians are similar to those on Table 4 for fourth and fifth grade reading and mathematics databases and proportionately similar on the alternate tests (see Appendix C).

Independent Samples *t*-Test

Testing Assumptions

In undertaking a statistical analysis, it is important to address the assumptions that are related to the specific statistical test. I was using an independent samples *t*-test for the analyses of each of the 32 databases. For this statistical test there are six assumptions. The first three are having a continuous dependent variable, a categorical independent variable with two groups, and independence of observations. I met all of those assumptions as achievement scores are continuous variables, and school librarians are a categorical variable with groups which either had a full-time certified school librarian or did not have a full-time certified school librarian. There is no relationship between the two groups, as each group has different participants, meeting the assumption of independence of observations. All outliers outside the bounds of plus or minus three standard deviations were removed from the database used to find the matches and the match process was run again. All of the analyses were approximately normally distributed because they were all large enough to meet the requirement of the Central Limit Theorem (Field, 2013), with the smallest analysis containing 190 cases. The homogeneity of variance was violated on six of the analyses and the Welch *t*-test was used to determine analysis results on those tests.

Research Question 1

The following results were generated in answer to the first research question: To what extent does the presence of full-time certified school librarians in elementary schools impact students' end-of-year state achievement tests compared to similar students in elementary schools without full-time certified school librarians, based on the following grade level and subject area scores?

Reading Tests

There were three years of data for fifth grade reading tests analyzed. In the EOG 2016 reading tests there were 10,305 pairs, totaling 20,610 cases. Homogeneity of variances were violated, as assessed by Levene's test for equality of variance (p = .018), so the Welch t-test was used. The students in the schools with full-time certified school librarians had higher scores (M = 451.19, SD =9.49) than students in schools without full-time certified school librarians (M = 449.52, SD = 9.58), with a statistically significant difference M = 1.67, 95% CI [1.41, 1.93], t(20606.124) = 12.566, p < .001, Cohen's effect size of d = .18. The EOG 2017 reading tests had 19,004 cases, with 9,502 matched pairs, and met homogeneity of variances with Levene's test result of p = .574. The students in schools with full-time certified school librarians had higher reading test scores (M = 450.65, SD = 9.89) compared to the students in schools without school librarians (M = 449.67, SD = 9.88), with a statistically significant mean difference, M = 0.98, 95% CI [0.70, 1.26], t(19002) = 6.832, p < .001), Cohen's effect size d = .10. The EOG 2018 reading tests had 22,214 cases with 11,107 matched pairs, and met homogeneity as assessed by Levene's test for homogeneity (p = .050). Results again found that students at schools with full-time certified school librarians scored higher (M = 450.00, SD = 10.09) than students in schools without full-time certified school librarians (M = 448.69, SD =

10.16) with a statistically significant difference of M =1.31, 95% CI [1.04, 1.57], t(22212) = 9.623, $p < .001$, Cohen's effect size of d = .13 (see Table Appendix B1).

The fourth grade reading test score means are a little lower than the fifth grade score means, but they produced similar results. There were four school years of data to analyze for this grade level, as the third-grade data was available from the 2013-2014 school year. The data for all four years met the requirement for homogeneity of variances, showing each year's groups variances were equal in the population. The score means for the students with full-time certified school librarians were higher than the means of the students without full-time certified school librarians all four years. The 2015 EOG reading tests had 10,430 cases, with 5,215 pairs for the analysis. Homogeneity of variances was attained as assessed by the Levene's test was p = .286. In the results using the 2015 reading test, the students in schools with full-time certified school librarians higher scores mean (M = 446.65, SD = 9.59) than the students in schools without full-time certified school librarians (M = 444.92, SD = *9.66*) with a statistically significant difference M = 1.73, 95% CI [1.36, 2.10], t(10428) = 9.167, $p < 001$, with Cohen's effect size d = .18. With a larger database, the 2016 EOG reading test scores included 26,564 cases, with 13,282 matched pairs. Homogeneity of variances was met with Levene's test at p = .360. The students with full-time certified school librarians had reading scores (M =446.49, SD = 10.19) higher than the students without full-time certified school librarians (M = 444.54, SD = 10.11), with a statistically significant difference in mean, M = 1.95, 95% CI [1.71, 2.20], t(26562) = 15.667, $p <$ .001, with Cohen's effect size at d = .19. In 2017, the fourth grade reading test included 24,464 cases with 12,232 matched pairs, with homogeneity of variances met as assessed using Levene's test, providing a result of p = .868. The students in schools with full-time certified school librarians again scored higher on the reading test (M = 445.97, SD = 10.41) than students without

full-time certified school librarians (M = 444.54, SD = 10.32), statistically significant with a difference in mean, M = 1.44, 95% CI [1.18, 1.70], t(24462) = 10.855, $p < .001$, with a Cohen's effect size of d = .13. The 2018 reading test had 26,638 cases, with 13,319 matched pairs, and met homogeneity of variances with a Levene's result of p = .632. The students in schools with full-time certified school librarians scored higher (M = 445.70, SD = 10.53) than students in schools without full-time certified school librarians (M = 444.73, SD = 10.47), with a statistically significant difference of mean, M = 0.97, 95% CI [0.72, 1.22], t(26636) = 7.548, $p < .001$, and with a Cohen's effect size d = .09, (see Table Appendix B2).

Mathematics Tests

Like the reading tests, there were three years of data available for the fifth grade analysis. In the EOG mathematics tests for 2016 there were 20,774 cases, with 10,387 matched pairs. This data did not meet Levene's homogeneity of variances (p = .003) so the Welch test was used. The students in schools with full-time certified school librarians had higher scores (M = 452.24, SD = 9.95) than the students in schools without full-time certified school librarians (M = 450.73, SD = 9.67), with a statistically significant difference in mean, M =1.50, 95% CI [1.24, 1.78], t(20755.398) = 11.046, $p < .001$, and Cohen's effect size of d = .15. In the 2017 EOG mathematics test there were 19,068 cases and 9,534 matched pairs, and the homogeneity of variances were met, with Levene's test at p = .691. The students at schools with full-time certified school librarians scored higher (M = 451.69, SD = 9.93) than the students without full-time certified school librarians (M = 450.70, SD = 9.95) with a statistically significant difference of mean, M = 0.99, 95% CI [0.71, 1.28], t(19066) = 6.905, $p < .001$, and a Cohen's effect size of d = .10. The 2018 mathematics tests included 22,288 cases that resulted in 11,144 matched pairs. This data did not meet Levene's homogeneity of variance, p = .006, so the Welch's test was used

for the analysis. The students with full-time certified school librarians scored higher on the mathematics test (M = 451.59, SD = 10.02) than the students in schools without full-time certified school librarians (M = 450.59, SD = 10.18) with statistically significant difference of mean, M = 1.00, 95% CI [0.73, 1.26], t(22280.314) = 7.361, $p < .001$, with a Cohen's effect size of d =*.10* (see Table Appendix B3*).*

The fourth grade results were again slightly lower than the fifth grade results. The 2015 EOG mathematics test had 10,546 cases making 5,273 matched pairs. The homogeneity of variances was not met with a Levene's test result of p = .004, so Welch's test was used. The students in schools with full-time certified school librarians had higher scores on the mathematics test (M = 450.80, SD = 9.94) than students in schools that did not have full-time certified school librarians (M = 448.38, SD = 9.54) with a statistically significant difference of mean, M = 2.43, 95% CI [2.05, 2.80], t(10526.218) = 12.778, $p < .001$, with a Cohen's effect size of d = .25. The 2016 EOG mathematics test had 26,710 cases resulting in 13,355 matched pairs. This database met homogeneity of variances with a Levene's test result of p = .480. The students in schools with full-time certified school librarians had higher mathematics scores (M = 450.65, SD = 9.99) than students in schools without full-time certified school librarians (M = 448.92, SD = 9.84), with a statistically significant difference in mean, M = 1.73, 95% CI [1.49, 1.97], t(26708) = 14.247, $p < .001$, and a Cohen's effect size of d = .17. On the 2017 EOG mathematics test there were 24,554 cases and 12.277 matched pairs that met homogeneity of variances with a Levene's test result of p = .639. The students in schools with full-time certified school librarians had higher scores on the mathematics test (M = 450.36, SD = 10.09) than the students without full-time certified school librarians (M = 449.59, SD = 10.05) resulting in a statistically significant difference, M = 0.77, 95% CI [0.52, 1.03], t(24552) = 6.014, $p < .001$, and

a Cohen's effect size of d = .08. The 2018 EOG mathematics database had 26,810, resulting in 13,405 matched pairs. Homogeneity of variances was met as Levene's test results were p = .116. The students in schools with full-time certified school librarians again had higher scores (M = 450.58, SD = 10.15) than students in schools without full-time certified school librarians (M =449.72, SD = 10.03), with a difference of mean, M = 0.86, 95% CI [0.61, 1.10], t(26808) = 6.939, p < .001, and a Cohen's effect size of d = .09 (see table Appendix B4).

Alternate Reading Tests

North Carolina students with disabilities who meet requirements can take an alternate reading test (NC DPI, 2020b). The alternate tests are given to students with significant cognitive disabilities, whose instruction is based on the North Carolina Extended Content Standards. These students require "extensive and repeated individualized instruction and support to make meaningful gains" (NC DPI, 2019). The number of students taking the alternate reading test is much smaller than the regular reading test. The 2016 fifth grade alternate reading test had 250 cases and 125 matched pairs. Homogeneity of variances was achieved, with Levene's test result p = .908. The students in schools with full-time certified school librarians had higher scores (M = 20.72¸ SD = 6.12) than students in schools without full-time certified school librarians (M =18.67, SD = 6.67) with statistically significant mean difference, M = 2.05, 95% CI [0.45, 3.64], t(248) = 2.528, p = .012, and a Cohen's effect size d = .32. The 2017 cohort taking the alternate reading test was 256 cases, making up 128 matched pairs. The results of the 2017 alternate reading test introduce a difference in the pattern that has been established with the test results to this point. Homogeneity of variances was met with Levene's test at p = .402. In this test the students with full-time certified school librarians scores (M = 20.15, SD = 5.12) failed to show significance in comparison to the students without full-time certified school librarians (M =

20.70, *SD* = 5.44), and the difference in the mean is *not* statistically significant, *M* = 0.55, 95% CI [-1.85, 0.75], *t*(254) = 0.829, *p* = .408, with a Cohen's effect size *d* = .10. The 2018 alternate reading test includes 254 cases, making up 127 cases. Homogeneity of variances was again established, with Levene's test resulting in *p* = .303. The students in schools with full-time certified school librarians scored higher (*M* = 20.85, *SD* = 5.43) than students in schools without full-time certified school librarians (*M* =18.76, *SD* = 6.03), with a statistically significant difference in the mean, *M* = 2.09, 95% CI [0.68, 3.51], *t*(252) = 2.909, *p* = .004, Cohen's effect size is *d* = .36 (see Table Appendix B5).

The fourth grade alternate reading test had results similar to the fifth grade version. The fourth grade 2015 alternate reading test had 170 cases and 85 matched pairs. Homogeneity of variances was achieved with Levene's test result *p* = .956. The students in schools with full-time certified school librarians scored higher (*M* = 20.72, *SD* = 5.28) than students in schools without full-time certified school librarians (*M* = 17.61, *SD* = 6.01) with a statistically significant difference in the mean, *M* = 3.11, 95% CI [1,39, 4.82], *t*(168) = 3.579, *p* < .001, with a Cohen's effect size *d* = .55. The 2016 test had 312 cases and 156 matched pairs. Homogeneity of variance was confirmed with a Levene's test at *p* = .671. The students in schools with full-time certified school librarians scores (*M* = 20.49, *SD* = 5.34) failed to show significance in comparison to scores of students in schools without school librarians (*M* = 20.15, *SD* = 5.35), with a non-significant mean difference of *M* = .34, 95% CI [-0.85, 1.53], *t*(310) = .562, *p* = .575, with a Cohen's effect size *d* = .06. The 2017 database had 286 cases and 143 matched pairs. Homogeneity of variances was confirmed with Levene's test at *p* = .097. The students in schools with full-time certified school librarians scored higher (*M* = 20.62, *SD* = 5.55) than the students without full-time certified school librarians (*M* = 18.69, *SD* = 6.60), with a statistically

significant mean difference, M = 1.93, 95% CI [0.51, 3.35], $t(284) = 2.678$, p = .008, and Cohen's effect size d = .32. The 2018 fourth grade alternate test had 290 cases and 145 matched pairs, meeting homogeneity of variances with Levene's p = .462. The students in schools with full-time certified school librarians scores (M = 20.12, SD = 6.18) failed to show significance compared to the scores of students without full-time certified school librarians (M = 19.14, SD = 6.37), with a non-significant mean difference of M = .99, 95% CI [-0.46, 2.44], $t(288) = 1.339$, p = .182, and Cohen's d = .16 (see Table Appendix B6).

Alternate Mathematics Tests

Like the alternate reading test, the NC DPI has provided an alternate mathematics test for students who meet requirements in place of the EOG mathematics. From the 2016 fifth grade alternate test database, 240 cases were used to make 120 matched pairs for analysis. As homogeneity of variances was not met, with Levene's test results showing p =.004, the analysis was continued using Welch's test. The students in the schools with full-time certified school librarians scores (M = 19.41, SD = 4.98) failed to show significance in comparison to the students without full-time certified school librarians (M =19.13, SD = 3.99), with a mean difference large of M = 0.28, 95% CI [-0.87, 1.42], $t(227.058) = 0.472$, p =.637, with Cohen's effect size d = .06. In the 2017 alternate mathematics test there were 256 cases with 128 matched pairs. Homogeneity of variances was confirmed with Levene's test, M =.395. The students in the schools with full-time certified school librarians scores (M =19.21, SD = 4.54) failed to show significance in comparison to scores of students without full-time certified school librarians (M = 19.06, SD = 4.94), with mean difference M = .15, 95% CI [-1.02, 1.32], $t(254) = .250$, p = .80, with Cohen's effect size d = .03. The 2018 database of the alternate mathematics scores provided 252 cases and 126 matched pairs. Homogeneity of variances were confirmed with Levene's test

results, p = .755. Again, the students in the schools with full-time certified school librarians scores (M = 18.86, SD = 4.88) failed to show significance in comparison to scores of students without full-time certified school librarians (M = 17.87, SD = 4.81), with a mean difference M = .98, 95% CI [-0.22, 2.19], t(250) = 1.613, p = .108, Cohen's effect size is d = .20 (see Table Appendix B7).

The 2015 fourth grade alternate mathematics database had 170 cases and 85 matched pairs. Homogeneity of variances was achieved, evident with Levene's test results, p = .633. The students in the schools with full-time certified school librarians scored higher (M = 18.62, SD = 5.14) than students without full-time certified school librarians (M = *16.62, SD* = 5.35), with statistically significant difference of mean, M = 2.00, 95% CI [0.41, 3.59], t(168) = 2.486, p = .014, and Cohen's effect size d = .38. The 2016 data provided 308 cases with 154 matched pairs. Homogeneity of variances was achieved with Levene's test p = .174. The students in the schools with full-time certified school librarians scores (M = 19.78, SD = 5.21) failed to show significance to scores of students without full-time certified school librarians (M = 19.06, SD = 4.94), with mean difference M = 0.72, 95% CI [-0.42, 1.86], t(306) = 1.246, p = .214, and Cohen's effect size d =14. In the 2017 fourth grade data, there were 286 cases with 143 matched pairs. Homogeneity of variances was again achieved, with Levene's test at p = .953. The students in the schools with full-time certified school librarians scored (M = 18.74, SD = 5.70) failed to show significance in comparison to the scores of students without full-time certified school librarians (M =17.64, SD = 6.16), with a mean difference of M = 1.105, 95% CI [-0.28, 2.49], t(284) = 1.575, p = .116, with Cohen's effect size d = .19. In the 2018 fourth grade alternate mathematics database there were 288 cases with 144 matched pairs. Homogeneity of variances was again achieved, with Levene's p = .116. The scores of students in the schools with full-time

certified school librarians (M = 19.70, SD = 5.42) failed to show significance in comparison to students without full-time certified school librarians (M = 18.64, SD – 5.00), with a mean difference M = 1.06, 95% CI [-0.15, 2.27], $t(286) = 1.730$, p =.085, and Cohen's effect size, d = .20 (see Table Appendix B8).

Research Question 2

The following results were generated in response to the second research question: To what extent does the presence of full-time certified school librarians in elementary schools impact students' end-of-year state achievement tests compared to similar students in elementary schools without full-time certified school librarians, based on changes in school librarian staffing after two years, either adding or losing a full-time certified school librarian?

Gain of School Librarian

This EOG reading achievement database is made up of students in six schools that did not have a full-time certified school librarian during the 2013-2014 and 2015-2016 school years. There was then a full-time certified school librarian added to the schools during the 2016-2017 and 2017-2018 school years. This research was used to ascertain whether the change in staffing would change students' achievement score. The 2018 EOG reading achievement test was used to evaluate the impact, matching 2015-2016 students to 2017-2018 students and determining the difference in their scores. There were 604 cases and 302 matched pairs coming from six schools. Homogeneity of variances was established with Levene's test, M = .173. The 2017-2018 scores of students in schools with added full-time certified school librarians (M = 448.95, SD = 9.13) failed to show significance compared to the 2015-2016 scores of students that did not have full-time certified school librarians (M = 449.35, SD = 9.84). The difference in means was not

significant, M = - 0.39, 95% CI [-1.91, 1.12], $t(602) = -0.510$, $p = .610$, Cohen's effect size is d = .04.

This EOG mathematics achievement database also is assessing the change in staffing through the gain of a full-time certified school librarian at six schools, using the same school years as used with the reading achievement scores. The mathematics database included 600 cases with 300 matched pairs from six schools. Homogeneity of variances was achieved, with Levene's test at $p = .303$. The scores of 2017-2018 students in schools with full-time certified school librarians (M = 450.13, SD = 8.71) failed to show significance in comparison to scores of 2015-2016 students that did not have full-time certified school librarian (M = 449.80, SD = 9.04), with a mean difference of 0.65, 95% CI [-1.10, 1.75], $t(598) = 0.451$, $p = .652$, with Cohen's effect size d = .05 (see Table Appendix B9).

Loss of a School Librarian

This EOG reading achievement database is made up of students in 19 schools that had a full-time certified school librarian during the 2013-2014 and 2015-2016 school years. There was then a loss of a full-time certified school librarian in these schools during the 2016-2017 and 2017-2018 school years. The number of cases was 2,190, with 1,095 matched pairs out of 19 schools. Homogeneity of variances was established with Levene's test result of $p = .100$. The 2015-2016 students with full-time certified school librarians scored higher (M = 452.47, SD = 9.39) than the 2017-2018 students without a full-time certified school librarian (M = 451.60, SD = 9.92), with a statistically significant difference of 0.87, 95% CI [0.06, 1.68], $t(2188) = 2.109$, p = .035, with Cohen's effect size d = .09.

This EOG mathematics achievement database contains scores for students that had a full-time certified school librarian during the 2013-2014 and 2015-2016 school years. There was then

a loss of a full-time certified school librarian in the 19 schools during the 2016-2017 and 2017-2018 school years. There are 2,316 cases and 1,158 matched pairs from 19 schools. Homogeneity of variances was achieved with Levene's test $p = .123$. The 2015-2016 scores of students with full-time certified school librarians ($M = 453.77$, $SD = 10.84$) failed to show significance in comparison to the 2017-2018 scores of students without a full-time certified school librarian ($M = 452.93$, $SD = 10.60$), with a non-significant mean difference of 0.085, 95% CI [-0.03, 1.72], $t(2314) = 1.900$, $p = .058$ Cohen's $d = .25$. (see Table Appendix B10).

Covariate Analyses

Assumptions

The one-way ANCOVA analyses included 10 assumptions. The first two are, again, having a continuous dependent variable and a categorical independent variable with two groups, Each analysis can include one covariate, measured at the continuous level, and all of the variables must have independence of observations. Linearity, a linear relationship between the covariate and dependent variable for each level of the independent variable (Lund Research, 2018), was observed from reviewing graphs of the dependent, independent, and covariate variables for each of the analyses. The assumption homogeneity of regression slopes, the regression lines in the graph created to gauge linearity must be parallel to indicate there is no interaction between the covariate and independent variable, is also determined when $p > .05$ (Lund Research, 2018). The assumptions of linearity and of homogeneity of slopes must be affirmed; if not, the analysis is not viable. I will address these assumptions as I report the ANCOVA analyses. The ANCOVA analyses also fall under the Central Limit Theorem in determining normality, as their large sizes allow them to approximate normal data as the smallest database had 776 cases.

ANCOVA Analyses

The results of the EOG reading and mathematics analyses in Research Question 1 included data from seven achievements tests across three years and two grades, that were analyzed across two subjects with statistically significant results. Research Question 2 had one reading test that also had one statistically significant result. All 15 of these analyses were assessed with three covariates provided on the DLMI (NC DPI, 2020a): the number of book titles in the schools libraries, the average copyright ages of resources (including fiction and non-fiction items) in the catalogs of the school libraries, and the average weekly circulations in the school libraries. This resulted in conducting 45 one-way ANCOVA analyses. There were 33 that did not meet the linearity and homogeneity of regression slopes assumptions and were removed from analysis. That left 12 available for a complete analysis. Five of the analyses were with the covariate of number of book titles in the libraries, six for the covariate of average copyright ages of the ages, and one analysis of the covariate of average weekly circulations in the school libraries. All of these remaining met the assumptions of linearity and homogeneity of regression slopes.

The number of book titles in the library were covariate to the impact of full-time certified school librarians on 2018 EOG reading and mathematics scores, in both fourth grade and fifth grade. This covariate was also related to the reading scores of students in schools that had full-time certified school librarians before they lost full-time certified school librarian midway in a four year period, with cohorts of 2018 and 2016. The first dataset analyzed was the fifth grade reading achievement scores tested in spring 2018. There was homogeneity of regression slopes as the interaction of the number of book titles and the librarian staffing (full-time certified school librarian or no full-time certified school librarian), were not statically significant, $F(1, 22209) =$

1.966, $p = .161$ Homoscedasticity was confirmed visually with a scatterplot, Levene's test of homogeneity of variance ($p = .054$) was met, and there were no outliers. The covariate, number of book titles, was significantly related to the staffing of full-time certified school librarians ($F(1, 22210) = 87.409$, $p < .001$, partial $\eta^2 = .004$. Post hoc analysis was performed with a Bonferroni adjustment. The number of book titles in the library significantly related to reading achievement scores of staffing full-time certified school librarians (M_{diff} =1.279, 95% CI [1.01, 1.55], $p < .001$; see also Table 5).

Table 5

Covariate: Number of Book Titles, Mean Effect for 2018 Reading Scores, Fifth Grade

		Unadjusted		Adjusted	
	N	M	SD	M	SE
FTCSL	11,107	450.00	10.09	449.99	0.10
No FTCSL	11,106	448.69	10.16	448.81	0.10

Note: N – number of participants, *M* = Mean, *SD* = Standard Deviation, *SE* = Standard Error, FTCSL = Full-Time Certified School Librarian, No FTCSL = No Full-Time Certified School Librarian.

The second dataset is fourth grade reading achievement scores tested in spring 2018. There was homogeneity of regression slopes as the interaction of the number of book titles and the librarian staffing (full-time certified school librarian or no full-time certified school librarian), were not statistically significant, $F(1, 26632) = 2.106$, $p = .147$. There were two outliers in this dataset. I winsorized by changing them to the next lowest score, two numbers

lower, which was within three standard deviations (Field, 2013). The data were run again after the adjustment. There was homoscedasticity determined by visual inspection of a scatterplot, and Levene's test of homogeneity of variances was met (p = .659). The covariate, number of book titles in the library, was significantly related to the staffing of full-time certified school librarians $F(1, 26633) = 47.783$, $p < .001$, partial $\eta^2 = .002$. Post hoc analysis was performed with a Bonferroni adjustment. The number of book titles in the library statistically significantly reflected on reading achievement scores in schools staffing of full-time certified school librarians ($M_{diff} = .897$, 95% CI [0.64, 1.15], $p < .001$; see also Table 6).

Table 6

Covariate: Number of Book Titles, Mean Effect for 2018 Reading Scores, Fourth Grade

		Unadjusted		Adjusted	
	N	M	SD	M	SE
FTCSL	13,319	445.70	10.53	445.66	0.10
No FTCSL	13,317	444.73	10.47	444.76	0.10

Note: N – number of participants, *M* = Mean, *SD* = Standard Deviation, *SE* = Standard Error, FTCSL = Full-Time Certified School Librarian, No FTCSL = No Full-Time Certified School Librarian.

The next two datasets are also from the 2017-2018 school year, but these are EOG mathematics achievement scores. The first is fifth grade scores, and again the covariate is the number of titles in the school library. The homogeneity of regression slopes was not significant, $F(1, 22283) = 2.139$, p = .144. Levene's test of homogeneity of variances was violated (p =.005). I reviewed the skewness of both the full-time certified school librarian group, with a skew value

of -0.220, and the no full-time certified school librarian group, with a skew value of -.126, then calculated the variance ratio as 1.75. As the values are practically equal, I continued the analysis as suggested by Field (2013). Homoscedasticity was determined by viewing a scatterplot and the assumption was met. The covariate, number of book titles in the library, was significantly related to the staffing of full-time certified school librarians, $F(1, 22284) = 48.045$, $p < .001$, partial $\eta^2 = .002$. A Bonferroni adjustment was used to perform the post hoc analysis. The number of book titles in the library significantly affected the mathematics achievement scores as related to staffing of full-time certified school librarians ($M_{diff} = .946$, 95% CI [0.68, 1.21], $p < .001$; see also Table 7).

Table 7

Covariate: Number of Book Titles, Mean Effect for 2018 Math Scores, Fifth Grade

		Unadjusted		Adjusted	
	N	M	SD	M	SE
FTCSL	11,144	451.59	10.02	451.56	0.10
No FTCSL	11,143	450.59	10.18	450.62	0.10

Note: N – number of participants, *M* = Mean, *SD* = Standard Deviation, *SE* = Standard Error, FTCSL = Full-Time Certified School Librarian, No FTCSL = No Full-Time Certified School Librarian.

The next dataset is the EOG 2017-2018 mathematics achievement scores for fourth grade students. Homogeneity of regression slopes was met, $F(1, 26804) = 0.037$, $p = .847$. Levene's test of homogeneity of variances was also met ($p = .122$). Homoscedasticity was visually reviewed, the scatterplot met assumptions, and there were no outliers in the data. The covariate

remains the number of book titles in the library and is significant in relation to the staffing of full-time certified school librarians $F(1, 26805) = 38.608$, $p < .001$, partial $\eta^2 = .001$. A post hoc analysis was performed using a Bonferroni adjustment. The fourth grade mathematics achievement scores in schools with staffing of a full-time certified school librarians is higher ($M_{diff} = .772$, 95% CI [0.53, 1.02], $p < .001$; see also Table 8).

Table 8

Covariate: Number of Book Titles, Mean Effect for 2018 Math Scores, Fourth Grade

		Unadjusted		Adjusted	
	N	M	SD	M	SE
FTCSL	13,405	450.58	10.15	450.54	0.09
No FTCSL	13,403	449.72	10.02	449.76	0.09

Note: N – number of participants, *M* = Mean, *SD* = Standard Deviation, *SE* = Standard Error, FTCSL = Full-Time Certified School Librarian, No FTCSL = No Full-Time Certified School Librarian.

The next dataset is from Research Question 2. These are the EOG reading achievement scores for schools who had a full-time certified school librarian in 2014-2015 to 2015-2016 and then lost their librarians. The next two years, 2016-2017 to 2017-2018, they had no school librarian. Homogeneity of regression slopes was met, $F(1, 772) = 0.429$, $p = .513$. Levene's test of homogeneity of variances also met ($p = .083$).The scatterplot indicated the homoscedasticity assumption was also achieved and there are no outliers. The covariate of the number of book titles in the school library again significantly affects the scores in relation to school library staffing of a full-time certified school librarian $F(1, 773) = 4.213$, $p = .040$, partial $\eta^2 = .005$. Post

hoc analysis using a Bonferroni adjustment reflects an effect on the reading scores based on staffing full-time school librarians (M_{diff} = 1.52, 95% CI [0.07, 2.97], p = .040; see also Table 9).

Table 9

Covariate: Number of Book Titles, Mean Effect for 2018 Reading Scores, Loss of Librarian

		Unadjusted		Adjusted	
	N	M	SD	M	SE
FTCSL	388	451.44	9.95	451.42	0.52
No FTCSL	388	449.90	10.61	449.91	0.52

Note: N – number of participants, *M* = Mean, *SD* = Standard Deviation, *SE* = Standard Error, FTCSL = Full-Time Certified School Librarian, No FTCSL = No Full-Time Certified School Librarian.

All but one of the remaining covariate analyses are based on a covariate of the average age library collection (both fiction and non-fiction) books on all topics. The 2016-2017 school year fifth grade EOG reading achievement scores are presented first. Homogeneity of regression slopes was achieved, $F(1, 18999) = 0.465$, $p = .495$. Levene's test of homogeneity of variances was satisfied (p = .588). Homoscedasticity was met through visual review of a scatterplot, and there were not outliers. The covariate, average age of the library collection, is significantly related to the scores based on staffing of full-time certified school librarians $F(1, 19000) = 46.976$, $p < .001$, partial $\eta^2 = .002$, although the means have not changed. Post hoc analysis using a Bonferroni adjustment shows significant differences on the fifth grade reading achievement scores as they relate to the staffing of full-time school librarians (M_{diff} = .983, 95% CI [0.70, 1.26], $p < .001$; see also Table 10).

Table 10

Covariate: Average Collection Age, Mean Effect for 2017 Reading Scores, Fifth Grade

		Unadjusted		Adjusted	
	N	M	SD	M	SE
FTCSL	9,502	450.65	9.89	450.65	0.10
No FTCSL	9,501	449.67	9.88	449.67	0.10

Note: N – number of participants, *M* = Mean, *SD* = Standard Deviation, *SE* = Standard Error, FTCSL = Full-Time Certified School Librarian, No FTCSL = No Full-Time Certified School Librarian.

The dataset of the EOG reading achievement scores from 2016-2017 fourth grade students is also being analyzed using the average collection age as the covariate. The homogeneity of regression slopes meets the assumption, $F(1, 24458) = 2.710$, $p = .100$. Levene's homogeneity of variances ($p = .866$) also meets the assumption. There are no outliers, and homoscedasticity was assessed by visual inspection of the related scatterplot. The covariate, average collection age, is significant in the effect on the reading achievement scores as they interact with the staffing of full-time certified school librarians, $F(1, 24459) = 116.591$, $p < .001$, partial $\eta^2 = .005$, although the means did not change. The post hoc analysis using Bonferroni's adjustment is statistically significant, showing students in schools with full-time certified school librarians score higher than without full-time certified school librarians ($M_{diff} = .1.431$, 95% CI [1.17, 1.69], $p < .001$; see also Table 11).

Table 11

Covariate: Average Collection Age, Mean Effect for 2017 Reading Scores, Fourth Grade

		Unadjusted		Adjusted	
	N	M	SD	M	SE
FTCSL	12,232	445.97	10.41	445.97	0.09
No FTCSL	12,230	444.54	10.32	444.54	0.09

Note: N – number of participants, *M* = Mean, *SD* = Standard Deviation, *SE* = Standard Error, FTCSL = Full-Time Certified School Librarian, No FTCSL = No Full-Time Certified School Librarian.

The last dataset from the 2016-2017 school year is the fourth grade mathematics achievement scores. The homogeneity of the regression slopes was established, $F(1, 24548) = 0.949$, $p = .330$. Levene's homogeneity of variances was met ($p = .645$) and homoscedasticity was evident in a visual review of the related scatterplot. The covariate, average library collection age, is again, statistically significant in relationship with the achievement scores and staffing of full-time certified school librarians, $F(1, 24549) = 34.939$, $p < .001$, partial $\eta^2 = .001$. The post hoc analysis using Bonferroni's adjustment is again statistically significant, showing interaction of student achievement scores based on staffing of full-time certified school librarians, ($M_{diff} = .760$, 95% CI [0.51, 1.01] $p < .001$; see also Table 12).

Table 12

Covariate: Average Collection Age, Mean Effect for 2017 Math Scores, Fourth Grade

		Unadjusted		Adjusted	
	N	M	SD	M	SE
FTCSL	12,277	450.36	10.09	450.35	0.09
No FTCSL	12,275	449.59	10.05	449.59	0.09

Note: N – number of participants, *M* = Mean, *SD* = Standard Deviation, *SE* = Standard Error, FTCSL = Full-Time Certified School Librarian, No FTCSL = No Full-Time Certified School Librarian.

Both of the fourth and fifth grade EOG 2015-2016 reading achievements tests produced scores that were interacting between the covariate, average age of the library collection, and the library staffing. The dataset for fifth grade reading achievement shows homogeneity of regression slopes met the assumptions, $F(1, 20560) = 0.882$, $p = .348$. Levene's homogeneity of variances was violated ($p = .024$). The statistics of the independent variable was reviewed, and both of two groups had the same skewness value of 0.24. Since there is no difference, the analysis was continued. There are no outliers, and homoscedasticity was established by viewing the related scatterplot, which met the assumption. The covariate, average age of the library collection, had a significant interaction with the staffing of full-time certified school librarians, $F(1, 20561) = 153.576$, $p < .001$, partial $\eta^2 = .007$, although the unadjusted and adjusted means stayed the same. Post hoc analysis was accomplished using Bonferroni's adjustment, with statistically significant mean differences ($M_{diff} = 1.647$, 95% CI [1.39, 1.91] $p < .001$; see also Table 13).

Table 13

Covariate: Average Collection Age, Mean Effect for 2016 Reading Scores, Fifth Grade

		Unadjusted		Adjusted	
	N	M	SD	M	SE
FTCSL	10,303	451.19	9.49	451.19	0.09
No FTCSL	10,261	449.54	9.57	449.54	0.09

Note: N – number of participants, *M* = Mean, *SD* = Standard Deviation, *SE* = Standard Error, FTCSL = Full-Time Certified School Librarian, No FTCSL = No Full-Time Certified School Librarian.

The dataset for the fourth grade 2015-2016 EOG reading achievement scores also was analyzed with a covariate of average library collection age. The homogeneity of regression slopes was met, $F(1,26515) = 1.559$, $p = .212$. Levene's homogeneity of variances ($p = .342$) was also met. Homoscedasticity was confirmed visually with a scatterplot, and there were no outliers. The covariate, average age of the library collection, was significant in the interaction with the student achievement scores and the independent variable and the staffing of full-time certified school librarians, $F(1, 26516) = 242.753$, $p < .001$, partial $\eta^2 = .009$. The post hoc analysis used Bonferroni's adjustment resulting in statistically significant differences between the two groups of the independent variable, school library staffing with a full-time certified school librarians or no full-time certified school librarians ($M_{diff} = 1.944$, 95% CI [1.70, 2.189] $p < .001$; see also Table 14).

Table 14

Covariate: Average Collection Age, Mean Effect for 2016 Reading Scores, Fourth Grade

		Unadjusted		Adjusted	
	N	M	SD	M	SE
FTCSL	13,272	446.49	10.19	446.50	0.09
No FTCSL	13,247	444.56	10.11	444.55	0.09

Note: N – number of participants, *M* = Mean, *SD* = Standard Deviation, *SE* = Standard Error, FTCSL = Full-Time Certified School Librarian, No FTCSL = No Full-Time Certified School Librarian.

The next dataset is the 2015-2016 fifth grade EOG mathematics achievement scores. Homogeneity of regression slopes met the assumption of a non-significant result, $F(1, 20179) = 2.801$, $p = .094$. Levene's test of homogeneity of variances was violated ($p = .003$). The skewness values of the independent variable were small for of both groups of the school librarian staffing. The skewness value for the full-time certified school librarian group was -.203, and for the no full-time certified school librarians skewness was -.130, with a variance interval of 1.56. There is very little difference between the two groups, so variance is minimal and the analysis was continued. There are no outliers, and homoscedasticity was established by visual review of the relevant scatterplot. The covariate, average age of the library collection, significantly interacted between the student achievement scores and the staffing of full-time certified school librarians, $F(1, 20720) = 119.331$, $p < .001$, partial $\eta^2 = .006$. Post hoc analysis was performed with a Bonferroni adjustment. The average age of the library collection statistically significantly interacted between mathematics achievement scores and

library staffing full-time certified school librarians (M_{diff} =1.489, 95% CI [1.22, 1.76], p < .001; see also Table 15).

Table 15

Covariate: Average Collection Age, Mean Effect for 2016 Math Scores, Fifth Grade

		Unadjusted		Adjusted	
	N	M	SD	M	SE
FTCSL	10,381	452.24	9.95	452.24	0.10
No FTCSL	10,342	450.75	9.67	450.75	0.10

Note: N – number of participants, *M* = Mean, *SD* = Standard Deviation, *SE* = Standard Error, FTCSL = Full-Time Certified School Librarian, No FTCSL = No Full-Time Certified School Librarian.

The last of the ANCOVA analyses is using a covariate of average weekly circulation with the 2015-2016 fifth grade EOG mathematics achievement scores. Homogeneity of regression slopes was met, F(1, 20719) = 0.272, p = .602. Levene's test was violated (p = .005). Skewness values were again reviewed with one group of the independent variable at .-.203 and the other at -.130, with a variance ratio of 1.56, with virtually no difference between. The analysis was continued. Homoscedasticity was confirmed with a visual review of the scatterplot and there were no outliers. The covariate, average weekly circulation, was analyzed for interaction with the staffing of full-time certified school librarians, F(1, 20720) = 108.153, p < .001, partial η^2 = .005. Post hoc analysis was conducted using Bonferroni's adjustment, and results are again a statistically significant difference in mean between the school libraries with a full-time

certified school librarian or without a full-time certified school librarian, (M_{diff} = 1.427, 95% CI [1.16, 1.70], p< .001;, see also Table 16.

Table 16

Covariate: Average Weekly Circulation, Mean Effect for 2016 Math Scores, Fifth Grade

		Unadjusted		Adjusted	
	N	M	SD	M	SE
FTCSL	10,381	452.24	9.95	452.21	0.10
No FTCSL	10,342	450.75	9.67	450.78	0.10

Note: N – number of participants, *M* = Mean, *SD* = Standard Deviation, *SE* = Standard Error, FTCSL = Full-Time Certified School Librarian, No FTCSL = No Full-Time Certified School Librarian.

Summary

In all of the EOG reading and EOG mathematics tests analyzed in the first question, the students in schools with full-time certified school librarians scored higher than the students in schools without full-time certified school librarians, with statistically significant results consistently $p < .001$. Not until the alternate test did this change. Even then, all but the 2017 fifth-grade alternate reading test continued to show students in schools with full-time certified school librarians scoring higher, with five of the alternative reading and mathematics tests showing statistically significant results. The 2017 fifth grade alternate reading test results showed no difference for students in schools without full-time certified school librarians even though their scores were higher than the students in schools with full-time certified school librarians, as the analysis failed to show significance at $p = .408$.

The results from the second research question are mixed. When the schools gained full-time certified school librarians there were mixed results. The EOG reading and mathematics tests showed no significance between students' scores before the schools added full-time certified school librarians and the scores of students after they were added. The reading achievement scores of students who lost full-time certified school librarians were lower than the students who were in schools when they had full-time certified school librarians with statistically significant reading scores at $p = .035$, but there was no significance on the mathematics scores when students lost a school librarian. It is possible that two years is not enough time to determine if adding or losing a full-time certified school librarian provides an impact on student achievement. The school librarian staffing prior to the years analyzed is also unknown, which may also make a difference. The fourth grade slump, "when students move from 'learning to read' to reading to learn'" (Goodwin, 2011), may also be a factor, especially if there was no full-time certified school librarian in the school in their early school years.

The results from the ANCOVA analyses were very consistent among the datasets used. All three of the covariates were statistically significant at $p < .001$, except the number of book titles in relation to the dataset for the students in schools that lost a full-time certified school librarians on reading achievement scores, which was statistically significant at $p = .040$.

The next chapter will further summarize and discuss these results.

CHAPTER V

DISCUSSION AND CONCLUSIONS

This chapter presents a summary of this research study and major findings as found in the data presented in Chapter IV. It provides conclusions and recommendations for future actions and further research.

Summary

Despite almost 30 years of school librarian correlational studies, there remains a gap of empirical experimental studies providing causal evidence of the impact of certified school librarians. The research guidelines under No Child Left Behind continued under the Every Student Succeeds Act (ESSA) with a call for education research on interventions "supported by higher levels of evidence, specifically *strong evidence* or *moderate evidence*" (U.S. Department of Education, 2016, p. 4) because these research methods confirm interventions to be effective. According to ESSA guidelines, research using a quasi-experimental study provides moderate evidence of an intervention and when it is well-designed and well-implemented can support making causal-inferences of evidence (U.S. Department of Education). The purpose of this study was to use a rigorous design to determine if full-time certified school librarians impact fourth grade and fifth grade achievement scores on reading and mathematics achievement tests.

The research was focused on two research questions: 1. To what extent does the presence of full-time certified school librarians in elementary schools impact students' end-of-grade state achievement tests compared to similar students in elementary schools without full-time certified school librarians, based on fifth and fourth grade reading and mathematics scores? and 2. To what extent does a change in staffing between full-time certified school librarian and no full-time certified school librarian in an elementary school impact scores on end-of-grade state

achievement tests with changes in library staffing midway through a four year period, either the loss of a full-time certified school librarian or a gain of a full-time certified school librarian based on the staffing the first two years? The research was conducted using a matching design, by matching individual students in a school with a full-time certified school librarian to individual students in a school without a full-time certified school librarian. Matching was based on third-grade achievement scores, age, gender ethnicities, disability status, English language learners, economically disadvantaged status, locale, and school division. Once matched, student achievement scores were compared using an independent samples *t*-test in a quasi-experimental study.

Major Findings

The End-of-Grade (EOG) reading and mathematics achievement tests are taken by the vast majority of North Carolina's elementary students in third through fifth grade. The remaining students meet requirements to take an alternate reading and mathematics test. The alternate testing scores were purposely included in my study of school librarian impact, because school librarians work with all students in the school and have an opportunity to impact all students. The students that are taking the alternate tests have significant cognitive disabilities and require extensive and repeated individualized instruction in order to make meaningful gains (NC DPI, 2019).

The most notable finding emanates from all the EOG reading and mathematics analyses. Every one of the analyses of each school year, for reading and mathematics in fourth and fifth grade, shows students in schools with full-time certified school librarians scored higher than students in schools without full-time certified school librarians, with statistically significant means of $p < .001$. The effect size ranged from Cohen's $d = .08$ to $d = .25$, all small effects.

These results support the hypothesis that full-time certified school librarians impact student achievement in both reading and mathematics and may lend evidence to a causal connection.

However, the results of the alternate reading and mathematics test were mixed. The scores of six of the alternate reading tests showed students in schools with full-time certified school librarians scored higher than students in schools without full-time school librarians, with only four of the analyses statistically significant. The seventh alternate reading test analysis showed students in schools without full-time school librarians scored higher, M = 20.70, than students in schools with full-time certified school librarians, *M* = 20.15, but not at the level of significance.

The results for the second question were mixed. These analyses of changes in school library staffing, either gaining or losing a full-time certified school librarian, had much smaller numbers of cases than the original EOG reading and mathematics tests, and were included in the 2018 EOG reading and mathematics cases analyzed in the first research question. Testing for impact of school librarians when fifth-grade students in six schools with full-time certified school librarians for two years (2014-2015 to 2015-2016) are compared to the fifth-grade students in same schools after the schools lost the school librarians the following two years (2016-2017 to 2017-2018), showed students in the schools when there were full-time certified school librarians scored higher on the EOG reading achievement, with statistically significant scores at *M* = .035. However, the difference of scores on the mathematics achievement test of students who gained a full-time certified school librarian from when they did not have a school librarian were not a significant difference. Also, in the analyses looking at EOG reading and mathematics achievement scores for fifth-grade students who gained librarians in 2016-2017 to 2017-2018, compared to fifth grade students in the same 19 schools without full-time certified

school librarians the previous two years (2014-2015 to 2015-2016), the scores for the mathematics showed no significant differences than when students did not have full-time certified school librarians.

The results of the ANCOVA analyses that met statistical assumptions were all statistically significant, one at p = .040, and 11 datasets at $p < .001$. There were 15 analyses conducted in the initial independent sample *t*-test analyses that had statistically significant results. Each were analyzed against all three covariates, with the majority not meeting assumptions. There were 12 final analyses. Five datasets were analyzed with the covariate, the number of book titles in the school library. All of the datasets were from the 2017-2018 testing year and included reading and mathematics at fourth and fifth grade, plus the dataset for the loss of a full-time certified school librarians. The second covariate was the average age of the media collection (including fiction and non-fiction items) was analyzed with six datasets from 2015-2016 and 2016-2017 reading in fourth and fifth grades, and with 2015-2016 fifth grade mathematics and 2016-2017 fourth grade mathematics. The final covariate, the average weekly circulation, was analyzed with the 2015-2016 fifth grade mathematics. As noted above, they were all statistically significant, 11 at $p < .001$, and one at $p = .040$, supporting covariate interactions resulting in higher achievement test scores for students with full-time certified school librarians.

Discussion

Findings related to the literature

The results in this study of school librarians' impact on elementary students' achievement are consistent with the existing correlational school library studies, which have overwhelmingly provided evidence of positive correlations between the presence of full-time certified school

librarians and higher student achievement (Lance & Kachel, 2018). Additionally, the covariate analyses showing interactions with the age of the collection were also consistent with results in the correlational studies (Lance et al., 199 Lance et al. 2014a, 2014b). However, this quasi-experimental study is different from a correlational study. A correlational study focuses on relationships between variables. In quasi-experimental research designs, there is more control of the variables, allowing an intervention to be conducted with a control group and compared to a treatment group without the intervention, approximating a true experimental design investigating cause-and-effect relationships (McMillan & Schumacher, 2010). In this case, the nonrandomized students who had full-time certified school librarians were the treatment group, while students without full-time certified school librarians were the control group.

These results suggest full-time certified school librarians do have an impact on student achievement. As the literature states, school librarians receive comprehensive training in all aspects of their roles in the school, with certification by their state similar to classroom teachers (AASL, 2018b) and are knowledgeable about effective teaching practices (Martin & Panter, 2015). Research has shown that teachers that are certified in their field have more impact on student achievement scores than teachers that are not certified (Clotfelter et al., 2007, 2010), and this study adds support to the idea that certification makes a difference in school librarians' impact on student achievement.

The systems theory suggests that the school librarian would have an impact on the student as part of the ecosystem (Bronfenbrenner, 1979; Senge, 2012), and my study provides evidence to support that. In the school mesosystem, students are working in the different microsystems and are gaining more knowledge than would occur in one setting. When there are

full-time certified school librarians involved in student learning in the library microsystem, the students have higher achievement than when they are just with their classroom teacher.

What school librarians do is different and the literature would suggest what the school librarian contributes to the ecosystem is unique. Mardis (2007a, 2013) has shown that a classroom teacher's self-identity is not the same as that of the school librarian. The classroom teacher cannot just leave teaching in the classroom, become a school librarian and continue to teach and manage the students the same way as they had in the classroom. Teaching and working with students in the school library is different and the education and training of school librarians in the field's roles and practices prepare school librarians to use multiple ways to interact with students (AASL, 2019a), and many ways to impact student achievement. The uniqueness of school librarians extends to the fact that school librarians are in a position to work with every student in the school throughout the student's time in their school.

Limitations

There are several limitations to this study. There is an expectation that North Carolina public schools have full-time certified school librarians in their schools. Unfortunately, the data from this study does not include analyses of exactly what school librarians do that makes the difference. Certified school librarians have received training to make them effective educators and leaders through the various roles of the school librarian, and preparation to make them experts in information literacy. The *National School Library Standards for Learners, School librarian, and School Libraries* were developed to provide the foundation from which the school librarian works. A key assumption is that these school librarians lead from the middle (AASL & AECT, 1998, p. 53) through collaborative teaching, integrating technology, and professional development (DiScala & Subramaniam, 2011) with knowledge of the school-wide curriculum,

incorporating horizontal (across subjects) and vertical (across grade-levels) integration of learning. They are able to see the big picture and help students build on prior knowledge and make connections (Purcell, 2010) in ways that may not be available or familiar to classroom teachers. Non-certified personnel have not received the necessary specialized training to effectively to step into the job of a full-time certified school librarian and may struggle to provide relevant instruction in the school library setting. Further research is needed in order to identify the practices of full-time certified school librarians that are making a difference.

There are other factors that may be affecting this study's results. Schools in Charlotte have been allowed to substitute reading and other specialists for school librarians' positions (Helms, 2015). The staffing surveys do not reveal changes that happen mid-year such as a full-time certified school librarian leaving their position mid-year. School librarians nearing retirement may not be as current on school library practices promoted in the standards as newer school librarians. More information would be required to determine if any of these factors affect the results.

Students change schools, and the students may have changed to a different staffing model between when they were in third grade and the grade of the analysis, so the matching might not actually reflect comparison of students with different staffing. Students who have changed schools may have experienced both having a full-time certified school librarian and not having a full-time certified school librarian when moving between schools during third and fourth or fifth grade, which may affect the quality of the match.

Matching itself may also provide limitations, as the majority of the matches were not exact, leaving some level of variation in the matched pairs, though variation should be small because of the caliper restricting the size of differences. The loss of many cases due to lack of

matches may also cause missed opportunity for the cases that are at the extremes of the distributions to provide evidence. Despite the matching based on multiple demographics and data, there may also be other confounding variables unidentified.

Conclusions

The overall results support the hypothesis that full-time certified school librarians impact student achievement. The EOG achievement tests had strikingly statistically significant differences in mean. Though the effect sizes were small, they were there. A small improvement in test scores may make a difference for individual students, classrooms, or schools where test scores are on the bubble between low or acceptable proficiency (NC DPI, 2018a). The results on the alternate tests were also significant in four of the seven reading achievement tests, and one of the mathematics achievement tests, thus the data again has confirmed the impact of school librarians on student achievement in reading and mathematics.

The second research question, analyzing the impact of loss or gain of a full-time certified school librarian in the middle of a four-year period provided mixed results. The analyses of the gain of a full-time certified school librarian included six schools, and the analyses of the loss of a full-time certified school librarian included 19 schools. Only one of the four analyses was statistically significant, reading achievement was higher before the loss of a school librarian, and suggests that the loss of a full-time certified school librarian disrupts reading achievement. The addition of full-time certified school librarian did not significantly impact student achievement, perhaps it will take a longer time to make up for the absence of a full-time certified school librarian. There may be other limitations in the school mesosystem that are affecting student achievement, including overall staffing, budgets, and/or instruction quality, that are not available through the data found in this study. The analysis examining the reading achievement after gain

of a full-time certified school librarian included only six schools and was the smallest of the analyses, and many of the schools included very few students in the analysis. The size of this analysis may have an effect on the results, including the possibility one or more of these schools were very small and the school library might be very limited.

Implications for Action

It is important for policy makers and administrators to support the schools by providing school library positions in every school. School librarians make an impact on student learning. The data show that loss of a full-time certified school librarian for only two years provided evidence of a statistically significant drop in reading achievement scores. The difference of one to two points on the reading or mathematics achievement tests could potentially be reflected on the school performance grade. A school with scores matching the means on the 2017-2018 reading achievement test would be Level 3 (sufficient command of knowledge and skills) with a full-time certified school librarian (M = 450.00) and Level 2 (partial command of knowledge and skills) without a full-time certified school librarian (M = 448.69) resulting in a lower school performance grade (NC DPI, 2018a).

This research provided significant evidence of the impact of full-time certified school librarians on students' achievement in both reading and mathematics. With 20 of the matched pair analyses providing statistically significant findings, there is more evidence for school librarians' advocacy with stakeholders. The additional evidence from the 12 covariate analyses, also providing statistically significant evidence that the school library led by a full-time certified school librarian is essential, and implications that the library budget is important, as the number of titles and the age of the collection interacted with the achievement scores supporting the

impact of full-time certified school librarians. The covariate analysis of the weekly circulation suggests the need for access to the school library to check out books regularly.

Educators of school librarians might evaluate their courses to see where more preparation can be provided to future school librarians to proactively make candidates aware of the differences in the roles of classroom teachers and school librarians (Mardis, 2007a) and their impact on both reading *and* mathematics, even as they move into their preservice placements. Educators of school librarians should also prepare school librarian candidates for the possible challenges of working in a school library that has not had a school librarian for two or more years.

School librarians' impact on student reading and mathematics achievement are evidence that they are bringing additional expertise to students' learning through the school library microsystem. Practicing school librarians can use this research to further advocate for their field, and as impetus for further research, including action research.

Recommendations for Further Research

This study should be replicated by other researchers to affirm the findings, in North Carolina and in other states and communities, to provide evidence that this one study in one state is not unique, but it truly represents the entire field of school librarianship. Additional quasi-experimental designs in school librarian research would further our advocacy efforts in our communities, states, and nationally. More rigorous research is needed to provide evidence of the specific practices of school librarians that are causing their impact on reading and mathematics achievement. The roles of school librarians as leaders, instructional partners, teacher, information specialists, and program managers are interlinked and interdisciplinary, and it might not to be possible to study them separately. There are many smaller facets of what school

librarians do such as developing the collection, providing reader advisory, integrating technology, curating resources, incorporating makerspaces, making curriculum connections, developing students' information literacy, guiding research, questioning, working with student independently and in groups. All of these facets are opportunities for research using strong designs to provide evidence of what school librarians do to impact student achievement. Longitudinal research to determine the implication of a school not having a school librarian for two or more years, or to determine how long it would take for a school librarian added to a school that had gone without a school librarian for two or more years to make an impact on student achievement would also provide additional information to the school library field.

Researchers throughout the 20th century, including Dewey (1938) and Vygotsky and Cole (1978), developed social development theories of education and learning as a social process that also includes individual efforts in constructing new knowledge. School library standards, including the *National School Library Standards for Learners, School Librarians, and School Libraries* (2108b) suggest the incorporation of social development theories by school librarians in instruction and practices, but there is not definitive research evidence of the embodiment of the social development theories in school librarian instruction. Research in this area would further explain what school librarians do that impacts student achievement.

School librarians should consider conducting more rigorous research to provide evidence for practice through either action research that is published in school library publications, or work with an experienced university researcher in research-practice partnerships to help provide strong evidence of what they do and to disseminate findings more widely.

Concluding Remarks

School librarians have an important role in their schools. The major finding of this research study was confirmation of the impact of full-time certified school librarians on EOG reading and mathematics achievement tests scores. The high statistical significance of the results confirms the hypothesis that full-time certified school librarians impact student achievement in reading and mathematics.

This study contributes to the CLASS Forum call for more rigorous school library research. The use of a quasi-experimental research design is unique in the school library research field and suggests a causal inference of impact of school librarians on student achievement. As a rigorous scientifically based research approach that provided control of extraneous and confounding variables through matching students on third grade scores, age, gender, ethnicities, disability status, English language learners, economically disadvantaged status, locale, and school districts, this study provided stronger evidence of school librarian impact than correlational studies.

We, as researchers in the school library field, have more work to do to make the connections to what is happening in the school library, providing evidence of why this works and what causes school librarians' impact on reading and mathematics achievement.

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APPENDIX A

OLD DOMINION UNIVERSITY

HUMAN SUBJECTS RESEARCH NON-EXEMPT APPLICATION FORM

Study Title
School Librarians' Impact on Students' English & Math Achievement

Principal Investigator (PI)		
The PI must be an ODU faculty or staff member who will serve as the project supervisor and be held accountable for all aspects of the project. Students cannot be listed as PIs.		
First Name: Sue	**Last Name: Kimmel**	
Telephone: 757-683-5714		**E-mail: skimmel@odu.edu**
Office Address: 4112 Education Bldg., Department of STEM and Professional Studies, Old Dominion University		
City: Norfolk	**State: VA**	**Zip: 23529**
Department: STEM and Professional Studies	**College: Darden College of Education**	
CITI Completion Date: 7/5/2018		

Investigators		
Investigator(s): Individuals who are directly responsible for any of the following: the project's design, implementation, consent process, data collection, and/or data analysis. Investigators must complete the CITI Basic Human Subjects Protection Training.		
First Name: Lois	**Last Name: Wine**	
Telephone: 757-508-5514		**Email: lwine004@odu.edu**
Office Address: 4112 Education Bldg., Department of STEM and Professional Studies, Old Dominion University		
City: Norfolk	**State: VA**	**Zip: 23529**
Department: STEM and Professional Studies	**College: Darden College of Education**	
Affiliation: ☐Faculty ☒ Graduate Student ☐ Undergraduate Student ☐Staff ☐ Other:		
CITI Completion Date: 10/1/2018		

First Name: Shana	**Last Name: Pribesh**	
Telephone: 757-683-6684		**Email: spribesh@odu.edu**
Office Address: 2307 Education Bldg., Old Dominion University		
City: Norfolk	**State: VA**	**Zip: 23529**
Department: Educational Foundation & Leadership	**College: Darden College of Education**	
Affiliation: ☒ Faculty ☐ Graduate Student ☐ Undergraduate Student ☐Staff ☐ Other:		
CITI Completion Date: 7/11/2018		
Upload a copy of the Additional Investigators form if more rows are needed.		

Type of Research

2. This study is being conducted as part of (check all that apply):

☐Faculty Research
☐Non-Thesis Graduate Student Research
☒Doctoral Dissertation
☐Honors or Individual Problems Project
☐Masters Thesis
☐Other:

Funding

2. Funding Status:

☒ Research is **not funded** **(go to 3)**
☐ Research is **funded** **(go to 2a)**
☐ **Funding decision is pending** (funding decision has not been made) **(go to 2a)**

2a. Type of funding source: (Check all that apply)

☐Federal Grant or Contract
☐ State or Municipal Grant or Contract
☐ Private Foundation
☐ Corporate contract
☐ Other (specify):

Funding Agency Name:	
Agency Proposal Number:	
Grand Start Date (MM/DD/YY):	
Grand End Date (MM/DD/YY):	

2b. List the point of contact at the funding source:	
Name:	
Mailing Address:	
Telephone:	
Email:	

Research Dates
3a. Date you wish to start research (MM/DD/YY): 4/1/2019
3b. Date you plan to end research (MM/DD/YY): 12/31/2019 **(End date for data collection and analysis)**

Research Location	
4. Where will the experiment be conducted? (Check all that apply)	
☒ On Campus	(Building and Room Number): ITS Engineering and Computational Sciences Data Center - Hosting remote server for this project
☒ Off-Campus	(Site Name and Street Address): Home of Lois Wine, 7613 Turlington Road, Toano, VA 23168

Human Subjects Review
5.Has this project been reviewed by any other committee (university, governmental, private sector) for the protection of human research subjects? ☐ Yes ☒ No **(If no, go to 6)** **5a. List the other committee(s) that have reviewed this project and indicate which IRB is serving as the primary IRB**

Study Purpose
6. Describe the rationale for the research project: Over the span of more than twenty-five years, more than 34 studies were conducted by school library researchers investigating the impact of school librarians in their schools. The majority of this research demonstrated correlation between the presence of a school librarian and higher student achievement, though these studies were published as reports without peer-review (Lance & Kashel, 2018). A small number of the additional studies during this time period were qualitative. There remains a gap in rigorous research of school librarian impact, which has been noted by the American

Association of School Librarians (AASL) in the release of the Causality: School Librarians and Student Success (CLASS) White Paper provides a research agenda that leads to research projects focused on causal relationships between school librarians and their contributions to student learning (AASL, 2014). The U.S. Department of Education identifies a rigorous approach as evidence-based interventions using well-designed and well-implemented research providing strong evidence through experimental studies, or moderate evidence through quasi-experiment studies (U.S. Department of Education, 2016).

My research will be conducted using a quasi-experimental matching design to compare individual students that have a full-time certified school librarian in their elementary school to individual students that do not have a full-time certified school librarian in their elementary school, matching students based on specific demographics. In the continuum of rigorous quasi-experimental research this project provides moderate evidence moving toward strong evidence.

Subjects		
7. What will be the maximum number of subjects in the study?	**500,000**	
7a. Indicate the approximate number of	**Males: 125,000**	**Females: 125,000**
7b. What is the age of subjects? (Check all that apply)		
☒ Children (Birth-17 years old)	☐ Adults (18-89 years old)	☐ Elderly (90+ years and older)

7c. Will students be enrolled in the study? (Check all that apply)

*If students are under 18 years old, parental consent must be obtained

☐ Undergraduate students	Department:	☐ Advanced students	Department:

7d. Provide rationale for the choice of subjects. Enumerate any additional defining characteristics, including age, of the subject population. (e.g., symptomatology, history, socio-economic status).

All students in North Carolina public elementary schools in grades 3-5 are included in the student population of this research. These students are in the population that are typically served by elementary school librarians, but not all have school have full-time certified school librarians. A very large dataset is being used to better establish if there is a difference in students' academic achievement in English/Language Arts or Math is impacted by the full-time certified school librarians. All data is de-identified and all reporting will be of large analyses.

This study will use a total population sampling design drawing from data from all public elementary schools in the state of North Carolina serving students in grade 3-5, based on school library staffing. For the first research question, all fourth and fifth grade students in elementary schools without school librarians will be matched to fourth and fifth grade students in elementary schools with full-time certified school librarians. All schools used will be traditional elementary schools (e.g. not charter or magnet). For the second research question, the sample will use all elementary schools serving grades three through five with a change in library staffing of a full-time certified school librarian between the second and third year of four years of data.

Vulnerable Subjects

8. Are research subjects being used whose ability to give informed voluntary consent may be in question? (e.g., children, persons with AIDS, mentally disabled, psychiatric patients, prisoners.)

☒ Yes
☐ No

8a. What type of vulnerable subjects are being enrolled? (Check all that apply)

☐ Critically Ill Patients	☐ Mentally Disabled or Cognitively Impaired Individuals
☐ Prisoners	☐ Physically Handicapped
☐ Pregnant Women	☒ Children
☐ Other (describe):	

If yes, explain the procedures to be employed to enroll them and to ensure their protection: All data is de-identified and is obtained from existing large databases. All reporting will be of large groups using general statements

Recruitment

Copies of all recruitment materials must be attached to this application.

9. Check all types of recruitment that will be utilized in the study.

☐ **Internet**	☐ **Letters**
☐ **Newspaper/radio/television advertising**	☐ **Posters/brochures**

☒ Other: N/A No recruitment will be used.

9a. What methods will be used to identify and recruit prospective subjects? Specify the source of potential subjects. If an outside agency or organization will recruit subjects on the investigator's behalf, a support letter must be included.
N/A, existing data

Inclusion and Exclusion Criteria

10. Are subjects equitably chosen for participation in the study? (no one group is excluded without justification)

☒ Yes

☐ No **(If no, specify criteria and justify in detail below.)**

Comments:

10a. Does the study require special evaluation and screening of potential subjects to determine their appropriateness for inclusion in the study?

☐ Yes **(If yes, elaborate on the screening process below and attach the screening questionnaire.)**

☒ No

Screening Criteria:

Outline the inclusion and exclusion criteria for the study:

Inclusion: All North Carolina public students in grades 3-5 are included in this study

Exclusion: Schools without full-time certified school librarians will be identified, with all fourth grade students over the course of the data used will be individually matched to fourth grade students in schools with full-time certified school librarians. Any students that are not matched based on the demographics [3rd grade English/language arts or mathematics scores, gender, ethnicity, age, economically disadvantaged status, special education participation (if applicable), and population group (urban, suburban, or rural)] will be excluded from the analysis.

Experimental Procedures

11. Describe the experimental procedures that will be followed. (Include a succinct, but comprehensive statement of the methodology relating to the human subjects. You are encouraged to include a discussion of statistical procedures used to determine the sample size.)

This research is using statewide data from all North Carolina public elementary schools serving grades 3-5. De-identified individual students will be pair matched with individual students in a school without a full-time school librarian to individual students in a school which has full-time certified school librarian based on demographics including 3rd grade end-of-grade state achievement test scores in either English/language art or mathematics, gender, ethnicity, age, economically disadvantaged status, special education participation (if applicable), and population group (urban, suburban, or rural). The greatest risk is identification of individual students, however the data will be analyzed on a secure server housed at ODU, and reporting will be based on overall data.

For the first research question, fourth and fifth grade scores of each pair will be compared using a t-test comparison of achievement scores of treatment subjects (students with full-time certified school librarians) compared to those of the matched control subjects (students without full-time school librarians). If there is a difference between the treatment and control groups in the t-test analysis, an analysis of covariance (ANCOVA) will be administered for each of the covariates to determine which factors contribute the most to the results.

For the second research question, the difference between English/language arts scores of fourth and fifth grade students immediately before a library staffing change and the scores two years after the change will be the dependent variable. The independent variable is one of two conditions, either the loss or the addition of a full-time certified school librarian. Separate analyses will be conducted for each condition. I will analyze the survey data to determine changes in library staffing after two consecutive years of the first treatment, followed by two consecutive years with the change in staffing. The first condition is no school librarian in the identified schools for two consecutive years followed by the addition of a full-time certified school librarian for two consecutive years through fourth and fifth grade. The second condition is the reverse, with a full-time school librarian in the identified schools for two consecutive years, followed by two consecutive years with no school librarian through fourth and fifth grade. Analysis will compare fifth scores from the first condition to the fifth grade scores of the second condition for each matched pair. Again, each pair will be compared using a t-test comparison of achievement scores of treatment subjects (students with full-time certified school librarians) compared to those of the matched control subjects (students without full-time school librarians). If there is a difference between the treatment and control groups in the t-test analysis, an analysis of covariance (ANCOVA) will be administered for each of the covariates to determine which factors contribute the most to the results.

11a. Will any aversive or painful procedures be employed (e.g., shock, the threat of shock or punishment, experimentally induced stress?)

☐ Yes **(If yes, specify and justify in detail below.)**

☒ No

Comments:

11b. Will the deliberate deception of research participants be involved as part of the experimental procedure?

☐ Yes **(If yes, explain the nature of the deception, why it is necessary, any possible risks that may result from the deception, and the nature of the debriefing with specific reference to the deception.)**

☒ No

Comments:

Compensation

12. How much time will be required of each subject?No time required, no contact

12a. Will research subjects receive course credit for participating in the study?

☐ Yes **(If yes, please explain in comments section.)**

☒ No

Comments:

12b. Are there any other forms of compensation that may be used? (e.g. Money, Gift Cards)

☐ Yes **(If yes, please explain in comments section.)**

☒ No

Comments:

Informed Consent

13. Do you intend to obtain informed consent from subjects?

☐ Yes **(please answer question 13a)**

☒ No (please complete Appendix F: Request for Waiver of Consent Form)

13a. Describe the procedures that will be used to obtain Informed Consent and attach the Informed Consent Document (follow the guidelines for preparation of the University Informed Consent Form).

Note: Subjects MUST be given a description of the procedures and rationale for the study to the extent possible. The benefits and ANY risks associated with participating in the study MUST be enumerated. The subjects MUST be informed of their right to terminate the experiment at any time. If there is no risk associated with the study and participants' signature on the informed consent sheet is the only identifying information about the name of the subject, then the subjects' signature may not be necessary.

N/A

Risks

14. What are potential risks of the research? (Check all that apply)

☐ **Physical harm**	☐ **Psychological harm**
☒ **Release of confidential information**	☐ **Other:**

According to 45 CFR 46.102 (i), Minimal risk means that the probability and magnitude of harm or discomfort anticipated in the research are not greater in and of themselves than those ordinarily encountered in daily life or during the performance of routine physical or psychological examinations or tests.

- **What is the investigator's overall assessment of the risk classification of the study? (none, minimal, or more than minimal risk)?**

Minimal

14a. Describe any potential risks to subjects for the activities proposed and describe the steps that will be taken to minimize the risks. Include any risks to the subject's physical well-being, privacy, dignity, emotions, employability, and criminal and legal status. A detailed, comparative statement of the risk (harm or likelihood) must also be described in the consent form.

All data will be received by the researchers as de-identified data and will be accessed through a secure server maintained by ODU ITS Engineering and Computational Sciences Data Center. A Data Security Plan has been established for this project by the ITS ECSDC and is attached to this document. All reporting will be based on large group results.

Benefits

15. Assess the potential benefits that may accrue to the individual subject as well as to others as a result of the proposed study. Do the potential benefits justify the possible risks involved? Although you may mention general benefits to society, such speculative benefits should not be presented to a subject as a direct benefit for informed consent. There are not direct benefits.

Depending on the outcome of the data analysis, the potential benefit to individual students is the data will support the need for full-time certified school librarians in every elementary school, further providing education achievement.

Protection of Anonymity

16. Describe in detail the procedures for protecting the anonymity (meaning that no one will ever be able to know the names) of the research subjects. If anonymity is impossible, then describe in detail the procedures for safeguarding data and confidential records. These procedures relate to how well you reduce the risk that a subject may be exposed or associated with the data.

Data will be de-identified and maintained on a secure server established by the ODU ITS department. A Data Security Plan has been established to explain the steps being used to secure the data. The data will be destroyed when the project is complete, no later than three years after the start of data access.

Data Security Plan for Use of NCERDC Data
Old Dominion University
March 2019

Executive Summary

The project researchers will connect to a Windows virtual machine hosted on VMware servers physically located on the Old Dominion University campus. The research environment will be accessed solely through the use of Microsoft's Remote Desktop Protocol, which will be limited to modern clients that can support Network Level Authentication (NLA) and TLS encryption.

All storage and analysis of NCERC data will take place exclusively on the virtual server. Data may not be downloaded to local workstations or to any external devices, and drive redirection will be disabled via Group Policy to prevent the mapping of local drives during a remote session.

Portable storage devices, including laptops, will not be used for downloading or storing data.

NCERCD data will not be shared with any other institution or investigator not currently listed in the data use agreement. This restriction applies to source data as well as derived data files. Project investigators, including the PI, do not have discretion to modify access to the NCERDC data. Any changes in access to the data on the secure server requires explicit approval by the NCERDC.

All data security protections apply to the original NCERDC data, derived files, and temporary analysis files.

Technical Details

Location: ITS Engineering and Computational Sciences Data Center

Physical Access is limited to data center staff and controlled by proximity cards. All access to the data center is recorded and monitored by cameras, and the network operations center (NOC) is present 24/7.

Computing Platform
Access to the virtual machine is controlled by the remote desktop user group within Windows, and any authorized user must authenticate using faculty/staff credentials stored in Active Directory. When connecting from off-campus, users must establish a VPN connection prior to initiating an RDP session. Access to the VPN is regularly monitored and requires the use of Duo multi-factor authentication.

The virtual machine will be backed up using Quest's vRanger product. Snapshots will be saved to a secure storage appliance that uses encryption in transit and at rest and is accessible only by ITS administrators. Snapshots will stored for a period of time no longer than two weeks after they are saved, and all snapshots will be deleted after the virtual machine has been terminated.

Security Systems

Authorization to login to the virtual machine will be limited to the designated researchers and staff members of the ITS Server Support Group. Researchers will not be provided administrative rights on the Windows operating system and will be unable to modify permissions on the VM or install additional software.

The virtual machine will have an endpoint protection agent installed to detect the execution of malicious software, and all network traffic between the virtual machine and the Internet will be monitored using a firewall with integrated intrusion prevention features.

Timeline for Data Use

The data will be under active analysis through December 31, 2019, but will be stored up to, but no longer than, three yeares from the execution of the data use agreement, andwill be destroyed no later than three years form the execution of the data use agreement.

Drugs or Devices

17. Will any drugs, devices, or chemical biological agents be used with the subjects?
☐ Yes **(If yes, please attach Appendix G: Drugs, Agents, and Devices Form)**
☒ No

Biological Materials

18. Will this research involve the collection, analysis, or banking of human biological materials (cells, tissues, fluids, DNA?)

☐ Yes **(If yes, please attach Appendix H: Biological Materials Form)**

☒ No

Training

19. Briefly explain the nature of the training and supervision of anyone who is involved in the actual data collection, research design, or in conducting the research. This information should be sufficient for the IRB to determine that the PI and investigators possess the necessary skills or qualifications to conduct the study.

All investigators have completed CITI training. Lois Wine has completed courses in research and statistical analysis. Dr. Pribesh is an established statistical reseacher with a background in working with large databases and currently teachers related courses. Dr. Kimmel is also an researcher, with a background in qualitative research. Dr. Kimmel is Lois Wine's disseratation chair and advisor. Dr. Pribesh will advise Lois Wine on statistical analyses as needed.

PLEASE NOTE:

- You may begin research when the University Institutional Review Board gives you final WRITTEN notice of its approval.
- You MUST inform the committee of ANY adverse event, changes in the method, personnel, funding, or procedure.
- At any time the committee reserves the right to re-review a research project, to request additional information, to monitor the research for compliance, to inspect the data and consent forms, to interview subjects that have participated in the research, and if necessary to terminate a research investigation.

OFFICE OF THE VICE PRESIDENT FOR RESEARCH

Physical Address 4111
Monarch Way, Suite 203
Norfolk, Virginia 23508 **Mailing Address** Office of Research 1
Old Dominion University
Norfolk, Virginia 23529
Phone(757) 683-3460 Fax(757)
683-5902

DATE: April 4, 2019

TO: Sue Kimmel FROM: Old Dominion University Institutional Review Board

PROJECT TITLE: [1330353-4] School Librarians Impact on Students' English & Math Achievement
REFERENCE #: 19-070 SUBMISSION
TYPE: New Project

ACTION: APPROVED APPROVAL DATE: April 4, 2019 NEXT REPORT DUE: April 3, 2020 REVIEW TYPE: Expedited Review

REVIEW CATEGORY: Expedited review category # *5*

Thank you for your submission of New Project materials for this project. The Old Dominion University Institutional Review Board has APPROVED your submission. This approval is based on an appropriate risk/benefit ratio and a project design wherein the risks have been minimized. All research must be conducted in accordance with this approved submission.

This submission has received Expedited Review based on the applicable federal regulations.

This project has been determined to be a MINIMAL RISK project. Based on the risks, this project does not require continuing review. You will receive an annual check in reminder. Please complete the annual check in form and submit it for administrative approval by your next report due date of April 3, 2020.

Please remember that informed consent is a process beginning with a description of the project and insurance of participant understanding followed by a signed consent form. Informed consent must continue throughout the project via a dialogue between the researcher and research participant. Federal regulations require that each participant receives a copy of the consent document.

Please note that any revision to previously approved materials must be approved by this committee

prior to initiation. Please use the appropriate revision forms for this procedure.

All UNANTICIPATED PROBLEMS involving risks to subjects or others (UPIRSOs) and SERIOUS and UNEXPECTED adverse events must be reported promptly to this office. Please use the appropriate reporting forms for this procedure. All FDA and sponsor reporting requirements should also be followed.

All NON-COMPLIANCE issues or COMPLAINTS regarding this project must be reported promptly to this office.

Please note that all research records must be retained for a minimum of three years after the completion of the project.

If you have any questions, please contact Danielle Faulkner at (757) 683-4636 or dcfaulkn@odu.edu. Please include your project title and reference number in all correspondence with this committee.

This letter has been issued in accordance with all applicable regulations, and a copy is retained within Old Dominion University Institutional Review Board's records.

APPENDIX B

End-of-Grade Achievement Test Analysis Results Tables

Table B1

Independent Samples t-test of 5th Grade End-of-Grade Reading Test

	FTCSL			No FTCSL			*t*	*p*	Cohen's *d*
	M	*SD*	*N*	*M*	*SD*	*N*			
2016	451.19	9.487	10305	449.52	9.578	10305	(20606.124) = 12.566	< .001***	.18
2017	450.65	9.889	9502	449.67	93877	9502	(19002) =6.832	< .001**	.10
2018	450.00	10.094	11107	448.69	10.157	11107	(22212) = 9.623	< .001***	.13

Note. FTCSL = Full-Time Certified School Librarian

*** $p < .001$

Table B2

Independent Samples t-test of 4th Grade End-of-Grade Reading Test

	FTCSL			No FTCSL			*t*	*p*	Cohen's *d*
	M	*SD*	*N*	*M*	*SD*	*N*			
2015	446.65	9.593	5215	444.92	9.662	5215	(10428) = 9.167	< .001***	.18
2016	446.49	10.192	13282	444.54	10.112	13282	(26562) = 15.667	< .001***	.19
2017	445.97	10.406	12232	444.54	10.316	12232	(24462) = 110.855	< .001***	.13
2018	445.70	10.529	13319	444.73	10.469	13319	(26636) = 7.548	< .001***	.09

Note. FTCSL = Full-Time Certified School Librarian

*** $p < .001$

Table B3

Independent Samples t-test of 5th Grade End-of-Grade Mathematics Test

	FTCSL			No FTCSL			*t*	*p*	Cohen's *d*
	M	*SD*	*N*	*M*	*SD*	*N*			
2016	452.24	9.948	10387	450.73	9.671	10387	(20755.398) = 11.046	< .001***	.15
2017	451.69	9.926	9534	450.70	9.945	9534	(22280.34) = 6.905	< .001***	.10
2018	451.59	10.023	11144	450.59	10.184	11144	(22280.314) = 7.361	< .001***	.10

Note. FTCSL = Full-Time Certified School Librarian

*** $p < .001$

Table B4

Independent Samples t-test of 4th Grade End-of-Grade Mathematics Test

	FTCSL			No FTCSL			*t*	*p*	Cohen's *d*
	M	*SD*	*N*	*M*	*SD*	*N*			
2015	450.80	9.945	5273	448.38	9.541	5273	(10526.218) = 12.778	< .001***	.25
2016	450.65	9.989	13355	448.92	9.842	13355	(26708) = 14.247	< .001***	.17
2017	450.36	10.089	12277	449.59	10.052	12277	(24552) = 6.014	< .001***	.08
2018	450.58	10.147	13405	449.72	10.025	13405	(26808) = 6.939	< .001***	.09

Note. FTCSL = Full-Time Certified School Librarian

*** $p < .001$

Table B5

Independent Samples t-test of 5th Grade Alternate Reading Test

	FTCSL			No FTCSL			*t*	*p*	Cohen's *d*
	M	*SD*	*N*	*M*	*SD*	*N*			
2016	20.72	6.123	125	18.67	6.672	125	(248) = 2.528	.012*	.32
2017	20.15	5.118	128	20.70	5.436	128	(254) = -0.829	.408	.10
2018	20.85	5.425	127	18.76	6.033	127	(252) = 2.909	.004**	.36

Note. FTCSL = Full-Time Certified School Librarian

* $p < .05$, ** $p < .01$

Table B6

Independent Samples t-test of 4th Grade Alternate Reading Test

	FTCSL			No FTCSL			*t*	*p*	Cohen's *d*
	M	*SD*	*N*	*M*	*SD*	*N*			
2015	20.72	5.277	85	17.61	6.014	85	(168) = 3.579	< .001***	.55
2016	20.49	5.336	156	20.15	5.348	156	(310) = 0.562	.575	.06
2017	20.62	5.546	143	18.69	6.595	143	(284) = 2.678	.008**	.32
2018	20.12	6.179	145	19.14	6.365	145	(288) = 1.339	.182	.16

Note. FTCSL = Full-Time Certified School Librarian

** $p < .01$, *** < .001

Table B7

Independent Samples t-test of 5th Grade Alternate Mathematics Test

	FTCSL			No FTCSL			*t*	*p*	Cohen's *d*
	M	*SD*	*N*	*M*	*SD*	*N*			
2016	19.41	4.981	120	19.13	3.985	120	(227.058) = 0.472	.637	.06
2017	19.21	4.538	128	19.06	4.940	128	(254) = 0.250	.803	.03
2018	18.86	4.879	126	17.87	4.807	127	(250) = 1.613	.108	.20

Note. FTCSL = Full-Time Certified School Librarian

Table B8

Independent Samples t-test of 4th Grade Alternate Mathematics Test

	FTCSL			No FTCSL			*t*	*p*	Cohen's *d*
	M	*SD*	*N*	*M*	*SD*	*N*			
2015	18.62	5.141	85	16.62	5.347	85	(168) = 2.486	.014*	.38
2016	19.78	5.207	154	19.06	4.944	154	(308) = 1.246	.214	.14
2017	18.74	5.696	143	17.64	6.156	143	(284) = 1.575	.116	.19
2018	19.70	5.417	144	18.64	4.999	144	(286) = 1.730	.085	.20

Note. FTCSL = Full-Time Certified School Librarian

*$p < .05$

Table B9

Independent Samples t-test of School Gain of Full-Time Certified School Librarian

	FTCSL			No FTCSL			*t*	*p*	Cohen's *d*
	M	*SD*	*N*	*M*	SD	*N*			
Reading									
2018	448.95	9.129	302	**449.35**	9.837	303	(602) = -0.510	.610	.04
Mathematics									
2018	**450.13**	8.705	300	449.80	9.935	300	(598) = 0.451	.652	.05

Note. FTCSL = Full-Time Certified School Librarian

***p* < *.01*, *** < .001

Table B10

Independent Samples t-test of School Loss of Full-Time Certified School Librarian

	FTCSL			No FTCSL			*t*	*p*	Cohen's *d*
	M	*SD*	*N*	*M*	SD	*N*			
Reading									
2018	**452.47**	9.388	1095	451.60	9.917	1095	(2188) – 2.109	.035*	.09
Mathematics									
2018	**453.77**	10.835	1158	452.93	10.598	1158	(2314) = 1.900	.058	.25

Note. FTCSL = Full-Time Certified School Librarian

**p* < *.05*

APPENDIX C

Propensity Score Matching Data Counts

Table C1

Propensity Score Matching, 5th Grade Reading Tests

	2016	2017	2018
Schools	1,216	1,204	1,228
Schools FTCSL	1,002	1,018	1,002
Schools No FTCSL	214	196	226
Cases Available	69,616	72,500	75,117
FTCSL cases	59,311	62,979	64,010
No FTCSL cases	10,305	9,521	11,107
No Match cases	49,006	53,477	52,903
Matched Pairs	10,305	9,502	11,107
Exact Matches	1	0	0
Cases for Analysis	20,610	19,004	22,214

Note. FTCSL = Full-Time Certified School Librarian

Table C2

Propensity Score Matching, 4th Grade Reading Tests

	2015	2016	2017	2018
Schools	1,217	1,281	1,291	1,300
Schools FTCSL	1,103	1,053	1,077	1,063
Schools No FTCSL	114	228	214	237
Cases Available	82,823	86,509	89,448	89,970
FTCSL cases	77,591	73,205	77,202	76,651
No FTCSL cases	5,232	13,304	12,246	13,319
No Match cases	72,376	59,923	64,970	63,322
Matched Pairs	5,215	13,282	12,232	13,319
Exact Matches	0	0	0	3
Cases for Analysis	10,430	26,564	24,464	26,638

Note. FTCSL = Full-Time Certified School Librarian

Table C3

Propensity Score Matching, 5th Grade Mathematics Tests

	2016	2017	2018
Schools	1,214	1,214	1,228
Schools FTCSL	1,000	1,018	1,002
Schools No FTCSL	214	196	226
Cases Available	70,530	72,697	75,342
FTCSL cases	60,033	63,143	64,198
No FTCSL cases	10,387	9,554	11,144
No Match cases	49,646	53,609	53,054
Matched Pairs	10,387	9,534	11,144
Exact Matches	0	1	2
Cases for Analysis	20,774	19,068	22,294

Note. FTCSL = Full-Time Certified School Librarian

Table C4

Propensity Score Matching, 4th Grade Mathematics Tests

	2015	2016	2017	2018
Schools	1,220	1,279	1,288	1,302
Schools FTCSL	1,106	1,050	1,074	1,065
Schools No FTCSL	114	229	214	237
Cases Available	82,823	86,862	89,801	90,357
FTCSL cases	77,591	73,485	77,510	76,952
No FTCSL cases	5,232	13,377	12,291	13,405
No Match cases	72,376	60,130	65,233	63,547
Matched Pairs	5,215	13,355	12,277	13,405
Exact Matches	0	1	1	0
Cases for Analysis	10,430	26,710	24,554	26,810

Note. FTCSL = Full-Time Certified School Librarian

Table C5

Propensity Score Matching, 5th Grade Alternate Reading Tests

	2016	2017	2018
Schools	147	163	161
Schools FTCSL	97	106	106
Schools No FTCSL	50	57	55
Cases Available	503	558	589
FTCSL cases	378	430	462
No FTCSL cases	125	128	127
No Match cases	253	302	335
Matched Pairs	125	128	127
Exact Matches	0	0	0
Cases for Analysis	250	256	254

Note. FTCSL = Full-Time Certified School Librarian

Table C6

Propensity Score Matching, 4th Grade Alternate Reading Tests

	2015	2016	2017	2018
Schools	103	200	179	181
Schools FTCSL	73	125	118	113
Schools No FTCSL	30	75	61	68
Cases Available	632	730	713	723
FTCSL cases	547	574	569	578
No FTCSL cases	85	156	144	145
No Match cases	462	418	426	433
Matched Pairs	85	156	143	145
Exact Matches	0	0	0	0
Cases for Analysis	170	312	286	290

Note. FTCSL = Full-Time Certified School Librarian

Table C7

Propensity Score Matching, 5th Grade Alternate Mathematics Tests

	2016	2017	2018
Schools	148	163	163
Schools FTCSL	99	106	108
Schools No FTCSL	49	57	55
Cases Available	499	559	589
FTCSL cases	379	431	463
No FTCSL cases	120	128	126
No Match cases	259	303	337
Matched Pairs	120	128	126
Exact Matches	0	0	0
Cases for Analysis	240	256	252

Note. FTCSL = Full-Time Certified School Librarian

Table C8

Propensity Score Matching, 4th Grade Alternate Mathematic Tests

	2015	2016	2017	2018
Schools	107	189	173	182
Schools FTCSL	77	116	112	114
Schools No FTCSL	30	73	61	68
Cases Available	639	727	710	720
FTCSL cases	553	573	566	575
No FTCSL cases	85	154	144	145
No Match cases	468	419	423	430
Matched Pairs	85	154	143	144
Exact Matches	0	0	0	0
Cases for Analysis	170	308	286	288

Note. FTCSL = Full-Time Certified School Librarian

Table C9

Propensity Score Matching, School Librarian Gain 5th Grade 2018 Tests

	Reading	Math
Schools	6	6
Schools FTCSL	6	6
Schools No FTCSL	6	6
Cases Available	607	607
FTCSL cases	302	305
No FTCSL cases	305	302
No Match cases	0	2
Matched Pairs	302	300
Exact Matches	0	0
Cases for Analysis	604	600

Note. FTCSL = Full-Time Certified School Librarian

Table C10

Propensity Score Matching, School Librarian Loss 5th Grade 2018 Tests

	Reading	Math
Schools	19	19
Schools FTCSL	19	19
Schools No FTCSL	19	19
Cases Available	2,260	2,459
FTCSL cases	414	1,158
No FTCSL cases	676	1,301
No Match cases	0	0
Matched Pairs	1,095	1,158
Exact Matches	0	0
Cases for Analysis	2,190	2,316

Note. FTCSL = Full-Time Certified School Librarian