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Reading Proficiency As A Public Policy Agenda Indicator: The Importance Of Reading Ability On The Educational Outcomes Of Students And The Collateral Effects To Society

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Reading Proficiency as a Public Policy Agenda Indicator: The Importance of Reading Ability on

the Educational Outcomes of Students and the Collateral Effects to Society

A Dissertation

Presented to the Faculty of the

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By

Mark W. Jaronczyk

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Dedication

       This dissertation is dedicated to all of our public school educators who work selflessly and tirelessly each and every day to support the needs of their students, their schools, and their communities. Their guidance and instruction deepen our thoughts, enrich our culture, and strengthen our society. Thank you for your devotion.

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Abstract

This study explores reading proficiency as a public policy agenda indicator and hypothesizes that reading achievement scores among phonics-based, *Reading First*, literacy curriculum participants will significantly increase when a neuroscience-based intervention model is integrated into the instructional program. Using a deductive approach, English Language Arts (ELA) achievement percentages from 31 school districts in Maine were analyzed and compared to the Maine state average across 3 groups: *All* students, *Economically Disadvantaged* students, and *Students with Disabilities*. Secondary data was obtained from the Every Student Succeeds Acts (ESSA) Dashboard available on the Maine state government website. One-sample case *t*-test results indicate that the sample school districts scored significantly higher relative to all 3 groups, and that the possible effect of the ABC neuroscience-based intervention on reading achievement ranged from higher than small to slightly below moderate. Applications for the use of these findings as a policy stream indicator for agenda setting are discussed in addition to recommendations for educational practice and future research.

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Chapter 1: Introduction

Educate and inform the whole mass of the people. They are the only sure reliance for the preservation of our liberty.

-Thomas Jefferson

Birkland (2016) begins his examination of theories, concepts, and models by framing public policy making through structural and historical contexts. He refers to the Founding Fathers and explains that the Constitution itself does not guarantee civil rights, but rather maintains the structure for constitutional order though mechanisms such as federalism, the rule of law, and the separation of powers. In other words, the Constitution places limits on the federal government, and the people, though their cultural commitment to personal liberty, are sovereign. To this, Birkland (2016) adds that political entities such as states and public officers, from the president to school board members, derive their political power through the consent of the governed, as written in the Declaration of Independence.

Next, Birkland (2016) reviews the historical development of constitutional order, and in the section discussing National Standards, he refers to Lyndon Johnson's Great Society program. He describes President Johnson's plan as a model that was utilized to address the public policy problems of the 1960's, such as poverty, racial discrimination, barriers to healthcare, environmental issues, and educational problems. Consequently, Birkland notes, this era "also saw the birth of the scientific study of public policy and public problems, as researchers asked, . . . what causes the problems; and do we have the policies and techniques to solve the problems, or to reduce their effects?" (2016, p. 81). This policy process, specifically the scientific study of public problems, subsequently frames the outline for this dissertation relative to the educational

problem of literacy achievement in public schools, and its collateral effects upon society, as well as the possible techniques and policy interventions that can help reduce the negative impacts.

Problem Statement

Federal education policy outlined under the No Child Left Behind Act (NCLB) promoted phonics focused instructional practices through guidance specified in the *Reading First* program, which was defined as a research-based approach to reading. The Every Student Succeeds Act (ESSA) eventually replaced the repealed NCLB Act, however it did not reauthorize *Reading First* after a study conducted by the Institute of Education Sciences (IES) revealed that it resulted in no overall improvement in student literacy achievement (Gamse et al., 2008). Subsequently, ESSA did endorse an alternative literacy program called *Literacy Education for All, Results for the Nation* (LEARN), but LEARN has not yet detailed its recommendations for evidence-based approaches to reading (Loewus, 2016). In addition to the lack of improvement unveiled by the IES, a deeper dive into the data compiled by the National Center for Educational Statistics (2016) reveals that in the year 2015, fourth grade reading scores from the National Assessment of Educational Progress (NAEP) were, on average, 15 points below the proficiency benchmark. Hernandez (2012) further noted that 66 percent of students overall achieved, at most, a basic level of reading comprehension.

Juxtaposing lack of reading proficiency with a flat trend in literacy achievement presents both a grim outlook for children entering the public school system, particularly disadvantaged students, as well as a public administration challenge across public governance levels and sectors. Educators have identified reading as a cornerstone for learning (Paris, 2005)**,** and researchers have linked reading proficiency, or lack thereof, to high school graduation rates. More specifically, students who fail to attain mastery of reading by the end of third grade are

four times less likely to graduate from high school (Hernandez, 2012). High school dropouts, in turn, face incarceration rates 63 times greater than college graduates (Sum et al., 2009), and they pose a negative net contribution to taxpayers and the general public relative to lower tax revenues and higher civic costs. Sum et al. (2009) elaborate on this adversity:

> Adult dropouts in the U.S. in recent years have been a major fiscal burden to the rest of society. Given the current and projected deficits of the federal government, the fiscal burden of supporting dropouts and their families is no longer sustainable. (p. 15)

Purpose

The pedagogical void initiated under LEARN, with respect to literacy instruction, creates the context for this dissertation which looks to bridge innovative instructional practices and public policy. By introducing neuroscience-based research as evidence to support a new reading intervention model, this study looks to guide the future of academic interventions that will integrate neurological rehabilitation into the learning process. However, because the research regarding neurological recovery involves exercises and activities that are typically included within the fields of physical therapy (PT) and occupational therapy (OT), this presents an administrative hurdle relative to public education because PT and OT fall outside the scope of general academic instruction. This conundrum, therefore, emphasizes the need for education policy reform that regulates and financially supports the incorporation of neuroscience-based instruction into the mainstream educational framework for all learners, hence framing the purpose of this dissertation.

Nevertheless, despite the potential to positively impact literacy achievement and, by extension, societal outcomes, converting promising research into public policy still requires vetting through extensive policy channels, foremost of which is placement on the policy agenda.

Birkland (2016) defines this as "the process by which problems and alternative solutions gain or lose public and elite attention" (p. 200). Birkland (2016) further adds that control over the agenda setting process includes defining a problem such that the issue gains attention and so that the approach is actively considered. Thus, the corollary purpose of this dissertation is to show how Kingdon's Multiple Streams Approach (2011, as cited in Birkland, 2016) can be used as a mechanism for gaining agenda status under the education policy domain. The agenda proposal would advocate for the inclusion of neuroscience-based interventions within the public school academic framework.

In short, the purpose of this study is to describe how a literacy model, that incorporates a neuroscience-based intervention, can serve as an indicator for public policy entrepreneurs to leverage the policy stream during the agenda setting process. To that end, in order to serve as an influential indicator, the effectiveness of the intervention first needs to be evaluated.

Research Question

The overarching research question guiding this investigation: Do reading achievement scores among phonics-based, *Reading First*, literacy curriculum participants significantly increase when neuroscience-based intervention models are integrated into the program?

Rationale and Significance

Given the increasing influence of state educational policy on classroom practices, it becomes increasingly important for educational professionals to shape educational policy. The more complete our understanding of state educational policymaking, the greater our ability to anticipate political action, and thus effectively mobilize and influence policy (Taylor et al., 1997, as cited in Young et al., 2010, p. 17).

While the rationale of this dissertation is well captured by the quote above, the significance is framed by its scholarly contribution to the fields of education and public administration. First, the results of this study can be utilized to guide the direction of research regarding the benefits of neurological rehabilitation within educational pedagogy. Second, this study will also inform the practice of applying the Multiple Streams Approach (MSA) as an agenda setting method within the education policy domain of public administration.

Dissertation Overview

Chapter 2 contains a detailed review of the literature beginning with a discussion of reading as a foundational life skill that contributes to the personal well-being of individuals which, in turn, elevates society by producing economic and administrative benefits. The discussion then transitions to an overview of both former and current federal education laws and intervention policies that fund and mandate pedagogical practices relative to literacy. Next, the literature review outlines the evolutionary history of reading instruction where evidence is presented describing the limitations of both past and present reading models because a significant number of learners are still failing to achieve reading proficiency. Consequently, new research is introduced providing information regarding an educational intervention model that targets activities and exercises which have been shown to remediate several neurological processes associated with reading acquisition, thereby leading to improved reading proficiency outcomes. Finally, Chapter 2 also includes a section that frames a specific political mechanism which can be used to advocate for the inclusion of this neuroscience-based intervention model on public policy agendas where it can receive the legislative support and administrative resources needed to reach learners in public school settings.

Chapter 3 of the dissertation focuses on the study's methodology. It begins with an introduction of the research design, and it re-states the overall research question, along with three sub-questions, as well as the corresponding hypotheses. Next, the research philosophy, the research approach, and the research strategy are articulated. The last section of Chapter 3 describes the research methods. This includes operationally defining the independent and dependent variables, detailing the sampling and data collection processes, outlining the research procedure, explaining the data analysis, and clarifying the study's limitations.

Chapter 4 discusses findings relative to data analyses which were conducted and used to interpret results that address the research questions and hypotheses presented in Chapter 3. The chapter starts by examining descriptive statistics related to the sample group and population school units. This data looks at the percentages of student test takers per school unit to show similarity between samples and population, and it aggregates reading proficiency percentages to display their averages. Test of normality results are further reviewed to verify normality of each group's data distribution, thus confirming the appropriateness of the parametric test used for statistical analysis. The chapter next segues into a presentation of results obtained from three one-sample case t-tests, one per sample group. *T*-test values are then assessed for significance. This section also includes calculation and discussion of effects sizes for each *t*-test, which is particularly important since effect size addresses the degree to which manipulation of an independent variable effects a dependent variable. Lastly, Chapter 4 evaluates correlations related to socio-economic levels and school district performance.

Chapter 5 presents the study's conclusion. This section begins with a discussion that reviews the dissertation's purpose relative to public policy and administration, and how the study was framed to contribute to this expanding field of in terms of theory, research, and application.

Next, the investigation's three hypotheses are interpreted in answer to the overall research question. This is followed by study limitations, recommendations for practice, and lastly, recommendations for future research.

Chapter 2: Review of Literature

The literature review is organized thematically across six sections. First, a background reviews the significance of public administration within public education, and it establishes the relevance of reading as a foundational skill. The second segment discusses the expansion of reading into the public administration and policy domains. Third, public administration theory is examined as it applies to the context of this dissertation. The fourth topic area includes an evaluation of historic literacy models. The fifth section provides a review of research regarding the potential integration of neuroscience-based interventions into the reading pedagogy. Finally, section six discusses the translation of research into public policy.

Public Administration within Public Education

Although there are various avenues for the inclusion of public administration within public education, a significant strand that fits within the context of this dissertation involves that of program evaluation. Because student academic data is regularly and continuously collected in schools across numerous subject areas, such as reading, and due to the link between the public election of school board members, who in turn appoint public school administrators responsible for the adoption of academic programs and the hiring of school staff, a direct connection can be made between program evaluation and education within a public context. "Evaluation is a systematic or careful assessment of the merit, worth, and value of administration, output, and outcome of government interventions, which is intended to play a role in future, practical, action situations" (Vedung, 1997, as cited in Dahler-Larsen, 2005, p. 616).

In terms of public education and administration, student academic skill output is primarily assessed through testing. Student test data, among other performance measures, is next used by administrators to evaluate teacher merit, and student standardized achievement test

scores, which are available to the public, are then considered by all stakeholders to determine

whether school administrators have met district goals and outcomes. Comparisons can then be

made between schools or other districts to evaluate the worth of curricular programs as well as

the value of future interventions in conjunction with school budget allocation, which is typically

approved through public consent, thereby completing the public process cycle. In fact, Dahler-

Larsen (2005) states that program evaluation in teaching is more intense than in other public

institutions, such as the courts or the military. Further, he adds that "in recent years, the

movement towards evidence-based practices has both intensified the search for empirical

underpinnings of professional practices and stimulated the evaluation field" (p. 621). This

dissertation follows suit in that regard relative to the evaluation of a newly integrated, science-

based intervention that can possibly improve professional teaching practices, within reading

instruction, for public school settings.

Reading – a Foundational Skill but an Instructional Conundrum

The connection between reading, high school graduation, and success in society involves

the pivotal role reading skills play in relation to literacy and academics. Castles et al. (2018)

describe reading as the basis for knowledge acquisition, civic engagement, and vocational

success. Because knowledge is distributed verbally through the medium of culture and

maintained historically in written form, the ability to develop satisfactory literacy skills is critical

to individual and societal well-being. "Learning to read transforms lives" (Castles et al., 2018, p.

5).

Academically, third grade is the year students transition beyond learning to read, and they

are subsequently expected to begin reading to learn. Fourth grade curriculum standards, in

reading, require students to comprehend text and apply their interpretations in order to draw

conclusions and evaluate them (Hernandez, 2012). This substantive shift in rigor captures why learners, who are still struggling with basic reading skills after third grade, tend to significantly fall behind in succeeding years (Wanzek et al., 2013). These circumstances are further compounded by students who are identified with neurological disabilities, such as dyslexia, and for whom evidence-based reading interventions fail to be effective, even when children otherwise demonstrate average intelligence, normal hearing, and good vision (Scammacca et al., 2016).

Consequently**,** teachers and public-school administrators have found themselves in an ongoing search for efficacious reading interventions to remediate skill deficits, especially before students matriculate to fourth grade (Wanzek et al., 2013). Over the last century, the understanding of reading as a learned skill, in conjunction with the evolution of instructional practices, has progressed from initial forays into standardized reading measures and individual case studies to recommendations by researchers for the universal screening of all students followed by the placement of struggling readers into intervention groups based on their area of deficit (Scammacca et al., 2016).

Along the way, education researchers and physicians have used two different approaches in their studies to better understand the connection between physical and cognitive disabilities, the reading skill deficits caused by them, and the types of interventions designed to bridge these gaps. Whereas the latter, such as physicians, seek to diagnose the physical cause and then prescribe a treatment, the former, educational psychologists, develop tests to assess academics skills so that educators can design instruction to develop the corresponding abilities (Scammacca et al. (2016). Over the past few decades, the preponderance of applied research has come from the latter approach, which appears logical considering that educational researchers frame studies

from an academic perspective. However, an increasing trend in diagnoses of dyslexia and autism spectrum disorders, both related to neurological causes and both of which inhibit positive responses to current evidence-based practices (even more notably after grade 3), has sparked a renewed interest in the treatment of physical causes as a possible solution to reading deficiency (Durrance, 2018; Grapin et al., 2019; Spencer et al., 2019).

Reading as a Public Policy and Administration Issue

The issue of reading entered the public mainstream via the United States military. As the U.S. entered World War I in 1917, military commanders quickly realized that legions of soldiers lacked the ability to comprehend basic written orders. As a result, the concern over struggling readers soon came to the forefront of society as a matter of national security (Smith, 2002, as cited in Scammancca et al., 2016).

Elementary and Secondary Education Act (ESEA)

Decades later, the prevalence of reading underperformance among low-income communities again placed reading on the policy agenda. This led to ratification of the Elementary and Secondary Education Act (ESSA) in 1965. While this monumental legislation authorized the expansion of educational funding, understaffed schools lacked the personnel to administer additional interventions. However, the legislation ensured that reading was now an area within the public domain that was eligible to receive federal support, new training programs for educators and research opportunities for reading interventions were financed by the National Defense Education Act (Harris, 1967).

Education Sciences Reform Act

By the turn of the millennium, new federal legislation attempted to significantly shape education policies with a specific focus on reading interventions and research. The Education

Sciences Reform Act of 2002 precipitated inception of the IES which would become responsible for establishing and maintaining rigorous research standards by prioritizing grants for studies involving Randomized Control Trials (RCTs), increased sample sizes, and standardized measurements.

No Child Left Behind Act (NCLB)

Also in 2002, passage of the No Child Left Behind Act (NCLB) instituted a more prominent role for the federal government in public education. Civil rights groups grew increasingly concerned about the growing achievement gap affecting minority students, and business groups became interested in increasing American competitiveness abroad (Davenport & Jones, 2005; Klein, 2015). Therefore, NCLB provided an update to the ESEA by mandating strict and punitive accountability mechanisms tied to ambitious academic student achievement goals thereby coercively influencing the structure of education vis-à-vis education policy (Bandeira de Mello, 2011).

The framework for accountability primarily took the form of standardized testing relative to yearly benchmarks for performance in reading and math (Browder et al., 2014). States subsequently structured enforcement through a sequence of cascading sanctions which increased in severity when schools failed to meet benchmarks over the course of two to three academic years. Although NCLB heightened public awareness of instructional deficiencies through yearly reports that revealed an expanding number of failing schools, it simultaneously cast a spotlight on itself as an inconsequential education policy. Criticisms included lack of appropriate funding in order to implement curricular and staffing requirements as well as a collateral narrowing of a viable curriculum because schools cut arts and humanities programming to essentially teach to subjects which were tested. Ultimately, by the deadline year of 2015, no states met the law's

mandate requiring 100 percent of students to be proficient in reading and math (Ahn & Vigdor, 2014; Klein, 2015)

Individuals with Disabilities Education Improvement Act (IDEIA)

A few years later, in 2004, passage of the Individuals with Disabilities Education Improvement Act (IDEIA) provided schools with a pathway to special education identification through a multitiered framework and referral process. The critical aspect of this model, which became known as Response to Instruction/Intervention (RtI^2), involved its proactive methods. Pre-assessments and progress monitoring mechanisms enabled schools to use reading scores both preventatively and reactively by applying interventions throughout instruction related to skill remediation as well as environmental responses such as smaller groups, longer learning blocks, and more targeted strategies. Essentially, the idea was to allow all students access to additional layers of support when and as needed instead of waiting until a student qualified for special education services only if or after a learning disability was diagnosed. Another positive outgrowth of the RtI^2 initiative was detailed as follows (Scammacca et al., 2015, as cited in Scammacca et al., 2016):

> This framework changed the landscape of reading intervention research in two ways: Students qualifying to participate in research could include all those not responding to general education curriculum (not just those with a discrepancy between IQ and achievement test scores) and schools were now implementing interventions with a larger percentage of students. (p. 775)

Response to Instruction/Intervention (RtI^2). Justice (2006) informed us that, prior to the introduction of the RTI framework, methods used to identify reading disabilities were not specific enough and thus frequently resulted in false negatives or false positives. Moreover, the

identifications typically lacked an empirical basis. Justice (2004) further added that children who continually demonstrate lack of reading progress may present with a neurologically based learning disability.

Other RTI studies reflected inconsistent results with recommendations for additional research. Grapin et al. (2019) found that RTI facilitation in early elementary grades may produce long-term reading achievement, but the evidence is non-linear. The researchers specifically recommend ongoing solicitation of innovative intervention strategies combined with advocacy for reform. Wanzek et al. (2013) looked at two research-based RTI elements that involved increasing intervention time and decreasing group size in upper elementary grades (Grade 4 and above). The study, however, did not discover significant differences with regard to student outcomes as a result of moderating instructional hours or group sizes, and suggestions included defining the intensity of other variables within a system of supports delivered through an RTI model.

Post NCLB Education Policy and Management Implications

Borman and Hewes (2002) contended that American policies for educational improvement have not produced long-lasting benefits to society due to poor research designs relative to education initiatives. However, research also shows that reading is a key predictor of students' future economic prosperity. (Ritchie & Bates, 2013). Therefore, "as long as literacy education plays such an important role in the economic well-being of individuals and their communities, then policies will be established to try to ensure that children succeed in reading" (Shanahan, 2014, p. 11).

In their review of educational management and leadership theories, Ghasemy and Hussin (2014) also emphasized that the effective management of educational organizations is a critical

public management perspective since education is the most significant instrument of change in evolving societies. Peterson (2000) argued that, in addition to discerning variables or inputs impacting educational outcomes and then collecting data to measure progress, the political elements of the educational process must likewise be addressed from a larger perspective. He went on to state that although no single solution can transform the entire process, individual innovations may result in modest positive effects on education.

To this, Shanahan (2014) pointed out that the connection between educational policymaking and teaching is currently distant. To bridge this divide, he recommends that it is necessary for teachers to become more involved in the enterprise of education, that they make more serious efforts to understand education policies, and subsequently that they look to shape and inform education policies either personally or professionally. Nevertheless, in a case study examining the Massachusetts Education Reform Act (MERA), McDermott (2004) interviewed an education stakeholder who "warned 'The schools are overwhelmed with all they have to do. Don't assume they know best how to do Ed Reform in their schools'" (p. 55). Essentially, education policies and administrative departments impose policies and regulations but do little to provide instructional resources and training (McDermott, 2004; Shanahan, 2014). Thus, the responsibility for improved literacy outcomes will fall to educators and other policy actors through the integration of new research-based practices that inform better education policies.

Agenda Setting and Public Administration Theory

According to Birkland (2016), "The emergence of complex problems and the need for greater analytic capacity than that possessed by the federal and state governments has led to the growth of independent research organizations" (p. 169). Birkland (2016) clarified that universities qualify as one such entity because they provide critical input into the policy process

that is more scholarly than ideological. In terms of the stagnant and sub-par reading achievement levels confirmed by standardized reading scores and the high probability for adverse economic and societal impacts in the future, now is the time to look to experts in research for relevant information regarding literacy instruction. Moreover, in order to utilize scientific research as a policy tool, Kingdon's theoretical framework, known as the Multiple Streams Approach (MSA), will be discussed relative to the agenda setting process as it pertains to executing public policy and administration.

Garbage Can Model

Young et al. (2010) explained that Kingdon's MSA framework was based on Cohen, March, and Olsen's (1972) garbage can model of organized decision-making. The theory postulates that three components are involved with respect to organizational choice. These streams include participants, problems, and solutions, and within each stream, numerous possible opportunities for decisions exist. These elements are then metaphorically mixed into a garbage can where problems can find solutions or vice versa, and participants can decide when a relevant match materializes between the two (Birkland, 2016).

Multiple Streams Approach (MSA)

Kingdon (2011, as cited in Birkland, 2016) effectively adapted the garbage can model for use in the policy-making arena. Kingdon's version of the streams approach integrated the elements of problems, politics, and policies, where each stream represented a set of ideas pertaining to various policy actors or groups, from individuals to agencies and institutions. Kingdon (1995, as cited in Young et al., 2010) described the streams as follows:

1. The problem stream focuses on the issue of problem recognition when societal conditions attract public attention via focusing events, negative feedback, or systematic indicators.

Disasters, crises, or dramatic personal experiences describe examples of focusing events.

Negative feedback can come from program evaluators or constituents. Finally, systematic

indicators are assessments which reveal the magnitude of a problem or condition.

2. The political stream elucidates the state of public opinion regarding issues on the policy

agenda as reflected by balance of political power, national mood, and governmental action.

Decision makers can gauge levels of opposition or support for policies by monitoring the

organizational movement of political groups. Similarly, the political climate can sense national

mood via social movements. Lastly, actions or events within the government, such as personnel

changes or jurisdictional shifts, can affect the standing of a policy issue.

3. The policy stream conveys the ideas and possible alternatives to be advocated as policy

solutions by members of the policy community both inside and outside of government. Within

this stream, policy entrepreneurs utilize resources to actively increase the influence of a policy

idea by amending proposals, issuing reports, or conducting studies.

Although the three streams function independently, the probability of gaining agenda

status increases when multiple streams (and mechanisms within streams) can be simultaneously

leveraged by policy actors during a window of opportunity (Chow, 2014; Kingdon, 2011, as

cited in Birkland, 2016).

For this study, the policy window has been opened by several indicators in the *problem*

stream relative to deficient reading scores as reflected in lower graduation rates (Hernandez,

2012) and a higher probability of incarceration by students who drop out of high school (Sum et

al., 2009). These adverse consequences are subsequently predicted to negatively impact the

socio-economic well-being of communities as a whole leading to greater public administration

challenges in the long-term (Sum et al., 2009). In addition, the *political* stream reflects a

national mood that expects a high quality and equitable education system that serves all students. The business community, as well as interest groups concerned for the rights of disadvantaged students, continue to advocate for educational improvement (Davenport & Jones, 2005; Klein, 2015). Consequently, in order for policy actors to take advantage of this policy window opportunity, the research conducted in this study will contribute a mechanism to the *policy* stream thereby allowing for the combination of all three streams. In effect, this dissertation proposes the integration of a novel neuroscience-based approach to literacy instruction which will frame an alternative to the status quo reading model.

Young et al. (2010) also pointed out that while the MSA has guided policy research and agenda setting over a range of various policy domains, there is "little systematic comparative evidence of the applicability of MSM [Multiple Streams Model] to education policy" (p. 5). Therefore, by pairing this policy solution with the societal problems and political issues identified, this study will also inform the practice of integrating and applying the Multiple Streams Approach (MSA) as an agenda setting method within the public policy and administration processes (McLendon & Cohen-Vogel, 2008).

Literacy Instruction – the Research

As educational research increased in scope and frequency, experts from other fields such as psychology and behaviorism added their insights into the reading and learning dilemma using research framed from the lens of their particular discipline. For example, behaviorists explored techniques to reduce student anxiety which was thought to be induced by stress associated with the reading teacher (Cameron et al., 1972) or from phobias related to reading aloud (Word & Rozynko, 1974). Psychologists, on the other hand, tried explaining the issue from a cognitive standpoint. They hypothesized that reading disabilities resulted from learner passivity. In other

words, student failure resulted from the inability to actively recall knowledge or the incapacity to synthesize meaning from text (Torgesen, 1982, as cited in Scammancca et al., 2016).

Based on these studies, still more researchers responded by designing interventions that aligned with the proposed symptoms or targeted the skill deficiencies. Fortunately, certain metacognitive interventions yielded positive outcomes (Anders et al., 1984), but due to the lack of standardized research measures relative to the interventions, proximal relationships between interventions and reading tasks were confounded by distal variables when evaluating the transfer of an acquired reading strategy to an improved effect. This explanatory uncertainty prompted the need for an increase in quasi-experimental and experimental scholarship in order to enhance the validity of results supporting efficacious reading instruction (Scammancca et al., 2016). The following subsection will review reading reforms and interventions from the past several decades to examine their constructs and methods.

Historic Literacy Models

Pearson (2000) comprehensively outlined the development and evolution of reading pedagogy throughout the twentieth century. He subdivided this period into thirds to represent different levels of activity relative to educational practice, research, and policy. The first third of the century was marked by an instructional tug-of-war between the phonics and whole language approaches. However, because reading achievement data was not yet available on a large scale, pedagogical debates were primarily framed by professional prerogative and curricular constructs (Pearson, 1999).

Early Twentieth Century. At the turn of the twentieth century, synthetic phonics was the approach that predominantly guided reading instruction. This method was based on alphabetic principles and the concept of learning the parts before the whole. As such, the

succession of teaching and learning progressed from letter naming to letter sounds to syllable blends where activities were defined by drill and practice exercises. The processes of recognizing letter shapes followed by associating them with sounds produced decoding skills, and practice drills were expected to increase the speed of decoding. Subsequently, a higher decoding pace led to increased fluency rates where students could then begin to listen to themselves pronounce combinations of words, or oral reading. Because listening to words was thought to induce the construction of meaning through the mode of verbal language, oral reading was an integral component for the production of textual comprehension. Therefore, according to the alphabetic and phonics formula, decoding skills plus, or times, listening comprehension equals reading comprehension, which was the goal of reading instruction. (Pearson, 2000; Pearson & Hiebert, 2010).

Nevertheless, critics of the synthetic phonics model were quick to point out that "reading disabilities existed in countries where phonics were taught exclusively and where languages had more regular . . . phoneme correspondence than English" (Harris, 1967, as cited in Scammancca et al., 2016). Early reformers also sought to counter the drill and practice reading mechanisms pertaining to alphabetics, which they considered to be mindless procedures. Instead, reformers introduced and advocated for an obverse method that eventually became known as the whole language approach (Pearson, 2004).

As opposed to learning the parts first, the two main forms of whole language reading instruction that emerged included words to letters, whole to part, and words to reading, or the look-say method, collectively referred to as analytic phonics. The words to letters teaching technique integrated the presentation of words in conjunction with lessons that asked students to decompose these words into their component letter parts. In words to reading, students were

initially taught a bank of approximately 100 site words. Once this reading foundation was established, a modified version of the words to letters method was introduced. However, rather than a strict adherence to decomposing words into each component part, or letter, teachers used a focused analysis strategy. As an example, a reading lesson might group a series of words beginning with the same letter where students would initially be asked to recognize the similarities with the initial letter. Next, students would analyze the remainder of each word in order to differentiate between the other letters and sounds (Pearson, 2000).

Pearson (2000, 2010) outlines five additional reading constructs that influenced the development of reading pedagogy through the first third of the twentieth century. These include testing, readability, readiness, skills, and remediation.

Testing. Early in the twentieth century, education researchers such as Thorndike and Gray identified reading performance as an educational phenomena worthy of scientific examination. The first published reading assessment tested oral reading. However, because it was administered to students individually and required teachers to subjectively determine the quality of reading responses, silent reading tests using multiple choice questions were developed soon thereafter. These assessments allowed teachers to measure for both reading rate and comprehension in group settings, thus providing objective results in a more efficient format.

Readability. Text difficulty likewise became an object of research. But, unlike testing, readability was established from a child-centered perspective. In devising formulas to measure a text's level of reading difficulty, educators and psychologists attempted to match texts to students' interests and developmental capacities.

Readiness. Similar to readability, reading readiness was framed as a developmental construct, and, together with the testing movement, it also became the subject of research. To

that end, readiness was defined by a set of prerequisite abilities that were necessary for reading

acquisition. In other words, readiness skills were thought to be predictive of early reading

success, therefore some scholars recommended delaying formal reading instruction until such

capabilities were in place. Reading readiness skills included knowledge of the alphabet, oral

language development, the ability to follow instructions, and auditory discrimination as well as

visual discrimination.

  Skill Development Framework. In order to be systematically taught and learned,

educators organized a linear scope and sequence of reading skills. If this outline was followed

with fidelity and taught properly, the expectation was that this discrete curricular unit would

yield skilled reading for students. Two byproducts of the skills framework included standardized

teaching manuals and student workbooks. At the same time, another collateral effect of the

scope and sequence endeavor was its expansion. As smaller or different skill units were

identified, more complicated instruction became necessary resulting in even more complex

systems for learning facilitation.

  Remediation. The concept of remediation was borrowed from the medical field, and it

entered the educational fray when testing, readability, readiness, and skills-related evidence

provided scholars and educators with new information with which to discern reading deficits to a

more a specific degree. Once a deficient skill was diagnosed, a targeted reading intervention

could then be prescribed. This remediation would, theoretically, return the student to skill

equilibrium thereby restoring a typical reading acquisition trajectory.

  Mid-Twentieth Century. According to Pearson's (2002) account, the mid-twentieth

century, a span he defined as taking place between the 1930s and 1960s, served as a time for the

elaboration or calibration of early twentieth century reading models. However, a gradual shift in

momentum occurred throughout this interval so that, by the 1960s, over 90 percent of American students were taught using some variation of the whole language approach (Pearson, 2000).

Although the words-to-reading model had become ubiquitous in terms of reading instruction, the overall framework was loosely structured creating inconsistency with implementation and difficulty with evaluation relative to its overall effectiveness. Nevertheless, Chall (1967, as cited in Pearson, 2002) attempted to construct more systematic methods using these prevailing principles:

1. Reading goals, beginning in grade one, should include word recognition followed by comprehension, application, and interpretation.

2. Reading lessons should start with students silently reading material that is meaningful to them based on relevant interests and authentic experiences.

3. Upon the mastery of approximately 50 to 100 site words, analytic phonics strategies should be taught as a cueing system where children learn to use context clues.

4. Analytic phonics instruction should continue into upper grade levels rather than primarily being concentrated in early grade levels.

5. Analytic phonics lessons should be grounded within textual material rather than as an isolated activity focusing on stand-alone words.

6. Grade 1-3 level texts should be controlled for readability where those of appropriate rigor are repeated frequently.

7. Initial instruction should be conducted at a slow pace with easy readability. If evaluations determine a lack of readiness in particular students, the readiness period should be extended.

8. Reading instruction should take place in small groups.

While the pendulum representing instructional pedagogy swung much further towards the whole language approach during the mid-century period, reading fundamentals did not seem to veer significantly away from those of the early twentieth century (Pearson, 2000). Essentially, student texts and teacher materials maintained similar stories and structures, and the skill of reading continued to reflect the basic concept that readers translated written symbols into oral code. Pearson (2002) explained that if students acquired the ability to decompose (Dec) letters into their component sounds, the brain could then treat this as oral language, known as listening comprehension (LC), from which reading comprehension (RC) ensued (RC = Dec x LC).

Despite framing the whole language approach as more student-centered and literature-based, the overall schema was ultimately challenged by educators for its omission of direct instruction relative to fundamental reading skills (phonics), metacognitive reading strategies (comprehension monitoring), and textual structures (e.g., grammar, genre, etc.). The supposition was that these elements would be inferred during the whole language process. Moreover, the widespread appropriation of the model without universal oversight mechanisms for implementation resulted in significant misapplication of the framework (Pearson, 2004).

Consequently, the 1960s saw a rise in both research and political activity in an attempt to settle the phonics versus whole language reading debate. Pearson (2000) outlined several collective actions that were taken to meet this end. First, the United States Congress passed the ESEA in 1965 which ushered in new resources to fund compensatory education programs under the Title I program. Second, the United States Office of Education commissioned the Cooperative Research Branch to conduct studies, known as the First Grade Studies, regarding the various preferred methods of reading instruction. Third, *Reading Research Quarterly* was established in 1966 so that study results could be published in a scholarly journal format.

Finally, the national Right to Read program was instituted to confirm that reading was a right of every child in America.

Next, as results from the First Grade Studies emerged, they reported that virtually any alternative to basal reading programs produced equal if not greater student achievement in first grade students overall (Pearson, 2002). Furthermore, a critical conclusion indicated that "early attention to the code in some way, shape, or form, must be reinfused into early reading instruction" (Pearson, 2000, p. 163). Thus, Chall (1967, as cited in Pearson, 2000) recommended several substantive changes to improve reading pedagogy. These included emphasizing phonics-based instructional methods, re-examining the readability and content of reading materials, developing new standardized assessments to test both single-component and absolute measures, and improving literacy research while also making it more accessible to educators and policymakers.

By the end of the decade, intellectual movements began to shape the formation of some distinct educational constructs including criterion-referenced assessments and mastery learning (Pearson, 2000). However, as the 1970s unfolded, "reading was still a fundamentally perceptual process of translating letters into sounds" (Pearson, 2002, p. 428).

Late Twentieth Century. Pearson (2000) noted that the 1980s and 1990s saw an influx of ecumenical research advances in reading pedagogy from within the fields of linguistics, philosophy, and cognition. After decades of trial and error by educational researchers, scholars in other disciplines began to claim that educationists must being doing something wrong. Moreover, the concern that attracted experts from outside of education to join the debate involved reading's pivotal status relative to students' academic and societal outcomes. "Reading is considered by so many people to be a key to success in other endeavors in and out of school"

(Pearson, 2000, p. 67). Pearson (2002) further detailed the main theoretical arguments coming from intellectuals speaking to a variety of related concepts. Their reasons are explained in the following subsections.

   Linguistics. Linguists entered to the conversation by proposing that some reading skills are autonomously learned through oral language structures, and that formal instruction to unpack certain complex reading rules may only lead to more confusion for emergent readers. The example provided was that of the different pronunciations for *-ed* in the words *nabbed, jaded*, and *capped.* Simply allowing readers to learn the appropriate sounds through oral language should be more effective than attempting to teach students various rules regarding the proper syllabic versions of *-ed* after voiced and unvoiced consonants such as *-b, -d,* or *-p*. Chomsky (1957, as cited in Pearson, 2002) also asserted that language acquisition was a phylogenic ability, therefore behavioristic approaches to reading instruction may be flawed if reading acquisition was likewise based on phylogenesis. In other words, if humans can learn to speak a language by being immersed in an environment where people are talking, then perhaps students can learn to read by being immersed with books in a setting where others are reading (Teale et al., 2010), in which case deliberate reading instruction may be moot.

   Psycholinguistics. Following Chomsky's lead, psycholinguists contributed the idea of rule-governed learning mechanisms. This philosophical framework established students as active language participants who would infer reading conventions by applying the rules governing language use. Second, psychologists postulated that reading instruction could be made more effective through motivational means. Essentially, if students were made aware that communication using print, such as reading and writing, was an essential life skill, the learning process would occur more naturally (Teale et al., 2010). These assumptions also reflected the

first signs of deviation from the presumption that reading was a completely perceptual skill.

Third, Goodman (1967, as cited in Pearson, 2000) surmised that reading errors made by students

revealed the processes readers used to make meaning of text. He proposed that readers utilized

three cuing strategies to promote and support comprehension. By integrating grapho-phonemic,

which are letters and sounds of words, syntactic, which are the positions of words, and semantic,

which are the meanings of words, cueing systems, readers engaged in a constructive

comprehension process. As such, the psycholinguistic philosophy further devalued rote phonics

instruction in favor of incorporating natural language patterns into reading pedagogy.

     Cognitive Psychology. Cognitive psychologists developed a theoretical framework of

reading comprehension and perception associated with the effects of memory, attention,

executive function, and motivation on cognitive processes. Schema theory, based on Piaget's (as

cited in Pearson, 2000) concept of learning through assimilation and accommodation, contends

that the process of acquiring and retrieving knowledge occurs through schematic structures

which store perceptual experiences as memories. Subsequently, when new memories are

formed, a person's base of knowledge is reconstructed. Cognitive psychologists speculated that

because students similarly construct meaning from text, a reader's interpretation of its meaning is

significantly influenced by that individual's knowledge and experiences (Teale et al., 2010).

Conversely, if a reader lacks specific knowledge or experience referenced in a text, that student's

comprehension will effectively be compromised. Thus, schema theory presented educators and

researchers with a new challenge as it related to the production of meaning throughout the

reading process. Until ambiguity with respect to the construction of meaning was resolved,

attempts to increase reading comprehension through alternative instructional methods would

remain elusive.

Sociolinguistics. Sociolinguists called attention to the distinctions that formed between the various dialects within a single language. They went so far as to say that dialectical differences were potentially so great that dialects themselves could be considered individually developed linguistic systems. This premise led sociolinguists to the conclusion that dialects should not be viewed as improper forms of English to be corrected. Because "speakers of dialects expressed linguistic differences and not linguistic deficits" (Pearson, 2000, p. 174), the function of schools should not be the eradication of other dialects through rigid literacy instruction aligned to a preeminent version of English. Rather, schools should modify reading curricula to accommodate diverse student dialects. Nevertheless, as well-intentioned as this proposal sounded, the parents of students who spoke different dialects quickly rejected this *special* curriculum model. They felt it would put their children at a competitive disadvantage in the long-term under circumstances where standard English was the expectation. Despite the rebuke, sociolinguists emphasized the recommendation that educators should recognize dialects as separate language systems. By acknowledging this distinction, educators should understand that when students who have acquired other dialects are reading in English, mistakes should not necessarily be treated as substantive errors considering that reading, in this regard, is mainly about the process of translation. Consequently, "success in reading was not so much an indication of reading 'ability' per se, but of the success the individual experienced in learning how to use language appropriately in educational settings" (Pearson, 2002, p. 441).

The Twenty-First Century

In 1998, Pascal Forgione, the U.S. Commissioner of Education Statistics, issued a report with the following conclusion regarding reading achievement as reflected through NAEP data collected between 1971 and 1996: "The overall trend pattern in reading achievement is one of

minimal changes across the assessment years. . . . No significant changes at any age occurred during this time period" (p. 7). Therefore, after nearly one hundred years of pedagogical practice, research, and input from educators, administrators, and experts in a variety of related linguistic and psychological fields, it appeared as if reading achievement had plateaued. The metaphorical pendulum representing reading instruction had swung from one faction, emphasizing phonics and perceptual skills, to another, accentuating whole language and constructed meaning. In addition to the methodological debates between advocates for phonics or for whole language instruction, i.e., the role of teaching, that occurred in the early and mid-twentieth century, scientists in the final third of the century also attempted to impart their perspectives on reading by investigating social and cognitive structures, i.e., the role of learning, in order to uncover the missing link that continued to inhibit reading proficiency in many students (Pearson, 2000).

Nevertheless, despite all these negotiations and contributions, including the enactment of federal education policy in the second half of the century, the reading achievement dilemma persisted. Consequently, as the twentieth century gave way to the twenty-first and NCLB policy took center stage, Pearson (2002) recommended an ecologically balanced approach to reading. This alternative called for explicit phonics instruction involving word identification and spelling along with the integration of authentic texts and comprehension tasks. In this way, teachers could scaffold lessons focusing on skills, such as phonemic awareness and letter-sound analytics, but within the context of authentic literary texts where students would become active meaning makers (Teale et al., 2010). While the ultimate goal of reading was accurate comprehension established through the construction of meaning, the prerequisite processes involved the decoding of words encountered in text (Pearson, 2000). When presented in this fashion, a

balanced approach to literacy appeared to address the fundamentals of reading which were necessary for students to acquire proficiency.

Reading First

In response to converging evidence reported by the National Research Council in 1998 and the National Reading Panel in 2000, both of which highlighted systematic and explicit instruction across five key literacy components, legislators mandated the implementation of these recommendations, in their landmark NCLB law, by any school receiving federal education funds. These skill-related elements were packaged together with research-based teaching strategies, and the model was entitled *Reading First*. This balanced framework was supported by Scientifically Based Reading Research (SBRR), and Al Otaiba et al. cogently outlined the teaching and skill strands in their 2005 exploratory study.

Teacher Role. The six most effective instructional procedures for reading included the following features:

- using small groups to differentiate lessons according to student needs (Taylor & Pearson, 2001, as cited in Al Otaiba et al., 2005)

- maximizing the percentage of on-task student behavior (Taylor & Pearson, 2001, as cited in Al Otaiba et al., 2005)

- increasing instructional time relative to alphabetic principles (Scanlon & Vellutino, 1996)

- teaching analytic decoding tactics with a scaffolded approach (Pressley et al., 2001, as cited in Al Otaiba et al., 2005)

- integrating higher-order thinking questions throughout comprehension activities (Taylor & Pearson, 2001, as cited in Al Otaiba et al., 2005)

- incorporating a variety of texts based on student interest and ability (Duke, 2000)

Learner Role. The five essential skill sets needed for reading proficiency included systematic and explicit development in these areas:

- **phonemic awareness**: cognizance that individual verbal sounds (phonemes) can be manipulated and arranged to make spoken words. This also presupposes the ability to hear and identify sounds (Juel & Minden-Cupp, 2000).

- **phonics**: understanding the predictable connection between spoken sounds (phonemes) and the written letters that symbolize those sounds (graphemes). This leads to the recognition of familiar spellings followed by the automatic reading of sight words and then the accurate decoding of unfamiliar words (Foorman & Torgesen, 2001).

- **vocabulary:** development and storage of information related to the meaning of words. Vocabulary ability is further separated into four types including words that are understood when listening, words that are used when speaking, words defined through the use of context clues while reading, and words applied during composition or writing (Stahl & Fairbanks, 1986).

- **fluency:** rate and accuracy of word pronunciation. Oral reading fluency combined with vocabulary development creates the bridge between phonics and comprehension (Stahl & Kuhn, 2002).

- **comprehension:** application of strategies for assimilating, recalling, and expressing the meaning of textual information. The deliberate, interchangeable, and independent execution of these five literacy skills demonstrates the emergence of reading proficiency (Hiebert, 1999).

Reading First Impact Study. In 2008, Gamse et al. released their report, after three years of data collection, relative to the impact of funding provided for *Reading First* programming throughout the country. The study was commissioned with oversight by the U.S. Department of Education to evaluate the $1 billion per year initiative designated under NCLB to reach the goal of all children attaining grade-level reading proficiency by the conclusion of third grade. The investigation took place in 248 schools across 13 states, representing 17 school districts and one statewide program. The primary research question driving the purpose of the study asked, "What is the impact of *Reading First* on student reading achievement?" (p. xv), and the answer was that "Reading First did not produce a statistically significant impact on student reading comprehension test scores in grades one, two, or three" (p. xv).

Furthermore, Gamse et al. (2008) conducted exploratory analyses to examine the accountability factors related to any potential predictors of student outcomes. The study probed various schools, grade levels, and student subgroups during different school years, and the data suggests the following:

- There was a positive correlation between the five core components of *Reading First* and time spent on their instructional delivery.
- There were no statistically significant variations in reading comprehension outcomes overall either by school site, grade level, or classroom.

Newest Research

In the same year that Gamse et al. (2008) issued their final report evaluating the *Reading First* model, Shaywitz and Shaywitz (2008) published a study regarding the neurobiology of reading. Their article described an updated perspective in which "other cognitive processes are involved in reading . . . and that disruption of these attentional mechanisms play a causal role in

reading difficulties" (p. 1329) that has been unexplained by previous research and unaffected by

reading interventions up to this point. Breakthroughs in magnetic resonance imaging technology

have provided scientists with new insights into the neural systems that serve reading processes

(Castles et al., 2018). Moreover, neural imaging "has provided a neurobiological framework

within which to incorporate advances in cognitive psychology, developmental psychology,

linguistics, neurology . . . and education to provide an increasingly specified and fine-grained

account of reading" (Shaywitz & Shaywitz, 2008, p. 1329).

Shaywitz and Shaywitz (2008) concluded by discussing that initial data from

experimental interventions targeting the neural systems involved in reading have resulted in

significant changes in brain organization. Essentially, these interventions have shown greater

brain activation patterns in posterior regions of the brain, as well as in the left hemisphere,

thereby increasing cerebral attention mechanisms (Valera et al., 2007). Increased attention

capacity subsequently produced improvement in phonemic awareness in students, compared to

preintervention neural images). Despite these promising outcomes, however, current

pedagogical dogma treats the phonological reading components as modular procedures which are

automatically acquired, thus falling outside of cognitive processes. Nevertheless, recent

neurobiological experiments have revealed that phonology is attention demanding. Because

NCLB and *Reading First* have now created a policy driven educational paradigm, Shaywitz and

Shaywitz (2008) have emphasized that "these data have important implications for public policy

regarding teaching children to read" (p. 1340). Furthermore, the authors recommended

additional research to assess the long-term impacts of these interventions along with studies that

explore how neural systems affect the development of fluency. Scammanca et al. (2016)

likewise encouraged contemporary researchers to investigate factors that are often associated

with reading problems, such as the role of attention and behavior, due to the prevalence of "struggling readers who do not respond adequately to evidence-based interventions provided with high treatment fidelity" (p. 784).

Other research targeting the neurobiological bases of reading have focused on cognitive processing ability, working memory, and visual tracking. Castles et al. (2018) reported that deficiencies with neural processing affect an individual's ability to activate meaning which is not accounted for by variations in word recognition or vocabulary knowledge. Similarly, poor working memory impairs comprehension because it reduces the brain's attention span thereby compromising the storage and processing of verbal information (Carretti et al., 2009). In addition, because a person's ability to visually track letters and words from left to right, within text, is directly related to fluency, constraints to eye-movement control impede the construction of textual meaning during the reading of sentences, hence diminishing comprehension (Blythe, 2014; Mehlhase et al., 2019; Toffalini et al., 2018). Fortunately, technological advances have also allowed researchers to establish parameters for studying eye-movements, known as *saccades,* in order to integrate saccadic interventions throughout reading instruction (Bellocchi et al., 2019; Marx et al., 2016). According to Samuels et al. (2014), "one thing seems certain when considering all involved in the learning-to-read process: effective and efficient eye movements are critical" (p. 42).

One specific example of a neurological condition that affects language processing is dyslexia. Durrance (2018) reported that language processing disorders consequently make reading and writing more difficult. Because statistics estimate that between 10 to 20 percent of individuals suffer from dyslexia, this group comprises "a significant portion of students who perform below the Basic level on NAEP reading in fourth grade" (Durance, 2018, p. 1). Durance

further disclosed that, due to the different manner in which language is processed by the brains of dyslexic individuals, teaching and reading strategies require specialized procedures including multisensory methods. For instance, the Orton-Gillingham approach uses constant word sensory associations such as how a word feels in the speech organs or in the hand when written, in addition to how the words looks and sounds (Sheffield, 1991).

Another neurological approach has explored the role that reflexes play throughout reading. Sales and Colafemina (2014) described reading as an interdependent composition of motor and cognitive processes where visuomotor perception is coordinated with other psychosocial elements. More specifically, the vestibular-ocular reflex is responsible for the alternation of the *ocular globe*, or eyeball, between *fixation*, which is looking at a fixed point, *smooth-pursuits*, which are tracking objects that pass slowly by, and saccades, which are rapid eye movements from one point to another. In other words, for the retina to accurately capture an image, that image must be stabilized through the interaction of the vestibular system with the ocular muscles, hence the term vestibular-ocular reflex (Mahfuz et al., 2018). With respect to literacy, oculomotor deficiencies adversely impacted reading comprehension and fluency because effects such as *binocular instability,* which is the eyes drifting from the point of focus, and *saccadic latency*, which refers to delayed eye movements, resulted in the regular loss of attention and the omission or misreading of words within text (Scherer & Schubert, 2010).

Similarly, Taylor et al. (2004) studied the effects of primitive reflex retention on the academic achievement outcomes of students with Attention-Deficit/Hyperactivity Disorder (ADHD). ADHD is also a prevalent neuro-developmental disorder that is underdiagnosed because research results showed that, due to the wide range and severity of symptoms, individuals cannot be neatly separated into "diagnosed versus non-diagnosed" (Taylor et al.,

2004, p. 35) categories. Therefore, many students experiencing ADHD have been receiving

inadequate academic interventions that have not accounted for neurological deficits, in much the

same manner as students with dyslexia.

     Taylor et al. (2004) explored previous research which showed that a set of primitive

reflexes emerge during human uterine development that subsequently develop into automatic,

survival-oriented movements throughout the first several years of life (Goddard-Blythe &

Hyland, 1998). These four reflexes act as "the body's physiological response to a sudden or

potentially threatening source of stress" (Taylor et al., 2004, p. 24) and are automatically

initiated, hence the term reflexes, since a baby has not yet developed conscious motor control

relative to survival behavior. The startle reflex was cited as a prime example of a survival

movement. This automatic response causes a baby's arms to fling open, in a backward and

upward fashion, thereby triggering a gasp of air which provides the lungs with the capacity to cry

for help. Under normal developmental conditions, however, the primitive reflexes become

replaced by postural responses over the course of three years (Goddard, 1996, as cited in Taylor

et al., 2004). Conversely, if the primitive reflexes are retained past this typical three-year period,

the brain's maturation becomes inhibited thus reducing its ability to effectively process sensory

information (Gold, 1997, as cited in Taylor et al., 2004). Consequently, a startle reflex that is

appropriate for a newborn develops into a habitually over-reactive response to even mild stress

exposure as an adolescent (Hannaford, 1995, as cited in Taylor et al., 2004). This phenomenon

then produces the symptomology expressed in children, and even adults, with ADHD which has

been linked to the learning problems and academic difficulties associated with inattention and

impulsivity (Taylor et al., 2004).

Masgutova et al. (2016) further explored reflex integration in children with autism spectrum disorder (ASD). ASD is a developmental disorder affecting the brain and its ability to properly regulate neurotransmitters (Tatarinova et al., 2020). This dysfunction subsequently produces neuroinflammation that can manifest the following characteristics, among others: (a) poor eye contact, (b) auditory hypersensitivity, (c) problems with kinesthetic memory development, (d) inability to imitate or follow instructions, and (e) inability to connect to the surrounding world (Masgutova et al., 2016). As with the Taylor et al. (2004) study, Masgutova et al. (2016) determined that subcortical brain maturation is inhibited in children with ASD, thus neurosensorimotor reflex integration is likewise retained. Because reflex development is critical for the normal neurodevelopmental process to occur, disruption to this chronology potentially affects every aspect related to brain function including auditory, visual, and cognitive processing as well as language development, all of which are integral to reading acquisition.

Masgutova et al. (2016) also elaborated on the Taylor et al. (2004) description regarding primitive reflex maturation. The researchers first reiterated that certain reflexes are initially unconditioned so that infants can react involuntarily to the presence of danger. However, such automaticity must eventually mature to prevent inappropriate reactions to stimuli that are not dangerous. This occurs though the process of conditioning the reflexes. "Conditioned reflexes incorporate the effects of experience and learning, connecting the basic reflex, which is the lower level of the nervous system, with higher brain structures" (Masgutova et al., 2016, p. 2). As a result, internal or self-control is gradually developed. Once neural reflexes are appropriately integrated, differentiated motor patterns can be established freeing the brain to engage in the higher order thinking necessary for academic learning (Bell et al., 2019). In other words, if the brain is not trained (early in life) to calibrate reflex responses to match the degree of severity

relative to environmental stimuli, as children grow older, more of the brain's conscious effort becomes devoted to suppressing hyperactive responses to minor stimuli thereby impeding its capacity for more advanced learning, such as reading.

Neuroscience-Based Interventions

Interestingly, the integration or maturation of primitive reflexes, as it pertains to normal neurological progression as a prerequisite for cognitive development, resembles the *readiness* construct first deliberated in the early twentieth century (Pearson, 2000, 2010). In hindsight, although some educators at the time understood that learning more rigorous reading skills necessitated various degrees of cognitive ability, scientists lacked the technology, such as neural imaging, to explore and explain the neurological mechanisms involved throughout the developmental process. Therefore, rather than waiting for a student to become "ready" for reading instruction, particularly when a student's age surpassed the expected readiness criterion or when readiness appeared unlikely, arguments in favor of immersion in phonics instruction, regardless of a student's readiness, seemed substantively more robust.

In other words, because educators and scientists one hundred years ago were unaware of the connection between brain neurology and reading acquisition, neurological-based interventions were naturally unavailable. Thus, it seemed more logical to begin (phonics-based) reading instruction before a student displayed the prerequisite perceptual abilities rather than to wait too long and discover that a student many never fully attain these characteristics. When that philosophy did not work for all students, the whole language approach became the alternative. However, because whole language reading instruction principally still involved translating letters into sounds (Pearson, 2002), it likewise failed to account for students with perceptual processing deficits. Most alternatives at that point entailed remediating reading skills by modifying the

instructional environment, such as smaller groups, longer reading sessions, etc., and providing individual accommodations such as texts with larger print, cuing systems, etc. (IDEIA, 2004). But these interventions were essentially about providing more of the same instructional strategies instead of targeting different causes for a student's inability to read proficiently.

To that end, although linguists, psychologists, and sociologists next attempted to understand reading ability by unpacking the more innate phenomenon of language acquisition (Pearson, 2002), educators were not readily able to convert their recommendations into practical reading interventions. Nevertheless, their discoveries, combined with a more nuanced fusion of phonics and whole language, led to the legislation of what was considered to be a more balanced reading model called *Reading First* (NCLB, 2002). Unfortunately, data from the *Reading First* analysis in 2008 (Gamse et al.) revealed disappointing results when it concluded that the federally mandated literacy model failed to produce significant improvement in student reading outcomes. This was followed by NAEP scores in 2011, which showed that only 34 percent of students in fourth grade achieved the *proficiency* criterion, as well as by NAEP scores in 2015, which reflected the average fourth grade reading level to be 15 points below the proficiency benchmark. Hence, by the year 2015, after more than a century of input from educators and researchers, in addition to billions of dollars of funding granted through federal education policies (Gamse et al. 2008), the majority of public education students continued to unsuccessfully develop or learn the skills necessary to demonstrate proficient reading comprehension.

On a positive note, because over 30 percent of students have achieved reading proficiency through the *Reading First* instructional framework, the essential pedagogical elements should remain intact. However, many decades of historical data, in conjunction with

scientific discoveries obtained through recent neural research, clearly points to the need for new instructional strategies. With that, the remainder of this literature review will describe evidence-based interventions that can be integrated into an updated literacy model in order to target neurological deficits which are inhibiting reading acquisition in so many of our students.

MNRI. Masgutova (2016) has developed one such program which began as an alternative to pharmacological interventions used to treat neurological disorders related to trauma in children (Bell et al., 2019). Because memories are stored in the amygdalae, the brain's emotional processing center, repeated or prolonged exposures to traumatic events create dominant neurological pathways that become heavily influenced by fear and anxiety. When this occurs, subcortical brain structures produce over-reactive responses to stress, which subsequently limit or distort a person's ability to function rationally (Beck, 2011, as cited in Masgutova, 2016). Additionally, since pharmacological medications primarily provide symptom relief and because psychotherapy functions at the cortical (cerebral) brain response level, neither treatment method promotes substantive recovery (Masgutova, 2016).

Therefore, Masgutova (2016) proposed an alternative therapy that uniquely reintegrates neurosensorimotor reflex patterns using mechanisms which rehabilitate "neural schemes that aid in . . . the development of the nervous system" (Masgutova, 2016, p. 1). Masgutova's original study explored the adverse impacts of post-traumatic stress disorder (PTSD) in which the conditioned release of excessive cortisol and adrenaline produces incongruous overreactions to minor stressors that also manifest the following symptoms: (a) abated tolerance to distress, (b) increased emotional dysregulation, (c) more frequent physical ailments such as headaches, bowel discomfort, tremors, and shortness of breath, (d) shorter capacity for sustained focus, and (e) hypersensitivity to visual, auditory, and tactile stimuli (Masgutova, 2016).

After results from Masgutova Neurosensorimotor Reflex Integration (MNRI) therapy sessions showed improvements relative to all of these symptoms in children with PTSD (Masgutova, 2016), Masgutova et al. (2016) sought to replicate the study on children with autism spectrum disorder since ASD characteristics are neurotypically very similar to those described in clusters (a) through (e) above. Once again, post-MNRI therapy results led researchers to conclude that MNRI interventions produced substantial improvements in children with ASD relative to stress tolerance, emotional resilience, behavior regulation, focus, and sensorimotor coordination. Moreover, however, this second study (Dreiss et al., 2019; Masgutova et al., 2016; Tatarinova et al., 2020) also assessed the effects of MNRI interventions on higher order cognitive abilities which are supported by mature or integrated neurosensorimotor reflexes. Results from these indicators likewise showed improvements in clusters measuring speech and language, cognitive processing, memorization, and motivation for learning achievement (which are integral for reading comprehension).

VRNT. To test and extend these findings further, Masgutova et al. (2018) conducted a third study. This iteration deliberately focused on academic and visual skills, and it incorporated supplementary interventions alongside MNRI called Visual Reflex NeuroTraining (VRNT). The VRNT program was also administered to children with ASD, and it facilitates the development of visual tracking and perception functionality relative to the smooth-pursuits, eye fixations, and saccades necessary for reading. More specifically, VRNT exercises targeted the ocular-vestibular reflexes (Sales & Colafemina, 2014) and muscles to strengthen the binocular vision abilities and convergence/divergence sensory-motor patterns (Mahfuz et al., 2018) used for nearly all academic skills and particularly with reading. When combined with MNRI, both reflex and education assessment results confirmed that VRNT "increases the level of visual

reflex functionality for a range or variety of patterns of children diagnosed with ASD . . . which positively affects their academic skills of reading, writing, and overall neurodevelopment" Masgutova et al., 2018, p. 2).

Research into Policy and Chapter Summation

Although there exists an avenue, under prevailing federal education policy (IDEIA, 2004), where students with conditions or disabilities that affect reading development can qualify for interventions or Individualized Education Plans (IEPs) through which targeted academic instruction is supposed to be delivered (RtI^2), this literature review has substantiated that several disabilities, specifically those causing neurological deficits, such as dyslexia, ADHD, and ASD, do not effectively respond to the contemporary battery of reading interventions presently available in schools. Furthermore, due to the large percentage of students affected by these underdiagnosed neurological disorders (Taylor et al., 2004), the reality confronting educators and policymakers is that there are currently vast numbers of students who are receiving inadequate reading instruction as a result of the disconnect between education policy, education practice, and education research (Hudson et al., 2007).

Moreover, due to the connection that has been established linking reading deficiency and increased high school dropout rates (Hernandez, 2012; Sales & Colafemina, 2014) to the negative social and economic repercussions that this outcome has upon society (Sum et al., 2009), the need for prudent governmental action is imminent. The policy window is wide open because the problem and political streams (Kingdon, 1995, as cited in Young et al., 2010) have combined to bring the issue of reading proficiency to national attention yet again. Once a mechanism from the policy stream is added, the three streams can converge to compel the establishment of an updated reading pedagogy onto the policy agendas at all levels of

government. To that end, this study represents that policy mechanism as an alternative solution from outside of government in the form of influential research. "To translate science into policy requires scientists being in that loop of credibility" (Humphreys, 2019, p. 965).

Consequently, while promising results from neuroscience-based programs, such as MNRI and VNRT, have shown their potential to positively impact student reading outcomes in a clinical environment, studies documenting the effectiveness of these interventions have not yet been applied in public school settings. Therefore, this research study sought to address this gap by investigating a literacy intervention model that has incorporated equivalent sensory integration and visual tracking activities within its curricular structure. ABC, which is a fictitious name used to de-identify it, is a consulting organization whose early literacy initiative includes sensory integration and visual tracking exercises and whose model has been adopted by various public school districts within the state of Maine. The following chapter will discuss the research methodology utilized to examine the research question which frames this study.

Chapter 3: Methodology

The purpose of this study is to describe how a literacy intervention model, that incorporates a neuroscience-based framework, can serve as an indicator for public policy entrepreneurs to leverage the policy stream during the agenda setting process. However, in order to serve as an influential indicator, the effectiveness of the intervention first needed to be evaluated. This perspective has also been fittingly captured by Black's (1999) statement, "theories. . . . having been recognized as valid by the academic community, may form the basis for policy decisions in governments" (p.18). To that end, a pre-experimental research design was implemented under a normative approach which compared the results of a sample group's reading achievement to that of a larger population.

Research Philosophy

For this dissertation, a pragmatic research epistemology was adopted. Due to the pervasive nature of reading deficiency throughout public schools and the ubiquitous application of reading as a life skill, this study underscored the importance of taking a broad view of this problem relative to its educational, social, and political contexts. By framing the problem within the real-world situation where it is primarily taught, that of public schools, which are not conducive to experimental research designs due to ethical concerns regarding the random assignment of some students but not others to potentially beneficial instructional interventions, a pragmatic study was needed to better understand the nature of the problem. Next, an appropriate method was identified to investigate and interpret the phenomenon in order to find a solution or, at minimum, to advance research and education policy regarding effective literacy instruction for all learners.

Furthermore, the complexity of public school environments, combined with the multitude of developmental factors that impact reading ability, point to a pragmatic acknowledgement that there may be no single or certain solution to the problem of eliminating reading deficiency. However, by using a common-sense philosophical perspective, this dissertation aims to contribute to knowledge about the relevance of neuroscience-based literacy interventions that can inform current educational practices. This applied research can further benefit society by influencing public policy that authorizes curricular changes as well as future funding for educational resources and research, thereby further advancing the relevance of the Multiple Streams Approach to public policy agenda setting.

Research Design

A pre-experimental research design was used because samples relative to the independent variable were based on intact groups, such as school districts within the state of Maine. The achievement test scores represented the dependent variable. Although less rigorous than a true experimental design in terms of controlling for all extraneous variables, this pre-experimental study had the advantage of reflecting the real-life conditions associated with literacy instruction and intervention within a public school setting. Since the treatment school districts, those integrating the ABC intervention, were not randomly assigned, the use of such convenience samples supported the need for a pre-experimental research design.

In terms of the pre-experimental design description, a one group post-test structure was employed since the treatment group (X) was subjected to the intervention, the independent variable, and then observed (O1) or tested for reading achievement, the dependent variable. Moreover, data was filtered demographically so that scores from the *Economically Disadvantaged* subgroup and the *Students with Disabilities* subgroup were used to structure

detailed analyses since these two subgroups represented the students most affected by the adverse conditions discussed in the literature review.

Research Questions and Hypotheses

The overarching research question guiding this investigation: Do reading achievement scores among phonics-based, *Reading First*, literacy curriculum participants significantly increase when neuroscience-based intervention models are integrated into the program?

Three sub-questions follow:

Q1: Within the state of Maine, is there a statistically significant difference in state standardized literacy achievement test scores for *All* students between public school districts that integrated the ABC literacy model and the state of Maine student average?

H(o): Within the state of Maine, there is no statistically significant difference in state standardized literacy achievement test scores for *All* students between public school districts that integrated the ABC literacy model and the state of Maine student average.

H(a): Within the state of Maine, public school districts that integrated the ABC literacy model will score significantly higher on the state standardized literacy achievement test for *All* students than the state of Maine student average.

Q2: Within the state of Maine, is there a statistically significant difference in state standardized literacy achievement test scores for *Economically Disadvantaged* students between public school districts that integrated the ABC literacy model and the state of Maine student average?

H(o): Within the state of Maine, there is no statistically significant difference in state standardized literacy achievement test scores for *Economically*

Disadvantaged students between public districts that integrated the ABC literacy model and the state of Maine student average.

H(a): Within the state of Maine, public school districts that integrated the ABC literacy model will score significantly higher on the state standardized literacy achievement test for *Economically Disadvantaged* students than the state of Maine student average.

Q3: Within the state of Maine, is there a statistically significant difference in state standardized literacy achievement test scores for *Students with Disabilities* between public school districts that integrated the ABC literacy model and the state of Maine student average?

H(o): Within the state of Maine, there is no statistically significant difference in state standardized literacy achievement test scores for *Students with Disabilities* between public school districts that integrated the ABC literacy model and the state of Maine student average.

H(a): Within the state of Maine, public school districts that integrated the ABC literacy model will score significantly higher on the state standardized literacy achievement test for *Students with Disabilities* than the state of Maine student average.

Research Approach

This study employed a deductive approach to investigate the theory that the skill of reading requires neurological operations such as reflex integration and visual tracking, per the research presented in the literature review. Public education policy endorses pedagogical

practices that currently reflect the phonics-based, or *Reading First*, instructional model, where neurological processes are not directly addressed relative to the subject of reading.

Since the skill of reading can be broken down into sub-skills or components, such as vocabulary and comprehension, which can be measured objectively through standardized achievement tests, thus quantifying data, deductive research was conducted to test the hypothesis that neuroscience-based literacy interventions will increase reading proficiency in learners when integrated into existing literacy models compared to a population using the standard phonics-based model.

Research Strategy

In terms of research strategy, a quantitative method was utilized to collect existing numerical data which was then statistically analyzed for significance. Quantitative research is common in the social sciences as a framework for investigating a phenomenon affecting a sample of individuals which can then be examined through numeric patterns for making comparisons across sets of aggregated data collected through structured observations. Statistical results are subsequently used to answer research questions, draw conclusions with respect to theory, and make recommendations for future research (Black, 1999).

In this study, the phenomenon was a neuroscience-based literacy intervention model, acting as the independent variable. The sample of individuals was represented by thirty school districts, serving as the treatment group receiving the intervention. The data, collected through structured observations, was represented by the standardized literacy achievement test scores for each school district in the sample, as well as the state of Maine student population, thus serving as the dependent variable. A detailed description of the independent variable, the dependent variable, the sampling method, the study procedures, and the data collection tactics will follow in

the subsequent methods section. That section will also include a description of the data analyses as well as a discussion regarding the limitations of the study.

Research Methods

Study Variables

Independent Variable. The independent variable in this study was an early literacy initiative designed by two educators with special education and literacy credentials. The literacy initiative has been integrated within school districts in the state of Maine, but since the initiative website contains the names of those districts, most of which are included in the sample group, the fictitious name "ABC" was assigned to the initiative in order to de-identify the participants. The ABC initiative is a model of literacy instruction that integrates a neuroscience-based intervention in order to enhance the standard phonics-based instruction outlined in the *Reading First* program. More specifically, the ABC initiative engages students in activities that target neurological operations such as the reflex integration and visual tracking exercises described in the literature review and in the section below.

The ABC Intervention. As Figure 1 illustrates, academic learning, where vocabulary and reading comprehension are activated, and which are the skills measured on the NWEA assessment relative to ELA proficiency, occurs at the very top, or *cognitive*, level of the learning pyramid. Furthermore, these skills must be supported by many layers of developmental abilities and systemic sensorimotor functions that form the foundation for all learning. When all the building blocks are in place, even if a few are less stable, the learning process should be fairly smooth. However, if blocks are missing or increasingly underdeveloped, learning progression is more inhibited and academic learning becomes less functional or even less possible (Read Write Think, 2022).

The *Reading First* model identifies phonemic awareness, phonics, vocabulary, fluency, and comprehension as the five primary academic skills necessary for reading acquisition. Consequently, literacy instruction includes cognitive operations involving phonemes, where learners are required to recognize and blend sounds in order to create words, and graphemes, where students must decode sounds and identify the written symbols, or letters, associated with those sounds (Foorman & Torgesen, 2001; Juel & Minden-Cupp, 2000). Vocabulary assimilation then requires learners to connect words to meaning, and fluency is needed to rapidly string this information together, which subsequently produces comprehension of text (Hiebert, 1999; Stahl & Fairbanks, 1986; Stahl & Kuhn, 2002).

However, these critical academic skills assume that learners have functional auditory and visual abilities to process sounds and symbols, sufficient memory capacity to store and recall information, and effective linguistic processing aptitude to translate and interpret meaning. Moreover, a *Reading First* program presupposes that learners can maintain an attention span long enough to focus on direct instruction as well as other behavioral skills, such as the planning, organizing, and self-regulation necessary in order to sustain the independent practice of that academic material (Read Write Think, 2022).

These underlying skills, as Figure 1 shows, must be developed prior to successfully engaging in academic learning, which occurs in the top, or fourth, level of the learning pyramid. Leaners with Attention-Deficit/Hyperactivity Disorder (ADHD), dyslexia, and other language processing disabilities, for example, will be missing one or more of these important building blocks from the third and second, or *perceptual/sensory* developmental, levels. Additionally, learners with autism spectrum disorder (ASD), for instance, often have mild, moderate, or even severe sensorimotor processing deficits which can profoundly affect tactile sensitivity,

proprioception, or vestibular integration. In other words, ASD and other sensory processing

disorders impact individuals at the first, or *systems*, level. Therefore, missing blocks at this

foundational level can inhibit the learning of even basic skills, such as motor functioning and

hand-eye coordination, without which a skill such as reading becomes nearly impossible

(Awalludin, 2019).

Figure 1

Sensory Integration and Development Williams & Shellenberger (1996)
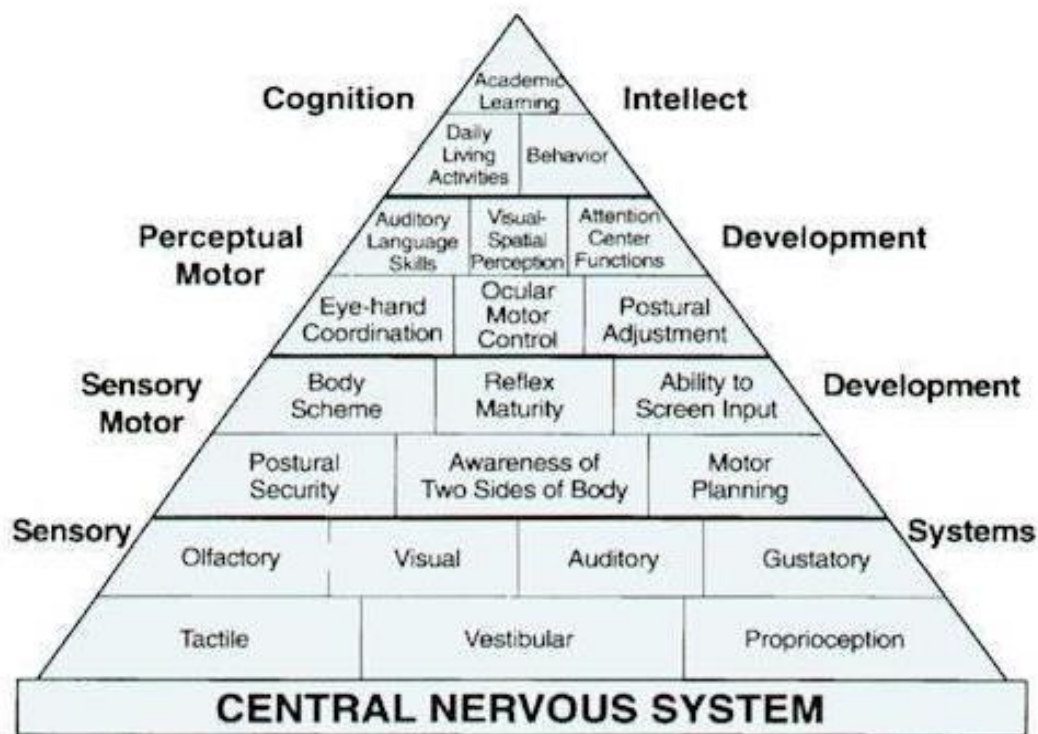
Note. Adapted from "Sensory integration and functional movement: A guide to optimal

development in early childhood," by Z. A. Awalludin, 2019, *Advances in Social Science,*

Education, and Humanities Research, 421, p. 312. CC BY-NC 4.0.

To that end, this study investigated the effects of sensory integration as well as visual processing relative to brain development and learning. Phonics-based literacy instruction, while an integral component of any reading program, focuses on the external processes involved in reading, which train and remediate surface level skills. Consequently, by investigating the instructional gaps between the *Reading First* and the ABC models and the subsequent impacts on reading achievement scores, this study sought to bridge this disconnect by informing the future of educational policy relative to reading pedagogy.

Dependent Variable. The dependent variable in this study was the Northwest Evaluation Association (NWEA) test for the English Language Arts (ELA) content area, which is a proxy test measuring reading achievement. The NWEA is an assessment instrument that uses psychometric calibration "to deliver valid and reliable assessments, stable measurement scales, and precise results" (NWEA, n.d.). Moreover, the NWEA platform provides contextual feedback to explain results which allows for "comparability studies to other assessment tools and . . . normative data" (NWEA, n.d.). Assessment results can subsequently be used by parents, students, teachers, school districts, state agencies, and public officials to construct meaningful interpretations of the data relative to instructional practices and education policy.

The Maine Department of Education, which governs public school accountability testing, requires school districts in Maine to administer the NWEA in the spring semester of each academic year for all students in third through eighth grade as well as students in their second year of high school. Maine Educational Assessments (2022) must also comply with federal requirements under the Elementary and Secondary Education Act (ESEA), the precursor to NCLB and ESSA.

Sampling Method

The ABC intervention model was implemented simultaneously to multiple schools within a district. Therefore, the ABC website lists its school clientele according to the districts that are integrating the neuroscience-based model within their literacy instruction blocks. The sample school districts, representing the independent variable group receiving treatment, were selected from this list. The sample's statistics were then compared to population parameters using the state of Maine average for ELA.

From the 33 school districts in Maine implementing the ABC model, 31 districts with available and relevant NWEA data were selected for the sample, with the exception of two districts with the highest English Language Learner (ELL) percentages. Public school students in Maine, who have been identified as English Language Learners, are assessed on their ability to use the English language across four domains, including reading. Based on the results of the assessment, students whose scores reflect limited English proficiency are supported through the development of multilingual learner plans and the allocation of additional school resources. However, ELL students are still required to take the NWEA assessment, and their scores are reflected in a school district's overall ESSA testing results (www.maine.gov/doe/Testing_Accountability/MECAS/materials/access). Because the neuroscience research included in the literature review does not specifically address intervention effects for individuals who are non-English speakers, but who are nevertheless learning to read English in school, the two ABC implementing school districts with the highest ELL percentages, 23.2% and 18.3% (maine.gov/doe/dashboard), were excluded from the study as outliers. The ELL average for the ABC implementing school units was 2.7%, with a standard deviation of 5.5. Therefore, the two ABC school districts excluded from the sample were both more than 2

standard deviations away from the sample mean in terms of the percentage of ELL students within their respective district. Consequently, the sample size for Q1, regarding *All* students, was 31, N = 31.

In addition, out of the 31 sample school districts, data for *Economically Disadvantaged* students was suppressed on the ESSA Dashboard for one district, so the sample size for Q2 was 30, N = 30. Similarly, from the 31 sample school districts, data for *Students with Disabilities* was also suppressed on the ESSA Dashboard for two different districts, thus the sample size for Q3 was 29, N = 29. These sample sizes met the minimum requirements, N = 27, for the bivariate parametric test that was used for this study with respect to the level of significance, the direction of the alternative hypothesis, the desired power, and the effect size selected for statistical analysis (Abu-Bader, 2021).

While the ABC literacy and intervention model is available to all schools, it is implemented on a contractual basis. Therefore, the sample group was established through convenience sampling. The convenience sample in this study was nonrandom because it was the only method by which to select participants for an intervention that was implemented on a school district scale and for a naturally occurring intervention. Although random samples are preferrable for statistical inferences to meet assumptions regarding population parameters, "virtually all samples used in social science and behavioral research are not simple random samples. The assumption of random selection is almost always violated" (Newton & Rudestam, 2013, pp. 140-141). Newton and Rudestam (2013) further explain that in studies where research is related to theory generalizability, such as in this dissertation, the goal is to explain a phenomenon across groups of people, thus the answer to the research question does not rely upon the statistics of random sampling. "The relationship between variables of theoretical

significance can be addressed with minimal attention to whether a sample matches the population" (Newton & Rudestam, 2013, pp. 143).

In addition, for some of the districts included in the sample, not all schools within the district were able to implement the intervention due to staff and other resource shortages which prevented full implementation.

Data Collection

In terms of data collection, I will be using secondary data that is publicly available through the Maine Department of Education website. The website hosts a dashboard which contains school district test score data pertaining to the Every Student Succeeds Act (ESSA). The ESSA data dashboard provides data at the district and school levels, and the Maine Department of Education complies with the Family Educational Rights and Privacy Act (FERPA), a federal law that protects the privacy of student education records (maine.gov/doe/data-reporting/privacy).

Students take the state standardized achievement test, the *NWEA*, in the Spring of each school year, and the ESSA Dashboard provides score data for school years as far back as the 2017-2018 school year. For this study, the most recent testing data will be used reflecting literacy achievement assessed during the 2020-2021 school year for *All* students.

The ESSA Dashboard additionally allows data to be disaggregated using various demographic categories. In order to account for the effects of socio-economic variability between sample groups, scores pertaining to the *Economically Disadvantaged* subgroup will also be used since research suggests that neurological exercises target the effects of traumatic experiences, such as poverty. The Maine Department of Education uses a student's Free/Reduced lunch status as a proxy for determining the *Economically Disadvantaged* criteria

per Maine state law (maine.gov/doe/schools/nutrition/economicallydisadvantaged). Likewise, to

account for the effects of students who receive Special Education services, scores pertaining to

the *Students with Disabilities* subgroup will be used since research indicates that neuroscience-

based interventions benefit students with neurological disabilities. In order to identify students

who are eligible to receive special education services, the Maine Department of Education

complies with the Individuals with Disabilities Education Act (IDEA). IDEA is a federal law

mandating a free and appropriate public education for all individuals, and the legislation outlines

how states and public agencies must provide early intervention and other related services to

students who meet special education eligibility criteria (maine.gov/doe/learning/specialed/law).

Procedures

The researcher's prior experience as an assistant principal provided a working knowledge

of public school administration from the standpoint of academic content standards, state

accountability testing, instructional leadership, and staff development, and it was through this

role where a colleague first introduced the ABC initiative. Therefore, the initial phase of this

study began by scheduling meetings with the lead consultant of the ABC literacy initiative to

discuss the evidence-based research supporting the neuroscientific exercises, the details of

intervention implementation within public schools, and the possibilities for data collection to

assess the effectiveness of the intervention relative to reading proficiency, as measured by ELA

achievement scores. Several conversations were arranged over the phone where the ABC

consultant recommended scholarly sources regarding the initiative's neuroscientific model.

After an extensive literature review to understand the impacts of neuroscience-based

exercises on neurological processes and connections to cognitive operations such as reading, the

researcher attended a full-day ABC workshop to learn about the program's framework relative to

public school implementation. In sum, the ABC model integrates neuroscience activities throughout the literacy block by embedding sensorimotor and visual tracking exercises before, during, and after phonics-based instruction in a sequence of centers. Additionally, staff facilitating activity centers are trained on exercise facilitation.

Next, the researcher asked the consultant to identify schools that had implemented the intervention. Since the consultant was based in Maine, schools identified were also from Maine. Because the intervention was implemented within the school setting to all learners in the environment, a true experimental design was not possible vis-à-vis randomly assigned treatment and control groups. However, since the purpose of the study was to inform public education policy, conducting research in a realistic environment was acceptable. Consequently, the researcher contacted several school district superintendents who had consulted with ABC to request access to literacy achievement data. But, after several phone and email messages, no responses were returned. Therefore, the researcher selected the treatment group from the list of school districts identified on the ABC website that implemented the intervention in their elementary schools. The ABC website also indicated that all school districts have continued or expanded their integration of the ABC literacy model after initial implementation.

Once a sample group of 31 school districts was selected from the ABC website, the researcher subsequently used the Maine Department of Education website to access ELA testing data for the ABC implementing school districts via the ESSA Dashboard. Although the dashboard provides testing data for the past 4 academic years, the Maine Department of Education switched from a paper version of a previous test, the eMPowerME assessment, to the digitally administered NWEA test in 2020-2021 in order to offer school districts more test administration flexibility due to COVID restrictions that were mandated in public schools. The

ESSA Dashboard notes, however, that the NWEA and the previous paper version of the test are not the same type of assessment, and testing results cannot be compared, thus making a pre-test and post-test quasi-experimental design not possible without reducing the sample size since most school districts in the sample group began ABC intervention implementation more than 4 years ago.

As a result, a pre-experimental design was selected where sample group ELA achievement data was statistically compared to the population data for the state of Maine based on the 2020-2021 test for *All* students, *Economically Disadvantaged* students, and *Students with Disabilities.* The ESSA Dashboard provided data filters for these latter 2 subgroups, and subgroup data comparisons between the sample and population data were conducted to add statistical integrity relative to the effectiveness of the ABC intervention across 2 conditions that adversely impact neurological development.

Data Analysis

A pre-experimental research design was used for this study, with a one group post-test structure, since the treatment group (X) was subjected to the intervention, the ABC literacy model, and then observed (O1) or tested for reading achievement using the NWEA English Language Arts assessment. Moreover, data was filtered demographically so that scores from the *Economically Disadvantaged* subgroup and the *Students with Disabilities* subgroup were also collected.

The dependent variable was continuous data, at the ratio level of measurement, and the measured variable (X, statistic) was compared with that of the population (μ, parameter), the Maine state average for ELA. This design framework suggested the use of a one-sample Case *t*-Test for statistical analysis with a one-tailed hypothesis, since the research hypothesis predicted a

positive direction change, at the 0.05 level of significance, which represents the most commonly reported confidence interval (Abu-Bader, 2021). Calculations were conducted using the Statistical Package for the Social Sciences (SPSS) software, and analyses were run for 3 ESSA Dashboard data sets: (a) *All* students; (b) *Economically Disadvantaged* students; and (c) *Students with Disabilities*. The significance of these results will be discussed in Chapter 4.

Also, because outlier scores can affect means and measures of variability that can, in turn, impact hypothesis testing conducted with inferential statistics, normality tests were run to confirm that the sampling data approached normal distributions across the groups posited in the three research questions, *All*, *Economically Disadvantaged*, and *Students with Disabilities*. The SPSS software was used to administer the Kolmogorov-Smirnov (K-S) and Shapiro-Wilk (S-W) tests, the most common normality tests, which are evaluated at the alpha .01 level of significance (Abu-Bader, 2021). The null hypothesis in normality tests indicates that the data distribution is not severely skewed and is therefore rejected if alpha is less than or equal to .01 ($p \leq .01$).

In addition, when examining the raw data, available in the Appendix in Tables 13 and 14, a pattern was noticed suggesting a potential relationship between NWEA ELA scores for *All* students, NWEA ELA scores for *Economically Disadvantaged* students, and the percentage of *Economically Disadvantaged* Students within the sample school districts. Consequently, three *Pearson*'s r correlation tests were also conducted using SPSS to determine if the results showed any statistically significant relationships between these variables. The significance of these outcomes will likewise be discussed in Chapter 4. It is important to note here that the results from the correlation analyses were not directly related to the effectiveness of the ABC intervention itself. Rather, the correlation results were used as an indicator for socio-economic inequity between school districts in the sample.

Limitations and Summation

Because the purpose of this study was to describe how a literacy intervention model, that incorporated a neuroscience-based framework, could serve as an indicator for public policy entrepreneurs to leverage the policy stream during the agenda setting process, it was guided by the following overarching research question: Do reading achievement scores among phonics-based, *Reading First*, literacy curriculum participants significantly increase when neuroscience-based intervention models are integrated into the program?

However, the natural implementation of the ABC model within existing public school settings, as well as changes that the Maine Department of Education made to the state standardized achievement test relative to COVID restrictions in public schools, created limitations preventing an experimental or quasi-experimental design. More specifically, random assignment of participants to the treatment group or a pre-test and post-test structure was not feasible. Consequently, the researcher used a pre-experimental treatment and post-test design with a normative strategy to compare sample quantitative testing data to that of a larger population. Moreover, due to the researcher's limited capacity to access sample school district administrators, this study did not include a measure to assess intervention fidelity. In other words, questions remain as to how accurately and thoroughly sample school district staff members implemented and facilitated the ABC intervention components relative to neuroscience-based activities and exercises.

Other potential sources of invalidity related to the reading achievement scores used for this analysis include the following confounding factors: longitudinal duration of ABC intervention within sample school districts, student transiency in and out of districts, student test taking ability, and level of intrinsic student motivation regarding reading proficiency. Since

these variables were not controlled in the study, and because they can affect a student's reading achievement score, they inhibit the generalizability of the data.

Therefore, the study was limited in the sense that the statistical analyses would not demonstrate the direct causality of reading achievement increases relative to the neuroscience-science based intervention. Nevertheless, the design still provided a statistical evaluation of the ABC model within the natural setting where it was intended to be implemented, and the results were still comparable to the population from which the sample was drawn since achievement score data was provided for the state average per Maine's ESSA Dashboard. Thus, conclusions were drawn and will be discussed in Chapter 5 in terms of the ABC intervention effectiveness along with the ability of this research to serve as a policy stream indicator for new education policy in the content area of reading. In addition, Chapter 5 will discuss how these results can be used to inform the direction of future research on the application of neuroscience within the field of educational pedagogy.

Chapter 4: Results and Analysis

This chapter analyzes the secondary data using both descriptive and inferential statistical methods to determine the significance of those findings relative to the effectiveness of the neuroscience-base ABC intervention model on reading achievement when integrated into public school literacy programs as well as the relationship between socio-economic levels and school district academic performance. First, data set descriptive statistics are conveyed to describe measures of central tendency and variability. Next, data set normality is discussed to address the appropriate selection of inferential statistics for hypothesis testing since the *t*-test assumes that the dependent variable, the NWEA reading achievement scores, are normally distributed in the study sample (Abu-Bader, 2021), the ABC implementing school districts. Third, results from the one-sample case *t*-tests are analyzed in relation to the three research questions and hypotheses. Finally, *Pearson's* r correlation outcomes within the sample set of school districts are evaluated to examine the relationship between variables related to educational equity.

Findings

Descriptive Statistics

Demographics. The information presented in Table 1 describes the sociodemographic percentages of students in Maine public schools in relation to the school units, or subgroups, included for statistical analysis. Because a one-sample case *t*-test was used to compare the mean percentages of students meeting or exceeding expectations on the NWEA English Language Arts assessment between school districts in the intervention sample and that of the known population mean of all public schools in the state of Maine, the table presents a profile regarding the demographic distribution of students.

First, the ALL column lists the percentage of students per school unit who completed the NWEA ELA assessment during the 2020-2021 academic year. Out of students eligible to take the assessment, 93.5 percent of students in the entire state took the test compared to the sample school districts, where 95.1 percent of students participated. The second column, labelled ECON, refers to the percentage of students per school unit who qualified for the *Economically Disadvantaged* subgroup. From the state pool of student test takers, 37.3 percent were eligible for the Free/Reduced lunch program, the proxy measure for the *Economically Disadvantaged* subgroup. From the sample school districts, 34.2 percent of student fell into this subgroup. The third column, SPED, refers to the percentage of students per school unit who qualified to receive special education services, thus representing the *Students with Disabilities* subgroup. From the state pool of test takers, 18.6 percent qualified compared to 18.1 percent of students in the sample school districts. Based on the data in Table 1, the sample district demographic percentages are representative of test takers in the overall state.

Table 1

Maine Public Schools: Sociodemographic Percentage of Students per School Unit

School Unit	Student %: ALL	Student %: ECON	Student %: SPED
State	93.5	37.3	18.6
Sample Districts	95.1	34.3	18.1

Note. ALL refers to the percentage of students who took the NWEA assessment per school unit. ECON refers to the percentage of Economically Disadvantaged students per school unit. SPED refers to the percentage of Students with Disabilities per school unit.

NWEA Assessment. Table 2 provides information about student proficiency regarding the English Language Arts (ELA) data presented on the Maine ESSA Dashboard. The ELA data is obtained from student performance scores on the reading section of the NWEA assessment

which covers academic content pertaining to literacy skills. The ESSA Dashboard subsequently

converts NWEA scores into three levels of performance: below expectations, at expectations,

and above expectations relative to a student's grade level (maine.gov/doe/dashboard). If a

student's score falls into one of the latter two categories, at or above expectations, the student is

considered to be proficient in reading achievement, which is a proxy measure for ELA.

The Maine ESSA Dashboard provides filters that allow users to view ELA data by school

district or the state as a whole. Individual student ELA scores are aggregated, and percentages

are calculated which reflect the number of students who scored at one of the three defined

performance levels. A separate filter further allows a user to disaggregate ELA data, per school

unit, by pre-identified subgroups. For this study, the *Economically Disadvantaged* and *Students*

with Disabilities subgroups were selected because students who qualify for those public school

services more specifically meet criteria reflective of factors and conditions addressed in the

neuroscience-based interventions discussed earlier in the literature review.

In this study, 31 school districts were included in the sample representing school units

that integrated the ABC intervention model into their literacy programs. When the mean ELA

scores for ALL test takers was calculated for the entire sample group, $n = 31$, 86.7 percent of

students were considered proficient on the NWEA assessment for reading achievement

compared to 85 percent for Maine state population. For the ECON sample subgroup, $n = 30$,

78.8 percent of *Economically Disadvantaged* student test takers achieved reading proficiency

compared to 76.3 percent of ECON students from the state population. In terms of the SPED

sample subgroup, $n = 29$, 58.3 percent of *Students with Disabilities* scored proficiently on the

NWEA reading assessment in comparison to 54.4 percent of students from Maine. Table 2

shows that each of the three sample group means were higher than the Maine state population groups.

Table 2

NWEA Assessment: English Language Arts Proficiency Data

NWEA Assessment Group	Sample Size *n*	NWEA Proficiency: Sample Mean %	Sample Standard Deviation	NWEA Proficiency: State Mean %
ALL	31	86.7	5.4	85
ECON	30	78.8	5.9	76.3
SPED	29	58.3	11.2	54.4

Note. The sample size for each subgroup was based on the NWEA data available through the ESSA dashboard. If data for a subgroup was suppressed, then that district was not included in the sample.

Results

Tests of Normality

In terms of the of the NWEA distribution for *All* (ALL) students in the sample group, the level of significance for both the Kolmogorov-Smirnov (K-S) and Shapiro-Wilk (S-W) tests was greater than the alpha of .01 (K-S: Sig. = .197; S-W: Sig. = .126) indicating that the distribution for *All* students was not significantly skewed. For the *Economically Disadvantaged* (ECON) sample group, levels of significance for both normality tests were also greater than alpha set at .01 (K-S: Sig. = .200; S-W: Sig. = .942) showing that the data distribution was not significantly skewed. Regarding the *Students with Disabilities* (SPED) sample group, the level of significance for both tests was again greater than the alpha of .01 (K-S: Sig. = .182; S-W: Sig. = .194) revealing that the distribution was not significantly skewed for the third subgroup as well.

Overall, the results of the K-S and the S-W tests showed that the data distribution for NWEA scores across all three sample groups approached the shape of a normal curve, therefor

the null hypothesis regarding normality is accepted. This evidence, presented in Table 3,

consequently confirmed that the one-sample case *t*-test was appropriate for parametric statistical

analysis.

Table 3

Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
NWEA: ALL	0.136	28	0.197	0.942	28	0.126
NWEA: ECON	0.080	28	.200[*]	0.985	28	0.942
NWEA: SPED	0.138	28	0.182	0.950	28	0.194

Note. * This is a lower bound of the true significance.

a. Lilliefors Significance Correction

Analysis

The overarching research question guiding this study asked if reading achievement scores

among phonics-based, *Reading First*, literacy curriculum participants would significantly

increase when neuroscience-based intervention models were integrated into the program. The

investigation structured to answer this question sub-divided the analysis into three research

hypothesis that matched the samples to the demographic data groups provided by the ESSA

Dashboard: *All*, *Economically Disadvantaged*, and *Students with Disabilities*.

With population data also available on the dashboard for all state of Maine student test

takers relative to the same demographic categories, three one-sample case *t*-tests were executed

in order to determine if the NWEA reading achievement sample means for ELA scores were

significantly different than the mean scores for the state population in each group. The

individual *t*-test results were then examined to collectively address this dissertation's guiding

question, which in turn was used to inform conclusions and recommendations regarding applications to public education policy and legislative agenda setting.

Research Question 1 (Q1)

The first sub-question looked at state standardized literacy achievement test scores for *All* public school students in Maine. The null hypothesis stated that there would be no statistically significant difference in scores between the sample school districts integrating the ABC intervention and the state of Maine student average, whereas the alternative hypothesis predicted that the sample school districts would score significantly higher than the Maine student average for *All* student test takers.

A one-sample case *t*-test was conducted to assess whether the mean percentage of ELA scores for a sample of N = 31 school districts differed from the Maine state average. For this sample, M = 86.7 and SD = 5.4. The one-sample *t* statistic was t(30) = 1.75, *p* = .045, one-tailed. Using p < .05 as the criterion for statistical significance confirmed that the results were significant. Therefore, the null hypothesis was rejected. The percentage of *All* students in the sample who scored at or above the expected level of proficiency in reading achievement was 1.7 percent greater than Maine state average indicating that the sample performance was significantly higher than the population. See Table 4.

Table 4

One-Sample Test: Test Value = 85

	t	df	Sig. (2-tailed)	Mean Difference
NWEA: ALL	1.746	30	0.091	1.6806

Effect Size. At the p > .05 level of significance, one-tailed, for a one-sample case *t*-test, with a sample size of 31 school districts, Cohen's definition was also used to calculate effect size. Effect size is a statistic that measures the magnitude of the relationship between two variables in a study by estimating the difference between the sample's mean and the population's mean. The effect size is further associated with statistical power which, in turn, relates to the probability of correctly rejecting a false null hypothesis, as is the case in this study. Essentially, a larger effect size is related to a more powerful statistical test. Accordingly, a 0.2 value is considered a small effect size, 0.5 a moderate effect size, and 0.8 a large effect size (Abu-Bader, 2021).

For the *All* students sample group, the Cohen's definition effect size statistic calculated the point estimate to be 0.314. See Table 5. This value falls in between a small and moderate effect size. Therefore, the 0.314 Cohen's definition value indicates that the independent variable in the study, the ABC intervention, had a higher than small effect on the dependent variable, NWEA test performance.

Table 5

One-Sample Effect Sizes: Cohen's Definition

		Standardizer[a]	Point Estimate
NWEA: ALL	Cohen's d	5.3601	0.314
	Hedges' correction	5.4989	0.306

Note. a. The denominator used in estimating the effect sizes.

Cohen's d uses the sample standard deviation.

Hedges' correction uses the sample standard deviation, plus a correction factor.

Research Question 2 (Q2)

The second sub-question looked at state standardized literacy achievement test scores for *Economically Disadvantaged* public school students in Maine. The null hypothesis stated that there would be no statistically significant difference in scores between the sample school districts integrating the ABC intervention and the state of Maine student average, whereas the alternative hypothesis predicted that the sample school districts would score significantly higher than the Maine student average for *Economically Disadvantage* student test takers.

A one-sample case *t*-test was conducted to assess whether the mean percentage of ELA scores for a sample of N = 30 school districts differed from the Maine state average. See Table 6. For this sample, M = 78.8 and SD = 5.9. The one-sample *t* statistic was t(29) = 2.35, *p* = .013, one-tailed. Using p < .05 as the criterion for statistical significance confirmed that the results were significant. Therefore, the null hypothesis was rejected. The percentage of *Economically Disadvantaged* students in the sample who scored at or above the expected level of proficiency in reading achievement was 2.5 percent greater than Maine state average indicating that the sample performance was significantly higher than the population.

Table 6

One-Sample Test: Test Value = 76.3

	t	df	Sig. (2-tailed)	Mean Difference
NWEA: ECON	2.350	29	0.026	2.5433

Effect Size. At the p > .05 level of significance, one-tailed, for a one-sample case *t*-test, with a sample size of 30 school districts, Cohen's definition was utilized to calculate effect size. See Table 7. For the *Economically Disadvantaged* students sample group, the Cohen's

definition effect size statistic calculated the point estimate to be 0.429. This Cohen's definition

value reflects that the independent variable in the study, the ABC intervention, had a nearly

moderate effect on the dependent variable, NWEA test performance.

Table 7

One-Sample Effect Sizes: Cohen's Definition

		Standardizer[a]	Point Estimate
NWEA: ECON	Cohen's d	5.9274	0.429
	Hedges' correction	6.0864	0.418

Note. a. The denominator used in estimating the effect sizes.

Cohen's d uses the sample standard deviation.

Hedges' correction uses the sample standard deviation, plus a correction factor.

Research Question 3 (Q3)

The third sub-question looked at state standardized literacy achievement test scores for

Students with Disabilities attending Maine public schools. The null hypothesis stated that there

would be no statistically significant difference in scores between the sample school districts

integrating the ABC intervention and the state of Maine student average, whereas the alternative

hypothesis predicted that the sample school districts would score significantly higher than the

Maine average for *Students with Disabilities* taking the NWEA examination.

A one-sample case *t*-test was conducted to assess whether the mean percentage of ELA

scores for a sample of N = 29 school districts differed from the Maine state average. See Table

8. For this sample, M = 58.3 and SD = 11.2. The one-sample *t* statistic was t(28) = 1.89, $p =$

.035, one-tailed. Using p < .05 as the criterion for statistical significance confirmed that the

results were significant. Consequently, the null hypothesis was rejected. The percentage of

Students with Disabilities in the sample who scored at or above the expected level of proficiency in reading achievement was 3.9 percent greater than Maine state average indicating that the sample performance was significantly higher than the population.

Table 8

One-Sample Test: Test Value = 54.4

	t	df	Sig. (2-tailed)	Mean Difference
NWEA: SPED	1.885	28	0.070	3.9138

Effect Size. At the $p > .05$ level of significance, one-tailed, for a one-sample case *t*-test, with a sample size of 29 school districts, Cohen's definition was utilized to calculate effect size. See Table 9. For the *Students with Disabilities* sample group, the Cohen's definition effect size statistic calculated the point estimate to be 0.350. This Cohen's definition value shows that the independent variable in the study, the ABC intervention, had a slightly less than moderate effect on the dependent variable, NWEA test performance.

Table 9

One-Sample Effect Sizes: Cohen's Definition

		Standardizer[a]	Point Estimate
NWEA: SPED	Cohen's d	11.1807	0.350
	Hedges' correction	11.4917	0.341

Note. a. The denominator used in estimating the effect sizes.

Cohen's d uses the sample standard deviation.

Hedges' correction uses the sample standard deviation, plus a correction factor.

Pearson Correlation 1

The first trend that was noticed in the raw data involved decreasing NWEA ELA proficiency percentages, for the *All* students subgroup in sample school districts, as the percentage of qualifying *Economically Disadvantaged* students increased. The *Pearson's* correlation for these two variables was statistically significant, r = -.54. See Table 10. This result shows a negative relationship between these two variables suggesting that more *Economically Disadvantaged* students within a school district adversely impacts the district's ability to produce a greater degree of reading proficiency for *All* students within that district.

Table 10

Pearson's r: NWEA ALL to ECON %

Correlations

		NWEA: ALL	Student%: ECON
NWEA: ALL	Pearson Correlation	1	-.564[**]
	Sig. (2-tailed)		.001
	N	31	30
Student%: ECON	Pearson Correlation	-.564[**]	1
	Sig. (2-tailed)	.001	
	N	30	30

**. Correlation is significant at the 0.01 level (2-tailed).

Pearson Correlation 2

Next, the data range with respect to the percent of students in the *Economically Disadvantaged* subgroup, within each of the sample school districts, was examined. See Table 11. The overall range extend 50.3 percentage points with a high of 62.2% and a low of 11.9%. When these percentages were aligned to the NWEA ELA proficiency scores for *Economically Disadvantaged* students, an unexpected observation occurred. The school district with the highest percent of *Economically Disadvantaged* students, at 62.2%, also had the highest NWEA

ELA proficiency percentage for *Economically Disadvantaged* students, at 90.5%. Therefore, a

Pearson's correlation was executed for these two variables, and the resulting value was smaller,

r = -.28, and not statistically significant. Consequently, it does not appear that variance in

NWEA ELA scores for *Economically Disadvantaged* students, in one direction or another, was

related to the percentage of *Economically Disadvantaged* students within district.

Table 11

Pearson's r: NWEA ECON to ECON %

Correlations

		NWEA: ECON	Student%: ECON
NWEA: ECON	Pearson Correlation	1	-.284
	Sig. (2-tailed)		.129
	N	30	30
Student%: ECON	Pearson Correlation	-.284	1
	Sig. (2-tailed)	.129	
	N	30	30

Pearson Correlation 3

Finally, a third variable was created to look at the difference between each sample school

district's NWEA ELA proficiency scores for *All* students as compared to that district's own

Economically Disadvantaged student NWEA ELA proficiency scores. See Table 12. The

Pearson's correlation between this new variable and the percent of *Economically Disadvantaged*

students within district was statistically significant, r = -.43. This negative relationship shows

that as the percentage of *Economically Disadvantaged* students within the sample school districts

increases, the range in NWEA ELA scores between *All* students and *Economically*

Disadvantaged students narrows, which possibly implies the existence of educational inequity

related to the availability of economic resources.

Table 12

Pearson's r: NWEA ALL minus ECON to ECON %

Correlations

		NWEA: ALL–Econ	Student%: ECON
NWEA: ALL–Econ	Pearson Correlation	1	−.432*
	Sig. (2–tailed)		.017
	N	30	30
Student%: ECON	Pearson Correlation	−.432*	1
	Sig. (2–tailed)	.017	
	N	30	30

*. Correlation is significant at the 0.05 level (2–tailed).

Summary

Chapter 4 presented the research findings from data that was gathered and interpreted in order to answer the overarching question framing this dissertation: Do reading achievement scores among phonics-based, *Reading First*, literacy curriculum participants significantly increase when neuroscience-based intervention models are integrated into the program? The subsequent analysis structured three hypotheses to examine the significance of the intervention relative to reading performance as measured by ELA achievement score percentages comparing sample school districts to the state of Maine student population across three subgroups selected for their relevance to the intervention: *All* students, *Economically Disadvantaged* students, and *Students with Disabilities*.

Three one-sample case *t*-tests were administered to determine if a statistical significance existed in terms of sample versus population means. Finally, effect sizes were calculated for each *t*-test to evaluate the relationship of the independent variable, the neuroscience-based intervention, to the dependent variable, reading proficiency.

First, descriptive statistics showed demographic similarities, between sample and population, regarding the percentage of *All* students who took the NWEA assessment as well as the percentages of *Economically Disadvantaged* students and *Students with Disabilities* comprising the tested school units.

Tests of normality were additionally conducted to verify that each school unit's data distribution was normal, thereby confirming the appropriate use of the one-sample case *t*-test for statistical analysis.

Next, the *t*-tests that were executed to compare ELA proficiency percentages between the three sample groups and the population all revealed statistically significant differences for the means. This result provides evidence which demonstrates that the higher ELA percentages for the sample school districts across each of the three subgroups could be attributed to the ABC intervention.

The Cohen's definition statistic for effect size was also computed for the three *t*-tests. The point estimate for *All* students had a higher than small effect, the effect size for *Economically Disadvantaged* students was nearly moderate, and the value for *Students with Disabilities* was slightly less than moderate. These results add to the significance of the *t*-test statistics by corroborating that the ABC intervention had between a small to moderate effect upon the reading proficiency scores relative to each of the sample school district groups.

Lastly, *Pearson's* r correlation coefficients were computed relative to the NWEA ELA scores for the *Economically Disadvantaged* and *All* students subgroups in relation to the percentage of *Economically Disadvantaged* students within each school district from the sample set. Outcomes from the two correlation statistics comparing the reading proficiency scores for

All students to those of *Economically Disadvantaged* students showed a significant negative

relationship between these two variables.

Chapter 5: Conclusion

Discussion

This dissertation had the following dual purpose. First, it sought to examine the effectiveness of a neuroscience-based intervention on reading proficiency when integrated into a public school literacy program implementing the *Reading First* model. Second, it explored the use of this study as a resource for policy entrepreneurs to influence an education policy idea by leveraging the *policy* stream described in the Multiple Streams Approach (MSA) to public policy agenda setting.

In terms of the first purpose, the literature review in Chapter 2 discussed the evolution of reading instruction over the last century highlighting its strengths and limitations including the currently employed *Reading First* framework that was codified under NCLB, a precursor to the Every Student Succeeds Act, which is the existing federal policy governing public education in the United States. Because standardized testing data for literacy achievement had shown a stagnation in learning progress despite the continuous influx of instructional interventions ranging from cognitive supports to school-wide structural changes, a problem was identified related to the need for a new intervention strategy to effectively improve reading achievement. In addition, scholarly evidence also showed that reading deficiency in students led to cascading difficulties for individuals and societies. Essentially, reading deficits, if not remediated by the third grade, increased the likelihood that a student would drop out of high school (Hernandez, 2012) which, in turn, increased the odds that a student would face incarceration. At the societal level, greater rates of incarceration caused lower tax revenues while raising civic costs, hence the important connection between reading ability, educational outcomes, and the collateral effects on the public (Sum et al., 2009).

Consequently, new research was introduced with the potential to fill this learning gap. Recent studies targeting neuroscience-based interventions showed significant effects that impacted the underlying skills and abilities of individuals in terms of sensorimotor reintegration and visual tracking, particularly for individuals with neurological impairments or trauma histories. Nevertheless, despite the scientific research supporting this novel approach to neurological remediation, which was also foundational to subsequent higher order cognitive processes such as academic learning (Awalludin, 2019), no peer-reviewed literature existed examining such interventions in school settings, primarily since neuroscience-based interventions were not being integrated into academic instructional models such as literacy programs.

Furthermore, because the education reform needed to scale up such an intervention would likely require the resources typically provided through policy changes, a public administration mechanism for change would also be required, hence the MSA. To that end, regarding the second purpose, although the Multiple Streams Approach has been utilized by policy advocates to combine elements from the *problem*, *political*, and *policy* streams in order to influence legislative agendas, the MSA model, in comparison to other public policy areas, had little comparative applicability as it pertains to education policy (Young et al., 2010).

Therefore, this dissertation framed an investigation to these problems through the following primary research question: Do reading achievement scores among phonics-based, *Reading First*, literacy curriculum participants significantly increase when neuroscience-based intervention models are integrated into the program? By evaluating the effectiveness of the ABC intervention in a sample of school districts, within Maine, integrating this new model, and then comparing their standardized reaching achievement scores to the state population average, the

results, if statistically significant, would support the use of this research as an influential

indicator relative to the MSA *policy* stream. Moreover, to enhance the validity of the results, the

research question was tested across three hypotheses that analyzed reading proficiency scores for

All students in Maine as well as for the *Economically Disadvantaged* and *Students with*

Disabilities subgroups. Data for the latter two subgroups was specifically disaggregated in order

to assess the effect sizes of the neuroscience-based ABC intervention due to the higher levels of

trauma history (Masgutova, 2016) and neurological impairments (Bell et al., 2019; Masgutova et

al., 2016) experienced by these students.

Interpretations

Research Question 1 (Q1)

Sub-question one of this dissertation first examined the effects of the ABC intervention

on *All* students in the sample school districts compared to all student test takers in the state

population as a whole. As the literature review in Chapter 2 highlighted, due to the varying

levels of severity and wide-ranging symptoms associated with neuro-developmental deficits,

such as those observed in dyslexia, ASD, and ADHD, neurological disorders are underdiagnosed

(Taylor et al., 2004). Second, because the activities included in the ABC intervention use reflex

integration techniques and visual tracking exercises to support the neural patterns and brain

structures present in all individuals (Masgutova, 2016), the ABC intervention impacts all

students.

In terms of the sample school districts, although not every school within each school

district implemented the ABC intervention, for each school that did integrate the intervention, all

students were included. Lack of district resources, mainly pertaining to the number of staff

needed to facilitate intervention activities, was the primary reason that some districts were not

always able to administer the intervention across every school. Under these circumstances, the affected school districts first concentrated ABC intervention resources in their elementary grades. However, because the ABC website lists its clientele by district, the reading achievement scores obtained from Maine's ESSA Dashboard and included in the data analysis were based on district percentages.

For the one-sample case *t*-test involving *All* students, the sample size included 31 school districts that implemented the ABC intervention. This represents thousands of students who participated in the intervention activities and exercises. With respect to this sample group, the SPSS output revealed a statistically significant result for a one-tailed hypothesis. This outcome indicates that the percentage of students in the sample, who were reading at or above grade-level expectations on the NWEA assessment, Maine's proxy measure for literacy achievement or ELA proficiency, was significantly higher than the ELA average for *All* students in the population, which included every student test taker in the state of Maine.

Although the *t*-test verifies that sample percentages were significantly higher than the population relative to the dependent variable, the NWEA scores, the statistic does not necessarily confirm that it was caused by the independent variable, the ABC intervention. However, because public schools are governed by federal policy which regulates the implementation of the *Reading First* phonics literacy model, it is logical to assume that reading instruction in the sample and population school units was fairly standardized. Further, descriptive statistics regarding demographics also showed that the student test taker categories most relevant to this intervention were extremely similar between sample and population. Therefore, the ABC intervention representing the independent variable was a major isolated difference between the sample and population groups. Considering that this independent variable was implemented in

active school settings, and with the limited resources available for this study, this pre-experimental design presented the best situation for analysis.

 With that, the SPSS software was also used to calculate the effect size for the first hypothesis test. The calculation indicated a higher than small effect size. Because the effect size statistic validates the power of the study in terms of the effect of the independent variable upon the dependent variable, it was included here to add credibility to effectiveness of the ABC intervention as a valuable method for increasing reading ability by activating the neurological processes that need to be engaged during phonics instruction. Consequently, the alternative hypothesis for research sub-question number one can be accepted. Within the state of Maine, public school districts that integrated the ABC literacy model will score significantly higher on the state standardized literacy achievement test for *All* students than the state of Maine student average.

Research Question 2 (Q2)

 Dissertation sub-question two next examined the effects of the ABC neuroscience-based intervention on *Economically Disadvantaged* students in the sample school districts compared to the same subgroup of student test takers in the Maine state population as a whole. As the literature review in Chapter 2, as well as in the discussion section above, pointed out, traumatic events, such as the neglect experienced by those in poverty (Masgutova, 2016), can adversely impact an individual's neurological processing system thereby stunting reflex integration that normally matures during the developmental stages learning progression. Again, these earlier stages are precursors to the intellection growth necessary for expected reading acquisition, resulting from the solid and stable academic learning framework formed at the top of the learning pyramid.

For the one-sample case *t*-test involving *Economically Disadvantaged* students, the sample size included 30 school districts that implemented the ABC intervention and whose ELA proficiency data was available on the Maine ESSA Dashboard. For this sample subgroup, the SPSS output also revealed a statistically significant result relative to a one-tailed hypothesis. The outcome shows that the percentage of students in the sample, who were reading at or above grade-level expectations on the NWEA assessment, was significantly higher than the ELA average for *Economically Disadvantaged* students in the population.

The SPSS calculation for effect size regarding the second hypothesis test produced a nearly moderate effect, which was a greater result than that for *All* students. This statistic further confirmed the benefits of sensory motor, proprioceptive, and vestibular exercises in terms of their contribution to strengthening the underlying abilities needed by students to more effectively access the academic activities used throughout literacy instruction, particularly for *Economically Disadvantaged* students whom are more likely to be affected by neurological trauma. Thus, the alternative hypothesis for research sub-question number two can likewise be accepted. Within the state of Maine, public school districts that integrated the ABC literacy model will score significantly higher on the state standardized literacy achievement test for *Economically Disadvantaged* students than the state of Maine student average.

Research Question 3 (Q3)

The third research sub-question finally examined the effects of the ABC neuroscience-based intervention on *Students with Disabilities* from the sample school districts in comparison to the same subgroup of student test takers in the state of Maine population. Regarding the three groups used for hypothesis testing, the *Students with Disabilities* subgroup experiences the greatest degree of neurological disorder, hence the eligibility to receive special education

services. The learning disabilities of students who qualify for special services include attention and memory deficits, language and sensory processing disorders, and other motor limitations that inhibit many basic living and behavioral functions which, in turn, compromise cognitive ability and academic learning potential (Awalludin, 2019; Bell et al., 2019; Masgutova et al., 2016).

The one-sample case *t*-test involving *Students with Disabilities* included 29 school districts in the sample that implemented the ABC intervention and for whom ELA proficiency data was available on the Maine ESSA Dashboard. Once again, the SPSS output presented a statistically significant result for this one-tailed hypothesis. The output shows that the percentage of *Students with Disabilities* in the sample, who were reading at or above grade-level expectations on the NWEA assessment, was significantly higher than the ELA average for the same subgroup of students in the population.

The effect size calculation produced by SPSS for the third hypothesis unveiled a slightly less than moderate effect. Therefore, the intervention effect on reading achievement for *Students with Disabilities* was lower than that for *Economically Disadvantaged* students but higher than the effect for *All* students. Consequently, the result verifies the positive or value-added utility of the ABC neuroscience-based intervention model when it is integrated into the *Reading First* program. The intervention not only strengthens the academic capacity of *Students with Disabilities*, it also improves the learning ability of all students. With this outcome, the alternative hypothesis for research sub-question number three can be accepted. Within the state of Maine, public school districts that integrated the ABC literacy model will score significantly higher on the state standardized literacy achievement test for *Students with Disabilities* than the state of Maine student average.

Study Limitations

Consistent with quantitative research applications, where generalizing results to a wider population or confirming that an independent variable causes effects on the dependent variable meets the experimental standard, this dissertation attempted to follow suit in that regard. However, as the methodology in Chapter 3 alluded to, this study was met with several limitations which presented threats to validity relative to that experimental research standard.

First, the independent variable was defined as a neuroscience-based intervention that was actively being integrated into existing public school literacy programs, within sample school districts. Therefore, rather than the random sampling required for true experimental research, this study needed to employ a convenience sample. Similarly, because sample school district administrators selected to implement the intervention due to its evidence-based benefits for all learners, separating students into intervention and control groups within the district was also not ethically possible.

Next, in terms of data collection and analysis, the reading achievement test percentages, representing the dependent variable via NWEA/ELA scores, were aggregated by school district when obtained from the Maine ESSA Dashboard. However, for some of the districts included in the sample, not all schools within the district were able to implement the intervention due to staff and other resource shortages which prevented full implementation. This means that some of the sample school unit percentages included in the *t*-test analysis contained reading achievement test scores from students who did participate in the intervention. Without more detailed access to student testing records, it was not possible to calculate whether this particular limitation would have actually increased or decreased the district's overall reading proficiency percentage.

Third, due to the researcher's limited capacity to access sample school district administrators, this study did not include a measure to assess intervention fidelity. In other words, questions remain as to how accurately and thoroughly sample school district staff members implemented and facilitated the ABC intervention components relative to neuroscience-based activities and exercises.

Consequently, the pre-experimental research design used for this study limits the researcher's ability to determine the causality of effects on the dependent variable, reading achievement, by the independent variable, the ABC intervention. As such, these limitations also compromise the generalization of results from sample to population, as would be the case in a true experimental design. Nevertheless, the statistically significant *t*-test results across the three tested groups, as well as the small to nearly moderate effect sizes, show promise in terms of using the ABC intervention as an agenda setting indicator for public education policy, especially in support of funding provisions for future research.

Professional Practice Take-Aways and Recommendations

The fact that all three *t*-tests produced statistically significant results, thus the acceptance of all three alternative hypotheses, renders an unequivocally positive answer to the overarching research question guiding the study. Stated another way, reading achievement scores among phonics-based, *Reading First*, literacy curriculum participants significantly increased when neuroscience-based intervention models were integrated into the program.

Consequently, the recommendations for practice provided in this section will outline the MNRI recovery exercises, many of which form part of the ABC intervention's neurosensorimotor reflex integration program. The MNRI protocol (Masgutova, 2016) is divided into five steps, each containing several exercises that either rehabilitate stressed neural

circuits or that activate dysfunctional reflex patterns in order to repair and strengthen the Central Nervous System which forms the foundation of the learning pyramid.

Step one targets the reduction of hyperactive reflex responses that can disrupt self-regulation, and exercises include Tactile Stroking, Fear Paralysis Reflex recovery, and the Moro Embrace. Step two enables the kinetic differentiation of reflex patterns maintaining the conscious control of rational thoughts. Exercises involve cross-lateral movements such as Leg Cross Flexion-Extension, Sequential Arms Opening, Eye Tracking, and Hands Pulling. Step three promotes sensory distribution that supports physical stability. This group of exercises incorporates Hand Grasp, Foot, Grasp, and Foot Metatarsi/Big Toe rotation. Step four regulates stress hormones through the removal of excess adrenaline and cortisol that are toxic to tactile receptors. Detoxification exercises are comprised of the Babinski stimulation, the Perez movement, and the Abdominal Sleep Posture. Finally, step five maximizes brain wave patterns integral to cognitive operations such as attention and executive functioning.

Exercises entail the Galant procedure, Trunk Extension, and Foot Tendon Guard. An intervention program that facilitates this recovery protocol will improve the coordination, timing, speed, and sensitivity of the neurotransmitters and reflex patterns (Masgutova, 2016) which initiate the motor and cognitive responses regulating the brain's sensory, perceptual, and intellectual processes (Awalludin, 2019), all of which are demanded during literacy instruction. With this in mind, early and long-term rehabilitation may be required for students with progressively more severe neurological conditions or traumatic experiences before intervention exercises have a noticeable effect on neurological performance (Masgutova, 2016).

Recommendation for Future Research

As illustrated through Figure 1 in Chapter 3, despite research that describes the hierarchical development of the *sensory*, *motor*, and *perceptual* blocks, that are pre-requisites for *cognitive* learning, such as literacy, the *Reading First* instructional paradigm taking place in public school schools does not account for these foundational skills, and neither do the academic or special education interventions currently being employed. Although instructional methods and accommodations, such as smaller groups, communication devices, alternative settings, modified assignments, or assist staff are being used to support learners, they are essentially strategies for increasing contact time, diversifying academic materials, or layering additional repetition. In other words, providing more of the same, at a slower pace, or a combination of both strategies within the top level of the pyramid, but not a program for remediating pre-requisite skills found in the lower levels.

Considering the large numbers of students that are diagnosed with learning, language, or sensory processing disorders along with the students that are undiagnosed, the *Reading First* instructional model is either not serving or underserving many learners attending public schools today. This phenomenon may explain the below-proficiency national reading average for fourth grade students (National Center for Educational Statistics, 2016) compounded by a flat trend in reading achievement overall (Hernandez, 2012). However, this is not to say that the *Reading First* model is without merit. For students who are not missing or are not underdeveloped in their developmental learning blocks, and thus independently and effectively operating at the *cognitive* level, the *Reading First* academic strategies have proven to be successful in promoting reading achievement (National Research Council, 1998; National Reading Panel, 2000).

Therefore, a significant part of the problem lies in the organizational and administrative structure of public schools. Learning standards are framed, or organized, to deliver academic content, consequently public school schedules and structures are designed to administer academic activities and interventions. On the other hand, perceptual, motor, and sensory skills are occupational and neurological in nature, so skill reinforcement and deficit remediation take a non-academic form. Hence, where and when should such development take place, and who should facilitate these interventions? After all, public school teaching credentials are not physical therapy certifications. Enter the ABC intervention model which integrates neuroscience-based activities into the *Reading First* program.

Based on the study limitations described earlier, recommendations for future research primarily include the development of research designs that establish conditions nearing that of true experiments. With more time and school district accessibility to records and staff, the succeeding follow-up studies can be conducted to confirm the validity of intervention effectiveness and the potential causality of those effects: pre and post-test designs can look at intervention effects for the same group before and after implementation, specific students attending intervention versus non-intervention schools/districts can be compared, one type of case study can examine the effects of the ABC intervention on students who start receiving the intervention at younger ages, another type of case study can conduct a longitudinal examination of intervention effects across time, and a qualitative study can focus on intervention integrity relative how well the ABC intervention is facilitated in terms of rigor and consistency.

Considering the extent to which researchers would need to access public records and facilities, in addition to the number of resources needed to carry out such studies, the level of public support both administratively and financially would necessitate public authorization in the

policy domain at local, state, and perhaps even federal levels. With that, the purpose of this dissertation was to serve as a catalyst for a first step towards awareness and inclusion in education policy discussions by political actors with influence over the agenda-setting process, and in that regard, it has succeeded in aligning to the Multiple Streams Approach.

Public Policy Implications

Some final thoughts regarding the ABC neuroscience-based intervention relate back to the ironic deficiency of the No Child Left Behind (NCLB) policy to produce reading proficiency in all children. In fairness, NCLB did endorse *Reading First*, an evidence-based literacy program focused on phonics, vocabulary, and fluency development, therefore policymakers made the best decision possible with the information provided at the time. However, NCLB's shortcomings involved *Reading First's* inability to support learners whose learning needs fell outside the scope of academic style instruction. In other words, public schools were, in fact, leaving children behind because educators and administrators lacked the scientific knowledge needed to design more targeted interventions. Fortunately, with new evidence-based information now available to assist in the understanding of learning at the neurological level, policymakers should take every measure necessary to adequately support current federal education policy, entitled the Every Student Succeeds Act (ESSA).

However, beyond simply mandating school administrative units to develop more standardized tests and academic benchmarks, education policymakers should empower and finance the research and development of learning interventions that increase the scope and depth of instructional strategies to include exercises that target the cognitive, perceptual, motor, and sensory learning needs of all students. Moreover, the correlation analyses included in this study potentially represent significant economic inequity issues related to educational resources, which

further confirms the need to expand programs such as Title I. Hopefully, this dissertation can arm policy entrepreneurs with the knowledge that they need to influence such political action. Otherwise, the Every Student Succeeds Act will be yet another education policy that fails to live up to its name. Even more consequentially, the failure to invest in education now will only result in growing costs to society later. "Intervention programs aimed at 'at-risk' youth can produce returns of up to fourteen dollars for every state dollar invested, realizing reduced costs in court costs, school dropout rates, adult crime prosecution and expenditures on public assistance" (Anton & Temple, 2007, as cited in Gooden, 2015, p. 225).

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Appendix – Raw Data

Table 13

Maine Public Schools: Sociodemographic Percentage of Students

School District	Student %: ALL	Student %: ECON	Student %: SPED
1	92.8	56.1	
2	97.9	18.8	16.2
3	95.9	14.9	14
4	95.5	28.1	18.5
5	93.7	42.2	22.7
6	98.8	36.6	17.7
7	96.5	22.2	12.3
8	95.3	11.9	14.6
9	85.6	22.4	
10	97.9	49.2	15.7
11	97.2	27.8	20.2
12	93.2	28.6	19.8
13	96.8	23.8	21.7
14	92.1	47.5	19.4
15	95.2	47.6	18.8
16	89.6	28	23.1
17	98.3	41.8	20.2
18	95.8	17.5	17.9
19	97.2	59.7	22.7
20	95	30	17.3
21	98.6	62.2	14.6
22	96.6	35.4	25.2
23	92.6	27.8	18.3
24	94.5		14.5
25	95.2	47.6	18.5
26	95	25.5	16.6
27	98.1	17.3	11.1
28	96.3	32.5	18
29	90.8	30	17.8
30	95.5	43.8	18.9
31	93.4	51.9	19

Table 14

NWEA Assessment: English Language Arts Proficiency Percentages

School District	ALL	ECON	SPED
1	76.1	70.4	
2	93.5	79.8	72.7
3	90.7	81.4	59.5
4	87.2	78.9	54.6
5	79.4	71	44.2
6	83.5	77.8	50
7	94.1	88.1	70.4
8	88.7	82.2	57.2
9	84.3	74.6	
10	77.8	70.3	42.7
11	91.6	83.3	68.4
12	84.5	67.7	61.6
13	91.1	82	71.6
14	80.8	71.6	53.6
15	79.9	73.7	40
16	85.6	77.9	56.2
17	85.4	77.7	53.1
18	93.6	87.9	73.3
19	89.5	86.6	61.8
20	84	78.5	50
21	92.6	90.5	69.4
22	89.9	84.5	70.2
23	91.5	84.6	68.8
24	96.1		81.7
25	80.5	73.3	39.1
26	87.9	76.9	57.6
27	90.1	83.8	50
28	89.5	81.7	62.8
29	85.9	80.1	56
30	81.7	74	49.1
31	80.1	74.5	45.5