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The Effect of Common Core Standards on Elementary Students' Learning

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Abstract

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Abstract

After implementing the Common Core Standards in 2012, local school districts faced additional costs in their annual budgets to train staff how to teach using these standards. One of the problems that faced the school district under study was whether to retain the Common Core Standards and to continue to fund the expense of training teachers . The purpose of this study was to assess the influence of the Common Core Standards on student achievement in a local Pennsylvania school district using scores from the Pennsylvania System of School Assessments (PSSA) for Grades 3 through 8. The research question addressed whether there were differences in the students' learning as measured by the PSSAs for the years before and after implementation of the Common Core Standards. The theoretical framework of the study was based on Piaget's constructivist theory of knowing, which explains how students know what they have learned in the active process of learning. A causal–comparative design was used for this study with extant test data drawn from 2 years before and 2 years after implementation. The total sample size was 27,605. A MANOVA was used for all grades' scale and raw scores to discern if a main effect could detect student achievement measured after the implementation of the Common Core Standards was lower than that reported before implementation and the standards had a mixed influence on student learning. This study has an implication for positive change. If educators have a better understanding of the effect of the Common Core Standards on student learning than they would be able to justify additional training.

Dedication

This study is dedicated to the true love of my life–my son William. He is my true reason for living. I would also like to dedicate my work to my father and my mother, Bill and Dorothy Arner, for their unconditional love and support. I could never have come this far without them. I am also grateful to my brothers Billy and Matt along with their families. My faith and my family are the two things in my life that keep me alive. Finally I thank in loving memory my dear friend Cheryl Kress who had shown me through her short life – how to be a strong woman and an amazing friend to everyone. In memory of my friend Victoria Ferrara – who showed me how to be the best mom possible. And to all of my family and friends who supported this amazing journey – Thank You!

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Section 1: The Problem

Introduction

The Common Core Standards for k-12 schools were developed in a joint effort that included the National Governors Association, the Council of Chief State School Officers, and the Bill and Melinda Gates Foundation (Lee, 2011, p. 43). In order to ensure the goal of instructional continuity across states, it is imperative that all states adopt them. As encouragement, former President Obama tied federal funding deriving from the Race to the Top initiative to participation in the Common Core program. As a result of the Race to the Top funding for the Common Core and other incentives, 42 states and the District of Columbia have officially adopted the standards. Five states have not: Alaska, Hawaii, Minnesota, Nebraska, Texas, and Virginia (Common Core State Standards Initiative, 2011b).

The stated intent of the standards is to provide teachers and parents with an outline and an understanding of what learning is expected from students no matter where they live (Common Core State Standards Initiative, 2011a). Through years of planning, consultations, and drafting, the Common Core Standards have been honed to speak clearly to the academic requirements for college and work. The standards were expected to provide a very strong content and application of knowledge that lead students to a higher academic skill. The standards also align each student with academic expectations in other countries so that students in the United States can compete in an increasingly globalized world (Common Core State Standards Initiative, 2011a). At present, and for

the foreseeable future, the standards are focused on English and language arts and mathematics. These three subjects are the foundation on which the other subjects rest (Core Standards, 2011). There are no plans to expand the standards into other subject areas; however, there are separate standards for ESL learners with disabilities.

Reactions to the Common Core Standards among educators vary. Ballard (2010) noted that educator organizations and associations are divided on the Common Core Standards' relative merits (or lack thereof). It is also pointed out that there is a substantial amount of federal money tied to these standards, so the incentive to make them work is in integrating them into the existing standards, such as the National Educational Technology Standards for Students. Garfunkel (2010) observed that regardless of one's opinion, 42 states (at the time of his writing) had adopted the standards, making them de facto national standards as opposed to the state-level standards educators used for decades. In fact, the spread of the Common Core Standards was a large part of the Obama Administration's stance on education (Sloan, 2010).

Former President Obama's education plan acknowledged that federal money was available to schools that implemented the standards. The plan also explained the rapidity with which the standards were written, revised, and adopted. According to Garfunkel, the Common Core Standards were "here to stay" (2010, p. 278). Garfunkel commented that the standards are rather general statements about what students are expected to learn by the end of each year. These expectations require that teachers apply new techniques to their current curriculum (Ballard, 2010).

Educating teachers and staff on the standards curriculm through workshops and resources would prove to affect school districts budgets. A University of Pennsylvania study stated that Common Core Standards would bring any additional costs to schools (Izumi, 2012). The Independent Regulatory Review Commission (IRRC, 2013), which reviews Commonwealth agency regulations, stated that the state's education department had indicated that the proposed regulation would not impose any new costs on school districts. The Independent Regulatory Review Commission disagreed and reported that the state education department's reports did not adequately address the fiscal impact.

One drawback of the Common Core Standards is there are no provisions for gifted and talented students (Johnsen, 2012). Johnson asserted that the challenges of being a gifted student is acceptable because the standards themselves are rigorous enough. Educators of gifted and talented students disagreed, saying that this was not the case and that these students would readily exceed the requirements of the standards and once again find themselves bored and unchallenged in school (Kendall, 2011). Johnsen (2012) recommended differentiating the Common Core Standards for such students to meet their needs. This author spoke not only to a limitation in the standards, but also to the freedom of teachers to modify the standards so long as the goals are met. According to Johnson (2012) more foundational drawback concerned the reason the Common Core Standards were created in the first place. One of the justifications for these national standards was that U. S. school children perform at a pace behind students in other countries (Harvard University, 2013). Another justification was that the national

economy relied upon the implementation of these standards, ostensibly because these standards would raise student performance and improve future job/career performance, as well as improve overall innovation and ingenuity (Tienken, 2010). However, as Tienken (2010) noted, most other countries test only selected groups of their students, often eliminating those from impoverished backgrounds. Given that poverty is the most important factor when considering whether students will perform well in school, and this skewed the results considerably. Luciano (2014) also commented that no research to date demonstrated any kind of cause-effect relationship between academic performance of a nation's students and economic performance of the nation itself within the seven years of its implemenation. Thus, the two foundations upon which the Common Core Standards were based are dubious and call into question the standards themselves.

On the other hand, the testing's rigor sought to elevate the overall standard for the majority of students. As Kern (2012) pointed out, the requirement that students learn how to read and interpret informational texts in the early grades can inspire them to become more avid readers and make connections between what they read and what they experience in the real world; the requirement could also prepare them for secondary education, where 80% of what students read is informational.

Because of this divided opinion on Common Core State Standards, some believe it would be better to start small—implement the standards in a few schools and then build upon their success (Lee, 2011). However, the almost complete nationwide sweep of states adopting the standards indicated that the majority of people (including those who hold

positions of power) thought it better to implement them on a wide scale from the beginning (Kendall, 2011). Nielson (2013) believed that children are being used as experimental products manufactured by corporations. Only time and further research can indicate whether implementation of the standards was a sensible approach.

Definition of the Problem

School administrators and educators are in an ongoing battle over the implementation of Common Core Standards. According to a mid-Atlantic school district's budget message (Larson, 2015) the district was facing a $3 million reduction in its 2016-2017 budget. Larson pointed out that the main reason for the depleted budget was decreases in schools' enrollments. The Bucks County Intermediate Unit (Berdnik, 2014) calculated a 14.7% decrease in the district's budget from 2009 to 2015.The Pennsylvania state department of education works with school districts in many areas of education, including planning, developing and implementating curricula within the schools. The standards are the curricula that the local education board uses in local schools. The correct approaches to teaching of the standards are shared with the school district's teachers and staff through workshops that are run throughout the year, including a 5-day summer program. One of the problems that faced the school district under study was whether to retain the Common Core Standards and to continue to fund the expenses of training teachers in the standards. Making that decision was made more difficult by the lack of data on the standards' effect on student learning.

The local school district used adequate yearly progress (AYP) for each school (Mundy, 2012) in order to measure each grades' progress in learning. The AYP measurements used PSSA scores and participation. They also gathered data from each students' scores to see whether they increased enough to achieve the level of proficient or advanced. The assistant superintendent aimed to have the AYP continue to grow until it scores 100% for that school. The AYP's measurement is based on the PSSA results.

Two years prior to the implementation of the standard, two out of the seven schools passed the AYP scoring while one received corrective action and four received warnings (Mundy, 2012). Mundy (2012) stated that an improvement in the (PSSA) could bring all of the schools up to a passing AYP score through the use of state-run workshops that concentrated on the teaching the standards within the classroom.

According to the district's future plan, the curriculum is to be aligned with local, state, and national standards. Research-based materials and teaching and learning strategies are implemented as a priority (Mundy, 2015). Mundy believed the foundations of the Commone Core Standards to be vital to the success of the district and its students. The basis of the foundations for the Common Core Standards is developing a scope and sequence in learning for each area of the standards.

The district's future plan listed ensuring a fiscal responsibility while implementing the district's initiatives as a priority (Mundy, 2015). The plan wanted the district system to guarantee the consistent application of standards-aligned curricula in all schools and with all students. The problem seen by local superintendents and educators

was the cost of training those in the districts to teach students using the standards (Quann, 2015).

A group known as Pennsylvanians Against Common Core stated that the standards are not working and that they are only confusing students and draining school district's budgets ("Loss of local control," 2015). The local education board discussed the group's concerns and recognized the depletion of school district's budgets; but the board also expected the districts to meet or exceed the requirements to meet the PSSA testing (Pennsylvania School Boards Association, 2015). Government officials in Pennsylvania also questioned the validity of the standards (Chute, 2015). Former Governor Tom Corbett stated that the standards were implemented too quickly. Current Governor Tom Wolf stated that in 2015 the PSSAs would not be used to evaluate school performance profiles or teacher evaluations. Pennsylvania Senator Andrew Dinniman wrote that the standards were new and the state was paying money for an initiative that no one could be sure was working in classrooms (Murphy, 2013). The senator questioned whether Pennsylvania should move ahead with implementing the standards and stated that he was concerned about the strictness of the standards which could lead to increased student dropout rates.

Since the 2012 implementation of the Common Core Standards educators, administrators and families have questioned its effectiveness on the learning of public school children. Some educators and lawmakers stated that the standards are beneficial to regulating the state's education system in the schools. Conservatives claimed that the

federal government was reaching too far into the state's school systems. Both sides agreed that the standards were implemented too quickly for educators, parents, and students to properly prepare to use them in the classroom. The quick implementation of the Common Core Standards led to confusion in schools and homes.

Rationale

Evidence of the Problem at the Local Level

The assistant superintendent for the local school district reported the use of adequate yearly progress (AYP) for each school (Mundy, 2012). AYP measures each grade's progress in learning each year, based on PSSA scores, participation, and whether enough of the students' scores increased enough to achieve the level of proficient or advanced. The goal each year is to have the AYP continue to grow until the score reaches 100% for that school. The PSSA scores are the basis of the AYP measurement.

The district's future plan lists the following as a priority: "Curriculum is aligned with local, state and national standards. Research-based materials and teaching and learning strategies are implemented" (Mundy, 2015). Mundy stated that the Core Foundations are vital to the success of the district and its students. The basis of the Core Foundations focuses in the developing a scope and sequence in learning for each area of the standards.

The district's future plan also lists a priority to "Ensure fiscal responsibility while implementing district's initiatives" (Mundy, 2015). The plan aims to "establish a District system that fully ensures consistent implementation of standards aligned curricula across

all schools for all students." The problem seen by local superintendents and educators is the cost of training those in the districts that will teach students using the standards (Quann, 2015).

A group known as Pennsylvanians Against Common Core has stated that the standards are not working and are only confusing students and draining school district's budgets ("Loss of local control,"2015). The BCIU shares the groups concerns and recognizes the depletion of school district's budgets but also expects the districts to meet or exceed the requirements to meet the PSSA testing (Board of director's agenda, 2016). Government officials in Pennsylvania have also questioned the validity of the standards (Chute, 2015). Former Governor Tom Corbett believed that the standards were implemented too quickly. Current Governor Tom Wolf stated that in 2016 the PSSAs would not be used to evaluate school performance profiles or teacher evaluations. Pennsylvania Senator Andrew Dinniman believes that the standards are new and the state is paying money for an initiative that no one is sure is working in the classroom (Murphy, 2013). Senator Dinniman has questioned whether Pennsylvania should move ahead with the implementation of the standards. He is concerned that the strictness of the standards may increase student drop out rates.

Evidence of the Problem in Professional Literature

This study investigated whether there were any differences in students' PSSA scores before implementation of the Common Core Standards and after implementation of the Common Core Standards. While many scholars continue to assert that the use of

standardized tests by educators to track progress in school is little more than a feel-good lie told to a public that wants to believe, these tests will be in place for the foreseeable future (Kastenbaum, 2012). There are still researchers who have found bias, especially along racial lines, in the creation, use, and analysis of standardized tests and in the data generated by these tests (Ross, 2015). Yet, according to Higgins (2009), "standardized tests are not a perfect tool...[but] they are the best tool we have to measure student achievement" (Fair Test, 2012). Teachers' perceptions of student achievement are problematic (Martinez, Stecher, & Borko, 2009), the objective state- and nation-wide tests look more attractive (Marzano & Toth, 2013). These standardized tests remain contentious in the context of public (and private) education (Greenberg, 2013). The key now becomes learning to use them as efficiently and effectively as possible.

Regardless of whose perspective on these tests, most teachers have already shifted their practices to include significant amounts of time for test preparation (Longo, 2010; Musoleno & White, 2010). Nevertheless, there is evidence to suggest that "teaching to the test" is unnecessary to prepare students to perform their best on such tests. For example, it was cited in several studies suggesting that rigorous instruction in writing involves instruction based on best practices rather than explicit teaching to the test leads to competitive, if not superior, test results (Marzan & Toth, 2014). What is especially compelling about such studies is that they show the positive side of such tests. All that is needed to pass these tests is rigorous, in-depth instruction in the relevant subject areas, something all students should have in any case. Due to new curricula, there was also a

lack of knowledge on the part of teachers (National Council for Accreditation of Teacher Education, 2014). Teachers should know that the tests will be passed if they teach in a manner that demands excellence (National Council for Accreditation of Teacher Education, 2014).

Mucherah and Yoder (2008) found that students who were positively motivated by their teachers were shown to have better test grades (Adams, 2013). After analyzing the test scores of 388 sixth and eighth grade students, researchers found that students who performed best on the ISTEP+ standardized test were those who were intrinsically motivated to read, as opposed to those mandated to read for school. Mucherah and Yoder did not consider some of the race and sex effects observed in the data, but this statement held true across other demographic identifiers. Longo (2010) found that in a classroom, creativity (related to the study of science) not only had a place in an age of high-stakes standardized assessment tests, but it also fostered the kind of thinking in students that could lead to success on such tests. Longo further noted that teaching a curriculum is a key to creativity that is linked to inquiry learning (Longo, 2010, p. 56).

In fact, teachers needed to deliberately learn how to administer the test that might be detrimental to overall progress and, consequently, detrimental to test scores (Kaziak, 2014). In Florida, a state experiencing a persistent achievement gap between White students and students of color, as well as between more and less affluent students, almost a decade of standardized tests and increased accountability standards have done nothing to improve the state of affairs. The standards curriculm is generalized for mid stream

students and does not take into consideration other students. Teachers have been teaching more and more to the test, so much so that hundreds of hours of instruction—real, rigorous instruction in key subject areas—are lost in the haze of test preparation (Kaziak, 2014). The situation was so dire for Florida that the legislature had to enact a new statute, beginning in the 2008-2009 school year, to prohibit every public school from limiting the regular class curricula to prepare for state wide assessment testing (Simon, 2010).

Fortunately, beyond research studies showing that rigorous instruction is most helpful in terms of test preparation, there is plenty of existing, practical material to show teachers how to best prepare students, not just for high-stakes tests, but for the rest of their educational and professional careers (Kaziak, 2014). However, it remains to be seen whether a cycle of poor teaching will be broken. For example, in William's (2010) article about high-stakes tests (so called because the fates of teaching careers, administrative promotions, and entire schools can rest upon the results of such assessments), he wrote the following:

> Where teachers do not understand the meaning of the curricular aims as expressed in the state's content standards, they are likely to key their instruction on sets of test items relating to that standard rather than to the aim that the items are intended to represent. (p. 119)

William (2010) argued that because of this misunderstanding on the part of teachers, as well as a few other issues such as the fact that there can be over 50 separate curricular goals for a particular subject area, the curricula need to be altered and made

more flexible. Indeed William believed that teachers were capable of understanding their own curricula. This type of thinking has set the stage for innovations such as the Common Core Standards.

Phillips and Wong (2010), in their overview of the Common Core Standards, noted that the goal is not to impose a rigid set of rules upon states, but rather to offer a curriculum for each subject area that brings "fewer, clearer, higher" goals for student achievement (p. 38). Loertscher and Marcoux (2010) agreed with this assessment of the new standards, stating that there are fewer of them and that they aim highly and are striving for evidence-based feedback. What is especially exciting about these curricula is that they are cross-disciplinary in nature (thus allowing knowledge in one area to support and further knowledge in other areas) while retaining a depth of focus on certain key areas (especially reading), all with the purpose of better preparing students for college or careers (Hill, 2011). Given the often-piecemeal approach to education reform used since No Child Left Behind was passed in 2001, these Common Core Standards appear to be a hopeful development. But with any new idea – only time and research will tell.

Definitions

Assessment: A test providing information on a student's achievement in a particular course (Bangert, 2004).

Common Core State Standards: The standards were established as benchmark performance goals for students in all grades in English and mathematics; designed to

standardize curricula in these areas across all states (Hoegh, Marzano, Simms, & Yanoski, 2013).

Education reform: This term refers to any effort made to improve public education, generally taken to refer to such reform measures as No Child Left Behind and the Common Core Standards (Ball, 1994).

PSSA tests: Pennsylvania System of School Assessment tests.

Standardized tests: A test administered and scored in a consistent fashion across test-takers and test-taking contexts; here taken to refer to a test used to measure progress, or lack thereof, in meeting the goals of the Common Core Standards (Procon, 2013).

Standards-based education: An educational movement that measures clear standards between students. Norm-based standards are used for all students (Procon, 2013).

Significance

Determining whether the Common Core State Standards had a positive effect on the students' PSSA test scores was significant at the local level because any increase in the budget depended on the performance of the local elementary schools . The standards are also significant for pedagogical reasons: Teachers and administrators need to know if using the Common Core has benefitted their students as measured by the total scores on the PSSA test.

Assessing whether there is a relationship between the use of the Common Core and total scores on the PSSA is also significant in a broader educational context.

Common Core State Standards have been adopted widely and quickly, with little independent research to show their efficacy. Given that almost every state in the nation has adopted these standards, it was vital to determine whether they improved student achievement. Therefore, every study investigating this issue is important, as each one contributes to a critical mass of literature that can be used to reach conclusions about the Common Core.

Research Question

The Common Core Standards work toward improving students' grades and prepare them for postsecondary education goals; they groom the student in preparation for higher learning. Student learning is measured through standardized tests, such as the PSSAs. Schools can monitor each student's cognitive growth in the classroom through these standardized tests. By comparing and analyzing PSSA test scores before and after implementation of the Common Core Standards, this study examined the effects [of what?] on students' learning. The PSSA scores for 2011 and 2012 preceded the implementation of the Common Core. The PSSA scores for 2013 and 2014 represented the post-Common Core implementation. Because different grades received different PSSA assessments, first, the MANOVA was used for all grades' scale and raw scores to discern whether a main effect could be detected. Second, follow up *t* tests were employed for the raw scores for each grade, because the independent variable of before and after Common Core was dichotomous. Additionally, the raw scores included all items on the

assessments and provided a more nuanced understanding of differences, and therefore, both the scale score and the raw score values were needed for the analysis.

This study was guided by the following research question:

Are there differences in students' learning as measured by the PSSAs for the years tested before and after the implementation of the Common Core Standards?

H_{01}: There is no significant difference in student achievement as measured by the PSSAs tested for the years before and after the implementation of the Common Core Standards.

H_{A1}: There is a significant difference in student achievement as measured by the PSSAs tested for the years before and after the implementation of the Common Core Standards.

Section 2: Literature Review

The purpose of this study was to see whether the implementation of the Common Core Standards had an effect on students' learning. In this chapter I will examine scholarly resources that are pertinent to the study and its purpose. The literature focuses on theory and practice, Common Core Standards and standardizations, the needs of learners and the learning process, evaluation of Common Core Standards, and uses of these standards in developing a skill base for students. The literature review contains an analysis and summary of the studies on Common Core Standards and their effect, if any, in education.

The literature review is organized around relationships to curricula and the Common Core Standards. The beginning of the review deals with learning theories and the concepts used by the learner; it then discusses equilibrium and how learners accommodate and assimilate information. The theoretical framework used in this study, Piaget's theory of learning, explains that student learning is a process of development (Gallagher & Reid, 2002). The Common Core standardization and new curriculum issues are considered plateaus of learning that reflect Piaget's theory of learning (McCarthy-Gallagher & Reid, 2002). There is an extensive discussion on summative assessments and common core standardization tests as a measure of learning outcomes.

The review was conducted after a search on journal databases focusing on standardized testing, the Common Core Standards and Piaget's theory of learning. The database and library catalogue search returned more than 100 papers on Common Core Standards and the role of standardization in education. Sixty of these papers were finally

selected, based on their relevance, and the literature review was conducted primarily on 50 current primary research articles providing significant information, analysis and insight on the use and role of Common Core Standards in education and learning.

Theoretical Framework: Piaget's Theory of Learning

The theoretical framework, Piaget's theory of learning, used for this study is based on the learning theory of Piaget. Piaget observed that children learn in levels or stages as they mature (Glasersfeld, 1982). Piaget directed his work toward children and education and became known as the pioneer of the constructivist theory of knowing—a theory that shows how a student knows what he or she knows. Any change in a learner (student) constitutes the active process called *learning*. This process occurs when a student goes through activities that bring about change. The activity or catalyst for change in this study was the implementation of Common Core Standards. Piaget believed that children's learning was transformative and not cumulative ("Learning Theory," 2014).

Piaget's learning theory explains of how the mechanisms of assimilation and accommodation are used by the learner to lead to a state of equilibrium. This state is challenged by the next "round" of learning, which requires that the learner assimilate and accommodate new information in a continual process (Zelazo, Chanerl & Crone, 2014). The Common Core Standards are based on the idea that the standards curriculum parallels Piaget's cognitive theory (Lipowitz, 2014). According to Piaget's cognitive theory, children learn new information and add it to the knowledge that they have already learned (Pulaski, 1980). For example, children can learn to write complex essays after mastering

the basics fundamentals of writing. They do this based on Piaget's developmental stages of learning. The belief is that students adapt to an ongoing process of learning. Given that this study was designed to evaluate the effectiveness of the Common Core standardized tests were used to measure whether students are mastering the content of the new core standards. The standardized tests enable the school to evaluate student learning at the end of the unit, grade, or school year. This information could be used in the school, home, or outside agency in order to measure how much the student learned during that year. This measurement is used to compare the student with others on a national level and in school in comparison to other students in their grade. The test scores are also used to monitor students against their own learning outcomes in order to make sure that they are progressing cognitively. For this study, the information would be used to provide evidence of the students' learning outcome to the school district.

Piaget's Theory

At its core, Piaget's theory treats learning as a process of development in which learners gradually create, and then modify, schemata, "cognitive or mental structures by which individuals intellectually adapt to and organize the environment" (Wadsworth, 1996). Schemata can be created to organize an otherwise random mass of data (Wadsworth, 1996). The specific schema we create changes with our developmental level; thus, a toddler might develop a schema to differentiate between cats and dogs, while an adult physicist might develop a schema to accommodate the discovery of a new particle (Wadsworth, 1996). The process of either modifying existing schemata or creating new ones is called

"accommodation." (Wadsworth, 1996). Once new information has been accommodated, it can be assimilated, when one exists in a state of balance between accommodation and assimilation, one can be said to be in equilibrium (Wadsworth, 1996).

Beyond these basics Piaget described discrete stages of learning, three of which are relevant to school-age children: preoperational (ages 2–8 years), concrete operational (ages 8–11 years), and formal (ages 11 and up) (Orlich et al., 2000). It is of little use to push a 10-year-old child to engage in formal reasoning tasks when their brains have not reached the formal stage; they simply cannot perform such tasks at that level. This result has been found even in children whose IQs are 160 or above; thus, it is not about intelligence, but about the literal ability of the brain to create and/or accommodate schemata relevant to particular types of information. As Nurrenbern (2001) noted, "intellectual development is characterized by a hierarchical development of successively more complex skills and operations" (p. 1108). Thus, any reform effort that seeks to improve student learning needs to be aware of these stages and maintain an age- and level-appropriate set of expectations for students. The Common Core Standards seek to do so by establishing standards for each grade level aligned with students' abilities while pushing them to excel given their developmental level (Common Core State Standards Initiative, 2011a).

Developmental stage theory is used to show how learners develop through stages. This theory demonstrates how students are expected to travel and advance cognitively as they learn what is necessary to do well using the Common Core curriculum. The standards call for "a 'staircase' of increasing complexity in what students must be able to

read so that all students are ready for the demands of college- and career-level reading no later than the end of high school" (Maine Department of Education, 2011, para. 1). Thus, Piaget's learning theory offered an opportunity for application in this study. Piaget believed that children learn in stages: as they mature in life, they would also mature in the classroom. Piaget believed that students could not move to the next level until they completed the previous level. The idea is that teachers in the classroom would have to present ways of learning to students so that they can learn and progress. With the continued workshops and training on the Common Core curriculum, teachers have the ability to prepare and present the curriculum to the students in the most thorough and understanding way. With this special in depth training that teachers are now receiving, they can teach the new curriculum allowing the students to learn and move forward. This is the basic premise of the Common Core Standards.

Effectiveness of Standards-Based Curriculum

The question of the effectiveness of standards-based curricula is not a new area of inquiry. Government officials in individual states, especially in the wake of No Child Left Behind, created standards that were meant to ensure education at any school in the state would meet a certain, measurable standard. Wiggins (1991) called for standards rather than standardization, pointing out that students learn best in their own ways. Most scholars agree that there is a need for some metric of measuring student learning, though Ohanian (1999) argued that educational standards create more harm than good. These

standards force students to reflect the priorities of those writing the standards, but these reflections make education too much of a one-size-fits-all experience.

However, researchers have shown substantially that standardized curricula are more effective in promoting student achievement than non-standardized curricula. One study found that standards-based curriculum, instruction, and assessment improved student achievement (Kim & Crasco, 2006). These impacts can be seen in historically underserved populations, over the course of several years in 22 major urban school districts.

Equally important, students who were exposed to sandards-based mathematics curricula performed better overall on standardized achievement tests than those who had been taught without a standard curriculum (Harwell, Post & Maeda, 2007). This fact was still true when the individual standards of the standardized curriculum varied to some extent. Drake (2012) found that students did significantly better with one of two standardized curricula than their demographically similar peers who were taught using non-standards-based curricula.

Curricula for the standards were used for students with severe developmental disabilities. A study in 2013 found that using a standards-based early education science curriculum was effective for students with severe developmental disabilities (Smith, Spooner, Jimenez & Browder, 2013). Even when the curriculum was not geared to the students being taught, they achieved with standards-based curricula. The practice of using

standards-based curricula and teaching methods may correlate with high-quality teaching, even in aspects outside the standards.

A study using data from the Early Children Longitudinal Study Progrem (which sampled over 20,000 students) showed that teachers attitudes and practices had a huge effect on learning as early as first grade (Palardy & Rumberger, 2008). The authors showed that teachers are the most important link between a student's growth and achievement in learning. Clearly, standards-based curricula are best implemented when paired with teachers who have been effectively trained in how to implement them and are willing to do so. In a study of students of 15 sixth and seventh grade math teachers using standards-based curricula, found that however effective the curriculum itself, student perception of the curriculum as a positive and engaging learning experience was dependent on teacher behavior (Bay, Beem, Reys, Papick, & Barnes, 1999). In a meta-analysis of 63 studies of early-grade reading achievement, found that a combination of a solid, standards-based curriculum and specific teacher behaviors and techniques were the best way to improve reading achievement, at least in early grades within the scope of this analysis (Slavin, Lake, Chambers, Cheung, & Davis, 2009). These researchers, examining 40 teachers and over 1,200 students, found that these teacher behaviors, as well as great expectations, made the standards-based math curriculum used in the study (CorePlus) more effective. Researchers found that a standards-based curriculum was effective when teaching biology students, but activities in the classroom, as well as teacher behaviors, looked different than in a classroom taught without a standards-based

curriculum (Leonard, Speziale, & Penick, 2001). To be effective, a standards-based curriculum must be taught by teachers who conform to the standards' recommendations regarding their teaching behaviors (Schoen, Cebulla, Finn & Fi, 2003).

Common Core Standards

The Common Core science, writing, mathematics and reading standards represent not just standards to be met by the learning community, but also expectations of knowledge and skills that high school graduates need to master in order to succeed in their careers (Johnsen, 2012). To develop these Common Core Standards, the Coucil of Chief State School Officers (CCSSO) and the National Govenor's Association (NGA) Center worked with state representatives, content experts, educators, researchers, national organizations, and community groups; the final standards reflect the feedback obtained from the general public, teachers, parents, students, business leaders, and content area experts. The Common Core Standards are in accordance with the standards in high-performing nations (Dacey & Polly, 2012). The incorporation of K-12 standards was aligned with college and work expectations from students, including high order skills.

The role of Common Core Standards was intended to prepare students to succeed in the global economy and society; all these standards are in accordance with the policies of high-performing countries (Hunt Institute, 2012). The standards were developed following evidence and research-based methods and the development practice has incorporated the best practices and research from around the world (Johnson, 2012; Lee,

2011). Despite the successful use of Common Core Standards, there is more to be learned regarding their effects on student success.

Conducting new research to evaluate the implementation of Common Core Standards helps revise and review the standards. The standards are expected to meet the high levels of assessment and expectations within the learning community. The evaluative framework also must be in accordance with those used in high-performing countries.

The Common Core Standards in English, language arts and literacy, history and social studies, and science and technical subjects are the culmination of an effort to create K-12 standards to ensure that all students in college or the workforce are well prepared in all aspects of English, science, mathematics, and arts. The Council of Chief State School Officers and the National Governors Association have laid the foundation for high education standards (Council of Chief State School Officers, 2012).

The standards are based on state departments of education, educators, scholars, assessment developers, and professional organizations, and represent the best elements of educational curricula (Loertscher & Marcoux, 2010). The Council of Chief State School Officers and the National Governors Association specify that all research on the standards and their incorporation be evidence-based and in accordance with work or educational expectations (Pennsylvania Board of Education, 2012). The standards have to be rigorous and benchmarked, and the available evidence must highlight the role of these standards in a globally competitive society (New York State P-12, 2012). There is now

better evidence on how these standards can be used in accordance with standards developed earlier in reading, writing, speaking, listening, language, and mathematics. However, these standards need to meet age and opportunity expectations.

The standards help students read, write, learn, speak, listen, and use language and numbers effectively. States have incorporated these standards and adopted these as literacy standards for different content areas (Porter, McMaken, & Hwang Jun, 2011). The standards describe the meaning and implications of being literate and provide the guidelines of literacy. These standards are widely applicable in classrooms and at the workplace, although there is wide applicability outside these areas as well; students who meet the standards develop skills in reading, writing, speaking and listening, which are the foundation of creative expression of language (Lee et al., 2011; Porter et al., 2011).

The Common Core Standards serve as the foundation for high-quality education for children. The standards of success in every school must be in accordance with these principles (Reynolds, 1999). Teachers and community leaders created these Common Core Standards that clearly communicate what students are expected to achieve or learn at each grade level (Kendall, 2011; Kern, 2012). The Common Core Standards focus on conceptual understanding and focus, and enable teachers to teach core concepts and procedures. Students, parents, and teachers work on the same shared goals to progress in classrooms and the workplace.

The American Council of Education (2011) has stated that the most important element in the process of implementing Common Core Standards is the preparation and

professional development of teachers. A new state guideline, Common Core Standards: Implementation Tools and Resources, was created by the Council of Chief State School Officers to allow teachers and school administrators to align themselves and their teaching methods with other states using the Common Core Standards (CCSSO, 2010). It is believed that in order for students to succeed, teachers and school administrators must be prepared (Ewing, 2010). Ewing found that teachers must adapt themselves to new ways of teaching and adapt their students to new ways of learning. There are three areas of change that need to happen in order for the Common Core Standards to be successful. These three areas include being proactive in recruiting the right students for the right levels of learning, correct preparation for incoming and current teachers, and revising professional preparation of teachers.

State Common Core Standards are internationally benchmarked and evidence-based standards. They also represent a set of expectations for what students should learn and do (Lee et al., 2011; Porter et al., 2011). The standards work as a guideline for successful implementation of learning standards in the classroom and help in the continual development of educator resources. The Common Core Standards were adopted recently in different states after being created through collaborative efforts of best practice developed by teachers and experts (Philips & Wong, 2010). According to the standards, educators are required to adhere to classroom instructions and curricula material, as well as follow all learning goals as specified in the standards.

Establishing an updated learning process for students in order to prepare them for college learning is a concern for schools. Ongoing funding and research must be presented in order to determine if the Common Core Standards are successful, according to Finn and Petrilli (2010). Their research suggested that there is not enough data based on the implementation of the Common Core Standards to proclaim it a success. Further studies and research must be conducted in order to monitor the success of the program and students.

The Common Core Standards reflect skills based on higher-level learning incorporated into the district curriculum. Common Core Standards aim for deeper learning; tests based on the standards focus on assessing analysis, critical thinking, and problem-solving skills in students. The Alliance for Excellent Education found that deeper thought in students helped them master their academic content within the classrooms, learn how to work on complex problems, work with other students, develop the ability to communicate more effectively, and become self-directed in their learning and processing of feedback (Alliance for Excellent Education, 2011). International studies show that deeper thought processing in education helps develop greater academic performances in the classroom (Dweck, Walton & Cohen, 2014).

Goals and Development of the Common Core Standards

The Common Core Standards are the latest attempt at a nationally standardized curriculum. They represent more than just standards that must be met by the learning

community. They represent expectations of knowledge and skills that high school graduates must master in order to succeed in college and beyond (Johnsen, 2012).

As high schools are differ from each other so do educational standards, which vary greatly from district to district. Ogawa, Sandholtz, Martinez-Flores, and Scribner (2003), who are advocates for instructional policies in school, found in a case study of one district that a lack of organizational leadership and cohesive instructional philosophy eventually resulted in district standards that fell below the state level standards, leaving students unprepared. The outcome of this study was why the Common Core Standards are so rigid with their introductory and continual training of teachers and administrators. While this study is of limited utility because it surveyed a single district, the worry that this sort of issue was widespread and that standards were not equally rigorous throughout the United States led to the idea of creating a Common Core Standards that, with the addition of state-specific topics, would become nationalized.

Representatives from the Council of Chief State School Officers and the National Govenor's Association Center worked with state representatives, content experts, educators, researchers, national organizations, and community groups to develop standards that reflected feedback from students, teachers, business leaders, and others (Dacey & Polly, 2012). These standards are in accordance with those in the highest-performing nations on international testing (Dacey & Polly, 2012). Even before there was a set of Common Core Standards, there was a small core of information and skills that appeared in every state's standards, according to an analysis by Porter, Polikoff, and

Smithson (2009). These skills were expanded upon in the design of the Common Core Standards.

The role of the Common Core Standards is to prepare students to succeed in the global economy and society; all these standards are in accordance with high-performing countries. The standards were developed following evidence and research-based methods, and the development practice has incorporated the best practices and research from around the world (Johnson, 2012; Lee, 2011). The standards have led to new assessments, such as the TerraNova3 which was created based on the Common Core Standards. The new assessment tests are neededin ord er to understand how well students are, in fact, learning under these new standards (Doorey, 2012).

Concerns Surrounding the Common Core

Common Core Standards were recently created and have not yet been fully implemented in many states and districts. No studies have been published yet on their specific implementation. However, an understanding of how they may impact student achievement and the teacher experience is possible from the currently available literature.

Concerns are present, both inside and outside the educational establishment. Bell and Thatcher (2012) pointed out that lawmakers face a large task, working to ensure that each state's individual laws work with and support the Common Core initiative. A rigorous analysis of state standards, found that they are extremely different from the Common Core as they currently stand, also raising concerns (Beach, 2011).

Others working from the perspective of the educator, believed that the Common Core initiative was a positive development (Eilers & D'Amico, 2012). These authors explored the six dimensions of effective educational leadership required to properly implement such wide-ranging reforms, which include a clear sense of priorities and the giving and receiving of feedback during all levels of the process. They also found that teachers and school administrators who implemented Common Core Standards were able to encourage their colleagues to move from traditional teaching methods to new teaching territory.

Loveless (2012) believed that the Common Core may fail on its own due to the lack of one key component – proper instructional materials. In support of that position, a 2012 study found that there is little research available on the effectiveness of various materials being used in which schools (Chingos & Whitehurtst, 2012). Without the use of the proper instruction materials, the Common Core may not succeed (Loveless (2012).

Similarly, the implementation of a nationalized core curriculum is no guarantee of success. The United States is not the only country facing diversity in the school system. In a small, localized study of Kenya's nationalized curriculafound two schools in Kenya, despite the same curriculum, had radically different student experiences and achievement levels (Branyon, 2013). Brooks and Dietz (2012) worried that the new standards could limit diversity in education, leading to too much standardization.

Many teachers and thinkers, however, are optimistic. It was noted that Common Core science Standards, with their inclusion of engineering and technology, are the first

step toward comprehensively better science instruction nationwide (Bybee, 2012). Ostenson and Wadham (2012) believed that the Common Core was a good fit with teaching young adult literature in the classroom, which Hipple (2000) and Broz (2011) agreed can increase student motivation and willingness to read, as well as introduce students to universal themes in ways they can easily understand and relate. However there was worry that there was too little emphasis on reading on the Internet, which a skill is growing in importance for today's students' success (Drew, 2012).

Another recent focus in the scholarly community has been the exploration of how to implement Common Core-based curriculum in the classroom. Researchers discussed how to implement best practices for the new math curricula (Saunders, Bethune, Spooner, & Browder, 2013). while others discussed the challenges of adapting these curricula to the growing population of autistic students in the United States (Constable, Grossi, Moniz, & Ryan, 2013).

Implications

The Common Core Standards were created as a clear vision on what students need to learn during their school years to prepare them for college. Students are aided in learning how to read, write, learn, speak, listen, and use language and numbers. The goal of the Common Core Standards is to provide the highest quality of education for students. The Common Core Standards map each grade in order for each student to excel and progress. When teachers, parents, and students share the same goal, they can monitor the progress of each student. Forty-five states along with the District of Columbia have

implemented these standards (Porter et al., 2011). The standards are used in classrooms and the workplace, although there is wide applicability of these standards outside these areas.

Summary

Since the Common Core State Standards were introduced in 2010, 45 states and the District of Columbia have adopted them, creating a de facto standard national curriculum in English and mathematics for the first time. The standards were designed to increase rigor in instruction for students beginning in first grade, in these two areas only, as these areas are seen as foundational for all other areas. The goal was to ensure that every student is ready for college or work, as he or she chooses, by high school graduation.

Of course, the standards were introduced into an educational climate where they were many other schools working with other standards, not to mention standardized tests that assess whether schools are teaching students to reach their greatest possible achievements. One such test is the Pennsylvania System of School Assessment (PSSA), which now has a version specifically designed to assess student progress in accordance with the Common Core State Standards. The present study is based on a school district in a Northeast city and is designed to assess whether the implementation of Common Core Standards is raising total scores on the PSSA tests in Grades 3, 4, 5, 6, 7, and 8 in science, writing, mathematics and reading.

Section 3 describes the methodology for the study. Note that the preview of the following chapter or section begins a new paragraph. I created a new paragraph here.

Section 3: Methodology

As of 2017 the Common Core Standards and its accompanying curriculum have been established in nearly every state. These standards have guided instruction in public and private schools across several states (Common Core State Standards Initiative, 2011b). However, the local effectiveness of these standards on student achievement, which is the primary problem for many parents and educators and the focus of this study, has yet to be determined through field research. Thus, the purpose of this study was to assess the influence of the Common Core Standards on student achievement using scores from the PSSA for Grades 3 through 8. The PSSA scores for 2011 and 2012 preceded implementation of the Common Core; the PSSA scores for 2013 and 2014 followed implementation.

Add a sentence here that tells readers what you are now doing. It's a big swith to how the scores were treated. Because different grades received different PSSA assessments, first, a multivariate analysis of variance (MANOVA) was used for the scale and raw scores of all grades to discern if a main effect could be detected. Second, follow up *t* tests were used for the raw scores for each grade because the independent variable—pre- and post-Common Core implementation—was dichotomous. Additionally, the raw scores included all items on the assessments and thus provided a more nuanced understanding of differences. Therefore, both the scale score and raw score values were

necessary in the analysis.

In this quantitative study, I assessed whether students' mastery of the Common Core Standards, as measured by the PSSA, have led to increased student achievement. Raw test scores of students in Grades 3, 4, 5, 6, 7, and 8 in one Northeast school district were compared for the 2 years before the Common Core Standards were adopted and the 2 years after the Common Core Standards were adopted. This comprehensive quantitative case study used extant data; there were no active participants.

Research Question

The following research question guided the data analysis: Are there differences in students' learning as measured by the PSSAs for the years tested before and after the implementation of the Common Core Standards? In order to answer this question, I tested the following null and research hypotheses:

H_{01}: There is no significant difference in student achievement as measured by the PSSAs tested for the years before and after the implementation of the Common Core Standards.

H_{A1}: There is a significant difference in student achievement as measured by the PSSAs tested for the years before and after the implementation of the Common Core Standards.

The four dependent variables for each of the hypotheses tests were the students' scores for science, writing, mathematics, and reading. The independent variable was the presence or absence of the Common Core Standards.

Research Design

The research design for this study was causal comparative design with extant test data. The main dichotomous independent variable was the absence or presence of the Common Core Standards. The use of the raw and scaled PSSA subject tests' scores for the 2 years prior to the implementation of the Common Core and of the scores for the 2 years following the implementation of the Common Core enabled the data to be longitudinally considered. The secondary independent variable was grade, represented by Grades 3, 4, 5, 6, 7, and 8. The dependent variables were represented by the raw and scaled test scores for the four subject tests of science, writing, mathematics, and reading that represented cross sections of data occurring within the 4 years of longitudinal data. The two dependent variables of raw score and scaled test score were moderately related ($r = 0.65$) and therefore adequate for use in multivariate analysis (Pallant, 2013).

The full factorial MANOVA enabled making a determination if the main effect of differences between the before and after common core conditions was present. However, for the follow-up analyses, MANOVA would not detect with full fidelity the nuances of differences for within grade and subject area differences. By analyzing data over time within grade for each subject test, nuances in data could be better understood through *t* tests. Because of differences in measurement between grades, such as variations in number of items per exam per year per subject area, the unit of measure led to within grade analysis for the raw scores on each subject test.

The dichotomous independent variable was defined as the absence or presence of the Common Core Standards for both within grade and subject area; the goal was not to test between grades and subjects because the constructs were substantively distinct and different from one another (Salzberger, 2012). The absence of the Common Core curriculum or the presence of the Common Core curriculum represented the dichotomy for testing. Each dependent variable as measured by PSSA raw test scores was tested independently of the other variables within each grade. Each grade of students could have taken the science, writing, mathematics and reading PSSA tests; however, each grade took different tests. Grade 3 students took only mathematics and reading tests. Grade 4 students took mathematics, reading, and science tests. Grade 5 students took mathematics, reading, and writing tests. Grade 6 students took mathematics and reading. Grade 7 students took mathematics and reading tests. Only Grade 8 students took all four PSSA tests of mathematics, reading, science, and writing. The lack of uniformity of tests between grades forced the conservative choice to forego analyzing data between grade and subject area in a full factorial design.

Population and Sample

Extant data were collected and used in the purposeful sampling. There were no active participants involved in this study because the data were secondary. The raw test scores collected from two middle schools and three elementary schools that fed into the middle schools for the school years of 2011 thru 2014 included data for students in third, fourth, fifth, sixth, seventh, and eighth grades during each of the 4 years. However the

approximate population size was Grade 3 was 400 students; for Grade 4, 401 students; for Grade 5, 436 students; Grade 6, 415 students: Grade 7, 439 students, and Grade 8, 398 students.

Measures Taken for the Protection of Participant Rights

PSSA test scores were used for this study. The data were supplied through a northeastern school district. The study used archival data and involved no human participants. Based on the regulations of Walden University and the Institutional Review Board, no populations were vulnerable or in need of protection. No identifying data were included in the data provided for this study.

I contacted the superintendent of this northeastern school district and requested approval for access to the data for the study. The school district's data administrator authorized the use of the data, and the study was approved by the Walden University Institutional Review Board. Each student's total raw test score was issued a number for use in this study to protect the identity of the students and keep them anonymous. Upon completion of the study, all of the test data and analyzed data were stored in my locked cabinet in my home office for at least 5 years.

Data Collection Instruments

The PSSAs are annual standardized tests for assessing Pennsylvania school students' academic achievement (Momitrix, 2011). The PSSA tests are issued in the spring of each school year. These tests assess achievement for the four subjects of mathematics, reading, writing, and science. Mathematics and reading tests are issued to

students in Grades 3 through 8. The writing test is used in Grades 5 and 8. Science is assessed in Grades 4 and 8.

The PSSAs were created by contractors working for the Pennsylvania Board of Education and Pennsylvanian teachers. The PSSAs are administered to all Pennsylvania public school students in third through 11th grades (excluding Grades 9, 10, and 12). The PSSA scores are regularly analyzed each year to monitor the transition of the public school students to accept and learn from the new Common Core Standards that were implemented in 2012.

The tests are given at three different intervals during each spring. The writing test is given first, followed by the combination of reading and mathematics, and then the science test. The goal of the Pennsylvanian Department of Education by 2014 was to have 100% of students pass the tests with a 63% passing benchmark (Hallenbach, 2014).

The tests offer two types of questions. The first type of question is for the common items. These questions are the same on all tests for that subject. The second set of questions on each exam refers to field questions. Field questions are used for research and are not scored or used in the students' final grades. The students do not know which questions are common items or field questions for research.

There are two styles of questions used for scoring the PSSAs. The first style is multiple choice, and these questions are worth 0 or 1 point each. The second style of questions is the open ended question. For reading they are worth 0 to 3 points. For mathematics, they are worth 0 to 4 points. For writing, they are worth 1 to 4 points, and

science is worth 0 to 2 or 0 to 4 for scenario questions. The number of correct answers are totaled to form the final raw score. The raw scores do not change year to year; however, the mid-Atlantic state education department redistributes the cut scores for each of the assessments annually (Pennsylvania Department of Education). The raw scores are then converted to scale scores that range from a minimum of 700 to a maximum of 2400, depending on the specific subject area (Pennsylvania Department of Education, 2013). The scaled scores are listed as below basic, basic, proficient, or advanced. The ranges for the four categories differ by both grade and subject tested. However, an example of how the PSSA cut scores were delineated follows for Grade 4 mathematics on the 2014 assessment: (a) below basic ranged from the minimum of 700 to less than 1156; (b) basic ranged from 1156 to less than 1246; (c) proficient ranged from 1246 to less than 1445; (d) advanced ranged from 1445 to the maximum for this grade's 2013 mathematics assessment of 2455 (Pennsylvania Department of Education, 2013).

Data Collection Methods

All data were supplied by a data administrator through the local school district. The administrator provided a report that listed individual raw test scores for each grade covering the four areas: science, writing, mathematics and reading. The data included the Grade 3 students' raw scores on the mathematics and reading tests. Grade 4 students' raw scores included the mathematics, reading, and science tests. Grade 5 students' raw scores included the mathematics, reading, and writing tests. Grade 6 students' raw scores included the mathematics and reading tests. Grade 7 students' raw scores included the

mathematics and reading tests. Finally, Grade 8 students' raw scores represented all four PSSA tests of mathematics, reading, science, and writing.

Types of Data Collected

The data collected were scaled and raw PSSA scores for the subjects science, writing, mathematics, and reading with each set representing the 2 years before and 2 years after the implementation of the Common Core on the PSSA tests for study: science, writing, mathematics and reading. Data for children completing these PSSAs in Grades 3 through 8 were included in the data. The years of test data included 2011 thru 2012 (no Common Core) and 2013 thru 2014 (after the Common Core). The data analysis involved a full factorial MANOVA and a series of follow-up *t* tests in a between-subjects design.

Data Collection and Analysis

PSSA archival data were provided by the mid-Atlantic school district via MS Excel spreadsheets. Data for each grade's assessments were provided. PSSA raw test scores for Grades 3, 4, 5, 6, 7, and 8 represented the years 2011 thru 2012 (no Common Core) and 2013 thru 2014 (after the Common Core). The data were provided in an MS Excel data file by the school district's data administrator and delivered directly to me. Collected data were analyzed using IBM SPSS Desktop Version 22, an analytical statistics program that manages and calculates data to report on a wide variety of statistics.

A professional statistician was engaged to facilitate data analysis. Data were analyzed using the full factorial MANOVA for the composite dependent variable of raw

and scaled scores. The data for students from impoverished backgrounds were eliminated from the sample to avoid skewing the results, given that poverty is the most important factor when considering whether students perform well in school. Moreover, Tienken (2010) commented that no research existed to demonstrate any cause and effect relationship for follow-up *t* tests for raw scores. Inferential tests discern the presence of statistical differences between two or more independent variables after the implementation of the dependent variable. The independent variable was the presence or absence of the Common Core curriculum, and the dependent variable in each test was the specific PSSA test's raw and scaled scores, such as those collected for science, writing, mathematics and reading. The rationale for using MANOVA with the moderately correlated dependent variables involved the fact that raw scores included all items on each assessment, and some items were not part of the scale score due to their status as research items (Pallant, 2013). The scale score was not used for the follow-up tests because it did not include all of the items as part of its structure.

I used multiple procedures to analyze the test scores. First, factorial MANOVA allowed me to test more than one dependent variable with the independent dichotomous variable. However, because students in different grades did not complete all four tests of mathematics, reading, science, and writing annually, it was necessary to conduct follow-up tests for differences in student achievement that occurred before and after the introduction of the Common Core within each grade only.

Second, for the within grade by test analysis for the dichotomous independent variable of before and after Common Core, the *t*-test was the optimal statistical test. I compared the assessment by the students within grade raw test scores of science, writing, mathematics, and reading using before and after the implementation of the Common Core as the dichotomous independent variable. The use of only raw scores occurred because only raw scores represented all items on the tests, and it was likely that differences between the two conditions would be more sensitive with raw scores.

Assumptions

This study was based on four assumptions. First, it was assumed that the schools in this study kept complete and accurate records of student scores for the PSSA test. Second, it was assumed that all teachers in the school were meeting the goals of the standards in each subject area to the best of their abilities as they implemented the Common Core Standards. Third, it was assumed that previous research on the PSSAs was reliable and valid. Regarding its validity and reliability in measuring the level of effectiveness of the Common Core Standards in improving student learning . Fourth, it was assumed that the between-groups design accurately reflected the relative effectiveness of the Common Core Standards, given that it was impossible to conduct the study with the same students due to restrictions in testing years because students were only tested in Grades 3, 4, 5, 6, 7, 8 and 11.

Limitations

This study was subject to eight limitations . The first limitation was related to the

lack of research on the Common Core Standards, including a limited amount of research on ways to test student learning beyond the PSSAs. Thus, I was confined to one choice of student assessment.

The second limitation was that the same students could not be studied before and after implementation of the Common Core. This condition limited the findings of the study in part because different individuals take tests differently and the study required a particular cross-sectional methodology with a particular data analysis plan based on availability of data. This limitation of not having the same students to assess implementation of Common Core Standards meant that we needed a different data set or a different group of students to study effects of Common Core implementation.

.A third limitations involved other causes of differences in scores for years could be external or confounding variables. A fourth limitation were confounding variables such as different teachers, different schools, different events happening within the schools each year (such as excessive snow days off) and different administrators. A fifth limitation were the ways that the effects of such confounding variables could be controlled or otherwise ruled out would be to identify these variables. A sixth limitation were the natural changes in students' maturation could have affected the outcome of the causal comparative design. A seventh limitation was the chance that the pre-Common Core test scores might have had increased or decreased scores; scores that decreased can only respond by going up and scores that increased can only respond by going down.

Finally, this study was limited by the fact that there was no way to gauge the

implementation of the Common Core Standards by teachers. The standards were new, and it is conceivable that the test scores could have improved more as teachers gained experience implementing the standards. Thus, the generalizability of the results was not likely.

Scope and Delimitations

The scope of this study included the collection and analysis of PSSAs from students in Grades 3, 4, 5, 6, 7 and 8 in the following subjects: mathematics, reading, writing, and science. The research problem was focused on identifying whether the implementation of the standards had positive impact on the learning outcomes of students or student achievement in specific grades.The tests are administered in the spring of each school year. PSSA raw test score data, in the form of reports, were collected for Grades 3 through 8 for the years 2011 and 2012 (before the Common Core) and for the years 2013 and 2014 (after the Common Core). The learning theory that formed the foundation of this paper is Piaget's constructivist model of learning. The other competing theories that were not considered as being beyond the scope of the paper were social learning theory, cognitivist model like gestalt learning, conditioning models and transformative learning theories.

The study was limited to the PSSAs for selected grades in five schools in a northeastern suburban school district that included two middle schools and three elementary schools. This study was delimited to 4 years of test scores from the years 2011 to 2014. To maintain internal validity of the study, a specific sample of students

from particular grades were chosen for research purposes. Students from grades lower than 3 or higher than 8 were excluded from the study. Since the study is based on an assessment of student achievement between the Grades 3 and 8, the research findings are not applicable for students above Grade 8 or below Grade 3. The study findings are applicable only to specific student population that was enrolled before and after the implementation of the Common Core Standards. The study cannot be extrapolated or generalizable to include all students, beyond the specific student population.

Section 4: Results

The purpose of this study was to assess the influence of the Common Core Standards on student achievement using scores from the PSSA) for Grades 3 through 8. The PSSA scores for 2011 and 2012 preceded implementation of the Common Core. The PSSA scores for 2013 and 2014 followed implementation of the post-Common Core. Because different grades received different PSSA assessments, first, the MANOVA was used for all grades' scale and raw scores to discern if a main effect could be detected. Second, follow up *t* tests were employed for the raw scores for each grade because the independent variable of before and after Common Core was dichotomous. Additionally, the raw scores included all items on the assessments and provided more nuanced understanding of differences, and therefore, both the scale score and raw score values were necessary for inclusion in the analysis.

Null Hypothesis Results from MANOVA

The null hypothesis H_{01} and the alternate hypothesis H_{A1} were tested for no significant difference or significant difference in student achievement after implementation of Common Core Standards. The full factorial MANOVA was used for this test because both the scale and raw scores represented a composite dependent variable. The results for the MANOVA are presented first because the presence of a main effect on this test dictates the need for discrete follow-up tests within each grade and within each test within each grade for the dichotomous independent variable.

The total sample size was 27,605. There were no missing values in the total sample. The descriptive data for the dependent variables tested via MANOVA appear in Table 1. The raw and scale scores before Common Core were greater than the raw and scale scores after Common Core, by seven points and one point, respectively.

Table 1

Measures of Central Tendency for Dependent Variables Before and After Common Core

Dependent Variable	Common Core	*M*	*SE*	95% Confidence Interval (C.I.)	
				Lower Bound	Upper Bound
Scale Score	Before[a]	1426	1.8	1423	1430
	After[b]	1419	1.8	1416	1423
Raw Score	Before[a]	47	0.1	47	47
	After[b]	46	0.1	46	47

[a]The *n* for before Common Core = 13,655. [b]The *n* for after Common Core = 13,950.

Before conducting a MANOVA, the dependent variables had to be tested for multicollinearity. Multicollinearity occurs when there is high correlations between two or more predictor variables. The variables for this study were the scores before and after the implemenation of the standards. I used only moderately correlated variables as a composite, dependent variable, reflecting the recommendations of Pallant (2013). This shows a measurement between several dependent variables using one measure of scores. The raw score and scale score variables correlated at 0.65, which is below 0.8 and thus acceptable for this study (Pallant, 2013). The MANOVA was used for the scale and raw scores of all grades' to discern whether a main effect could be detected. Second, follow up *t* tests were employed for the raw scores for each grade because the independent

variable of before and after Common Core was dichotomous. Additionally, the raw scores included all items on the assessments and provided more nuanced understanding of differences, and therefore, both the scale score and raw score values were necessary for inclusion in the analysis.

Next, the Box's *M* and Levene's tests were conducted to determine the homogeneity of the data. The Box's *M* was 35.47 with *p* of 0.000044, which suggested the data violated the assumption of homogeneity of variance-covariance matrices. This violation was not too troublesome because the sample size was 27,605 cases, and Box's *M* tends to be too sensitive with large data sets (Pallant, 2013). The Levene's tests for each of the dependent variables yielded mixed results. Table 2 shows the scale score as violating the assumption of homogeneity and the raw score as meeting the assumption of homogeneity. Therefore, all results for scale score were reported with alpha being set at 0.01, but results for raw score can be reported for alpha being set at 0.05 (Pallant, 2013). This test also suggested that using raw score for post-MANOVA follow-up tests was preferred.

Table 2

Levene's Test of Equality of Error Variances

Score type	*F*	df_1	df_2	*P*
Scale	33.561	1	27603	< 0.0001
Raw	0.866	1	27603	0.352

Because the Levene's test generated a violation of homogeneity, the Pillai's trace was used to assess the statistical significance of the MANOVA model. The Pillai's trace

yielded a .00028 with F (2, 27602) = 3.886, p = 0.021. The effect size was 0.00028, which was too small to suggest practical significance for the MANOVA result. However, statistically, there was a significant statistical difference for scores on the PSSA for the years before the implementation of the Common Core and the years after the implementation of the Common Core. Table 3 displays the results for the between subjects effects for the one independent variable. Again, in the between subjects test, η^2 was again minute and nonpractical; however, due to the statistical significance found in the Pillai's trace and the between subjects tests of the MANOVA, the null hypothesis was rejected; alternatively, the null hypothesis was not retained. A statistically significant reduction in mean PSSAs was observed following the implementation of the Common Core Standards.

Table 3

Tests of Between Subjects Effects for the MANOVA

Source	Score Type	*SS*	*df*	*MS*	*F*	*p*	η^2	Power
Corrected Model	Scale	342580.687	1	342580.687	7.663	0.006	0.000	0.791
	Raw	912.264	1	912.264	3.979	0.046	0.000	0.514
Intercept	Scale	55863386019.098	1	55863386019.098	1249644.861	0.000	0.978	1.000
	Raw	60057349.108	1	60057349.108	261933.817	0.000	0.905	1.000
Common Core	Scale	342580.687	1	342580.687	7.663	0.006	0.000278	0.791
	Raw	912.264	1	912.264	3.979	0.046	0.000144	0.514
Error	Scale	1233948213.894	27603	44703.410				
	Raw	6328938.460	27603	229.284				
Total	Scale	57101100164.000	27605					
	Raw	66389056.000	27605					
Corrected Total	Scale	1234290794.581	27604					
	Raw	6329850.723	27604					

Follow-Up Test Results for Grades 3, 4, 5, 6, 7, and 8

Due to the rejection of the null hypothesis, follow-up tests were conducted within each grade for the assessments provided to students of each grade. The follow-up tests were *t* tests conducted within-subject and within-grade because the independent variable of before or after Common Core was dichotomous (Pallant, 2013). First, the descriptive data for the grade is shared, then the results of the *t* tests used to follow-up test on the

MANOVA for raw scores is presented in this section. The *t* test provides its own homogeneity test and allows for alterations to the degrees of freedom in interpreting the statistical significance of the observed *t* score.

Grade 3 Results

Grade 3 students took the mathematics and reading PSSAs in 2010, 2011, 2012, and 2013. Table 4 displays the Grade 3 mathematics and reading assessments' raw score means, mean differences, and other measures of central tendency for the conditions of before Common Core (2010 and 2011) and after Common Core (2012 and 2013) for each assessment's raw scores. The Grade 3 mathematics PSSA mean fell by 5.05 after the Common Core was instituted. The Grade 3 reading mean also fell, but by a smaller margin of 1.443.

Table 4

Descriptive Statistics for Grade 3 PSSAs

Subject	Common Core	*n*	*M*	*SD*	*SEM*	*M* Diff.	*SE* Diff.
Mathematics	Before	825	60.06	8.806	0.307	5.050	0.517
	After	860	55.01	12.223	0.417		
Reading	Before	823	31.48	7.967	0.278	1.443	0.412
	After	859	30.04	8.927	0.305		

To conduct the t tests, the Levene's test for equality of variances was used for each subject test to discern if an adjustment to the degrees of freedom (*df*) was needed for the *t* test. As seen in Table 5, both of the Grade 3 subject tests violated the assumption of homogeneity. The adjusted *df* was used for the Grade 3 *t* tests.

Table 5

Levene's Tests of Equality of Variances for Grade 3 PSSAs

Subject	*F*	*p*
Mathematics	90.541	0.000*
Reading	20.612	0.000*

* indicates the Levene's test displayed lack of equality of variances and the degrees of freedom adjusted *t* test is applied.

The differences in the means of the Grade 3 mathematics and reading tests were statistically significant as seen in Table 6. The means for the assessments in the 2 years after the Common Core was instituted were less than the means from the 2 years before the Common Core was instituted. For mathematics, the mean difference was 5.05, and the t (1563.634) was 9.761, $p < 0.0001$. For the reading mean difference of 1.443, the t (1671.634) was 3.501, $p < 0.0001$. For Grade 3, the null hypothesis was not retained for both assessments. Grade 3 students earned decreased scores on both mathematics and reading after the Common Core was implemented.

Table 6

Results of t-tests for Grade 3 PSSAs

Subject	*t*	*df*	*p*	Lower 95% C.I.	Upper 95% C.I.
Mathematics	9.761	1563.011	0.000*	4.035	6.065
Reading	3.501	1671.634	0.000*	0.634	2.251

Note. * indicates statistical significance at *p* less than .001.

Grade 4 Results

Grade 4 students took the mathematics, reading, and science PSSAs in 2010, 2011, 2012, and 2013. Table 7 displays the Grade 4 mathematics, reading, and science assessments' raw score means, mean differences, and other measures of central tendency for the conditions of before Common Core (2010 and 2011) and After Common Core (2012 and 2013) for each assessment's raw scores. The Grade 4 mathematics PSSA mean rose by 1.541 after the Common Core was instituted. The Grade 4 reading and science means also displayed very small but observable but increases in the mean raw scores between the two conditions of before and after Common Core.

Table 7

Descriptive Statistics for Grade 4 PSSAs

Subject	Common Core	*n*	*M*	*SD*	*SEM*	*M* Diff.	*SE* Diff.
Mathematics	Before	842	50.39	11.593	0.400	-1.541	0.562
	After	893	51.93	11.783	0.394		
Reading	Before	852	35.70	8.330	0.285	0.309	0.417
	After	889	35.39	9.059	0.304		
Science	Before	856	48.51	10.137	0.346	0.800	0.507
	After	892	47.71	11.043	0.370		

To conduct the *t* tests, the Levene's test for equality of variances was used for each subject test to discern if *df* adjustment was needed for each respective *t* test. As seen in Table 8, the two Grade 4 subject tests of reading and science violated the assumption of homogeneity, and the adjusted *df* was used for these two *t* tests. The mathematics

means for before and after Common Core did not violate this assumption; no adjustment was needed.

Table 8

Levene's Tests of Equality of Variances for Grade 4 PSSAs

Subject	*F*	*p*
Mathematics	0.192	0.661
Reading	7.627	0.006*
Science	6.733	0.010*

Note. * indicates the Levene's test displayed lack of equality of variances and the degrees of freedom adjusted *t* test is applied.

The differences in the means of the Grade 4 mathematics, reading, and science tests displayed mixed findings as seen in Table 9. The mathematics assessment mean for the 2 years after the Common Core was instituted was statistically significantly greater than the mean for the mathematics assessment in the 2 years before the Common Core was instituted at 2.642, with t (1563.634) = 9.761, , p = 0.006. The means for Reading and Science were both observationally and statistically unchanged. The null hypothesis was retained for Grade 4 reading and science. For Grade 4, the null hypothesis was not retained only in the case of mathematics. Grade 4 students produced greater scores on the mathematics PSSA after the Common Core was implemented.

Table 9

Results for t-tests for Grade 4 PSSAs

Subject	*t*	*df*	*p*	Lower 95% C.I.	Upper 95% C.I.
Mathematics	-2.744	1733	0.006*	-2.642	-0.439
Reading	0.742	1736.044	0.458	-0.508	1.127
Science	1.578	1742.574	0.115	-0.194	1.793

Note. * indicates statistical significance at *p* less than 0.01.

Grade 5 Results

Grade 5 students took the mathematics, reading, and writing PSSAs in 2010, 2011, 2012, and 2013. Table 10 displays the Grade 5 mathematics, reading, and writing assessments' raw score means, mean differences, and other measures of central tendency for the conditions of before Common Core (2010 and 2011) and after Common Core (2012 and 2013) for each assessment's raw scores. The Grade 5 mathematics PSSA mean raw score increased by 2.223 after the Common Core was instituted. The Grade 5 reading mean displayed very little change. The writing mean raw scores between the two conditions of before and after Common Core fell by 1.644.

Table 10

Descriptive Statistics for Grade 5 PSSAs

Subject	Common Core	*n*	*M*	*SD*	*SEM*	*M* Diff.	*SE* Diff.
Mathematics	Before	850	47.88	11.788	0.404	-2.223	0.584
	After	843	50.10	12.255	0.422		
Reading	Before	859	36.45	7.971	0.272	0.323	0.385
	After	839	36.13	7.910	0.273		
Writing	Before	857	65.63	12.577	0.430	2.839	0.609
	After	834	62.80	12.459	0.431		

To conduct the *t* tests, the Levene's test for equality of variances was used for each subject test to discern if *df* adjustment was needed for each respective *t* test. As seen in Table 11, none of the Grade 5 subject tests violated the assumption of homogeneity. The standard *df,* defined as *n*-1, was applied to all three Grade 5 *t* tests; no adjustment was needed.

Table 11

Levene's Tests of Equality of Variances for Grade 5 PSSAs

Subject	*F*	*p*
Mathematics	0.838	0.360
Reading	0.001	0.980
Writing	0.039	0.844

Note. * indicates the Levene's test displayed lack of equality of variances and the degrees of freedom adjusted *t* test is applied.

The differences in the means of the Grade 5 mathematics, reading, and writing tests displayed mixed findings as seen in Table 12. The mathematics assessment mean for

the 2 years after the Common Core was instituted was statistically significantly greater than the mean for the mathematics assessment in the 2 years before the Common Core was instituted at 2.223, with t (1691) = -3.804, $p < 0.0001$. The mean for reading was statistically unchanged. The null hypothesis was retained for Grade 4 reading. The mean for Grade 5 writing decreased after the Common Core was instituted with a mean difference of 2.839, t (1689) = 4.662, $p < 0.0001$. The Grade 5 writing difference was statistically significant. For mathematics and writing, the null hypothesis was not retained; however, Grade 5 students produced greater raw scores on the mathematics PSSA after the Common Core was implemented but showed a decrease in raw scores on the writing PSSA after the Common Core was implemented.

Table 12

Resulst for t-tests for Grade 5 PSSAs

Subject	*t*	*df*	*p*	Lower 95% C.I.	Upper 95% C.I.
Mathematics	-3.804	1691	0.000*	-3.369	-1.077
Reading	0.838	1696	0.402	-0.433	1.079
Writing	4.662	1689	.000*	1.644	4.033

Note. * indicates statistical significance at p less than .001.

Grade 6 Results

Grade 6 students took the mathematics and reading PSSAs in 2010, 2011, 2012, and 2013. Table 13 displays the Grade 6 mathematics and reading assessments' raw score means, mean differences, and other measures of central tendency for the conditions of before Common Core (2010 and 2011) and after Common Core (2012 and 2013) for each

assessment's raw scores. The Grade 6 mathematics PSSA mean raw score increased by 2.342 after the Common Core was instituted. The Grade 6 reading mean raw score decreased by 1.165.

Table 13

Descriptive Statistics for Grade 6 PSSAs

Subject	Common Core	*n*	*M*	*SD*	*SEM*	*M* Diff.	*SE* Diff.
Mathematics	Before	856	48.26	12.086	0.413	-2.342	0.576
	After	874	50.60	11.879	0.402		
Reading	Before	857	36.80	8.554	0.292	1.165	0.398
	After	871	35.63	7.979	0.270		

To conduct the *t* tests, the Levene's test for equality of variances was used for each subject test to discern if *df* adjustment was needed for each respective *t* test. As seen in Table 14, the Grade 6 subject test of reading violated the assumption of homogeneity; the *df* adjustment was used as part of conducting the *t* test for the reading PSSA. For mathematics, the homogeneity assumption was not violated, and no *df* adjustment was needed.

Table 14

Levene's Tests of Equality of Variances for Grade 6 PSSAs

Subject	*F*	*p*
Mathematics	1.565	0.211
Reading	3.947	0.047*

Note. * indicates the Levene's test displayed lack of equality of variances and the degrees of freedom adjusted *t* test is applied.

The differences in the raw score means of the Grade 6 mathematics and reading tests displayed statistical significance as seen in Table 15. The mathematics assessment's raw score mean for the 2 years after the Common Core was instituted was statistically significantly greater than the mean for the mathematics assessment in the 2 years before the Common Core was instituted at 2.342, with t (1728) = -4.066, $p < 0.0001$. The mean for Grade 6 reading decreased after the Common Core was instituted with a mean difference of 1.165, t (1713.422) = 2.928, $p = 0.003$. The Grade 6 reading raw score mean difference was statistically significant. For both Grade 6 mathematics and reading, the null hypothesis was not retained; however, Grade 6 students showed higher raw scores on the mathematics PSSA after the Common Core was implemented but lower raw scores on the reading PSSA after the Common Core was implemented.

Table 15

Results for t *tests for Grade 6 PSSAs*

Subject	*t*	*df*	*p*	Lower 95% C.I.	Upper 95% C.I.
Mathematics	-4.066	1728	0.000*	-3.472	-1.212
Reading	2.928	1713.422	0.003*	0.385	1.946

Note. * indicates statistical significance at p less than .01.

Grade 7 Results

Grade 7 students took the mathematics and reading PSSAs in 2010, 2011, 2012, and 2013. Table 16 displays the Grade 7 mathematics and reading assessments' raw score means, mean differences, and other measures of central tendency for the conditions of before Common Core (2010 and 2011) and after Common Core (2012 and 2013) for each

assessment's raw scores. The Grade 7 mathematics PSSA mean raw score decreased by 1.757 after the Common Core was instituted. The Grade 7 Reading mean raw score increased marginally by 0.626.

Table 16

Descriptive Statistics for Grade 7 PSSAs

Subject	Common Core	*n*	*M*	*SD*	*SEM*	*M* Diff.	*SE* Diff.
Mathematics	Before	843	49.84	11.677	0.402	1.757	0.602
	After	896	48.08	13.314	0.445		
Reading	Before	844	35.39	7.526	0.259	-0.626	0.375
	After	891	36.02	8.085	0.271		

To conduct the *t* tests, the Levene's test for equality of variances was used for each subject test to discern if *df* adjustment was needed for each respective *t* test. As seen in Table 17, the Grade 7 subject test of mathematics violated the assumption of homogeneity; the *df* adjustment was used as part of conducting the *t* test for the mathematics PSSA. For Reading, the homogeneity assumption was not violated, and no *df* adjustment was needed.

Table 17

Levene's Tests of Equality of Variances for Grade 7 PSSAs

Subject	*F*	*p*
Mathematics	18.384	0.000*
Reading	1.202	0.273

Note. * indicates the Levene's test displayed lack of equality of variances and the degrees of freedom adjusted *t* test is read.

The raw score means of the Grade 7 mathematics test displayed statistical significance as seen in Table 18. The mathematics assessment's raw score mean for the 2 years after the Common Core was instituted was statistically significantly decreased than the mean for the mathematics assessment in the 2 years before the Common Core was instituted at 1.757, with t (1728.544) = 2.930, p = 0.003. The mean for Grade 7 reading increased after the Common Core was instituted, but the change was not statistically significant, t (1733) = -1.667, p = 0.096. The null hypothesis for the Grade 7 reading raw score was retained. For Grade 7 mathematics, the null hypothesis was not retained. Grade 7 students were the first assessed grade since Grade 3 to produce lesser raw scores on the mathematics PSSA after the Common Core was implemented. Grades 4, 5, and 6 had produced increased raw scores on the mathematics PSSA following the implementation of the Common Core.

Table 18

*Results for t-*tests *for Grade 7 PSSAs*

Subject	*t*	*df*	*p*	Lower 95% C.I.	Upper 95% C.I.
Mathematics	2.930	1728.544	0.003*	0.581	2.933
Reading	-1.667	1733	0.096	-0.626	0.376

Note. * indicates statistical significance at p less than .01.

Grade 8 Results

Grade 8 students took the mathematics, reading, science, and writing PSSAs in 2010, 2011, 2012, and 2013. Of note, only Grade 8 completes PSSAs for all four of the Common Core subjects. Table 19 displays the four Grade 8 assessments' raw score

means, mean differences, and other measures of central tendency for the conditions of before Common Core (2010 and 2011) and after Common Core (2012 and 2013). The Grade 8 mathematics PSSA mean raw score increased marginally by 0.677 after the Common Core was instituted. The Grade 8 reading mean raw score decreased by 1.036. The Grade 8 science mean raw score increased by 3.297 after the Common Core was instituted. The Grade 8 writing mean raw score increased marginally by 0.806 after the implementation of the Common Core.

Table 19

Descriptive Statistics for Grade 8 PSSAs

Subject	Common Core	*n*	*M*	*SD*	*SEM*	*M* Diff.	*SE* Diff.
Mathematics	Before	871	50.71	11.913	0.404	-0.677	0.592
	After	882	51.39	12.862	0.433		
Reading	Before	872	36.81	7.434	0.252	1.036	0.376
	After	878	35.77	8.295	0.280		
Science	Before	876	43.91	11.731	0.396	-3.297	0.543
	After	877	47.20	10.995	0.371		
Writing	Before	872	70.97	11.145	0.377	0.806	0.545
	After	872	70.17	11.601	0.393		

To conduct the *t* tests, the Levene's test for equality of variances was used for each subject test to discern if *df* adjustment was needed for each respective *t* test. As seen in Table 20, only the Grade 8 Writing PSSA raw scores did not violate the assumption of homogeneity, and for this assessment only, no adjustments were made for the *t* test. The other three Grade 8 subject tests' variances violated the assumption of homogeneity; the

df adjustment was used as part of conducting the *t* test for the Grade 8 mathematics, reading, and science PSSA raw scores.

Table 20

Levene's Tests of Equality of Variances for Grade 8 PSSAs

Subject	*F*	*p*
Mathematics	4.700	0.030*
Reading	9.378	0.002*
Science	9.490	0.002*
Writing	1.043	0.307

Note. * indicates the Levene's test displayed lack of equality of variances and the degrees of freedom adjusted *t* test is read.

The *t* tests for the four Grade 8 PSSA assessments' raw score demonstrated mixed results. The differences in raw score means of the Grade 8 reading and science tests displayed statistical significance as seen in Table 21. The mean for Grade 8 reading decreased after the Common Core was instituted, and the 1.036 change was statistically significant, t (1733) = -1.667, p = 0.096. The null hypothesis for the Grade 8 reading raw score was not retained. For Grade 8 science, the raw score means on the PSSA after the Common Core were increased by 3.297 and by a statistically significant margin, t (1733) = -1.667, p = 0.096. The null hypothesis for Grade 8 science was not retained. Grade 8 students performed better on the Science PSSA after the implementation of the Common Core. Neither the Grade 8 mathematics nor Grade 8 writing assessments' raw score means for the 2 years after the Common Core was instituted produced a statistically significant difference from the respective raw score means on these assessments in the 2

years before the Common Core was instituted. The null hypothesis was retained for Grade 8 mathematics and writing.

Table 21

*Results for t-*tests *for Grade 8 PSSAs*

Subject	*t*	*df*	*p*	Lower 95% C.I.	Upper 95% C.I.
Mathematics	-1.144	1743.868	0.253	-1.838	0.484
Reading	2.752	1729.896	0.006*	1.036	0.376
Science	-6.070	1743.430	0.000*	-4.362	-2.231
Reading	1.480	1742	0.139	-0.262	1.875

Note. * indicates statistical significance at *p* less than .01.

Only Grade 8 completes the Science PSSA; these results were discussed above the follow-up tests by grade. Math and reading were the only two subjects tested for all Grades 3 through 8. The reading PSSA showed no change between before and after Common Core for Grades 4 and 5. Grades 3, 6, and 8 all showed decreases in PSSA scores for reading, and Grade 7 showed a marginal increase, but not statistically significant change, from before to after Common Core. For the mathematics PSSA, Grades 3 and 7 showed significant decreases in scores; however, the mathematics PSSA scores for Grades 4, 5, 6, and 8 increased. The remaining subjects are taken by students in multiple grades. Both the mathematics and reading tests are issued to students in a total of six grades, including Grades 3, 4, 5, 6, 7, and 8. The writing PSSA was given in Grades 5 and 8. The follow up *t* tests were used to assess if there were differences in PSSA raw scores for pre and post-Common Core implementation by subject for mathematics, reading, and writing. The descriptive results by PSSA subject appear in Table 22.

Table 22

Descriptive Statistics for Mathematics PSSA

Subject	Common Core	*n*	*M*	*SD*	*SEM*	*M* Diff.	*SE* Diff.
Mathematics	Before	5087	51.14	12.078	0.169	-0.028	0.243
	After	5248	51.17	12.572	0.174		
Reading	Before	5107	35.47	8.176	0.114	0.628	0.166
	After	5227	34.84	8.656	0.120		
Writing	Before	1729	68.33	12.169	0.293	1.763	0.422
	After	1706	66.56	12.577	0.304		

To conduct the *t* tests, the Levene's test for equality of variances was used for each subject test to discern if *df* adjustment was needed for each respective *t* test. The three subjects' *t* tests appear in Table 23. Only the reading PSSA did not display homogeneity of variance, $F = 16.09$, $p < 0.0001$, and the adjustment was made to the *df* to compensate for this violation.

Table 23

T tests for Mathematics, Reading, and Writing PSSAs

Subject	*t*	*df*	*p*	Lower 95% C.I.	Upper 95% C.I.
Mathematics	-0.116	10333.0	0.908	-0.504	0.447
Reading	3.794	10320.183	0.000*	0.304	0.953
Writing	4.176	3433.0	0.000*	0.936	2.591

Note. * indicates statistical significance at $p < .001$.

As seen in Table 24, the differences in the mean scores on the mathematics PSSA for before and after Common Core did not show statistical significance. The lack of statistical significance was not surprising given that the pre and post-Common Core

means for mathematics were 51.14 and 51.17, respectively. Children produced the same levels of academic achievement in mathematics across grades both before and after the implementation of the Common Core.

The mean scores on both the reading and writing PSSA were reduced in the post-Common Core condition. The *t* tests for the reading PSSA, t (10320.183) = 3.794, $p <$ 0.0001, and writing PSSA, t (3343) = 4.176, $p < 0.0001$, demonstrated that the differences were statistically significant in both cases. The reading PSSA raw score mean fell from pre- to post-Common Core by 0.63 of a point. In addition, the writing PSSA raw score average fell from pre- to post-Common Core by 1.77 points. This result suggests that the Common Core did not lead to increases in overall student achievement. Moreover, the standards led to significant reductions in PSSA scores for reading and writing but had little to no effect on mathematics.

Finally, as seen in Table 24, the effect size *d* was calculated for each test within grade and across all grades for each subject test. According to Cohen (1988), effect size *d* does not produce a small practical effect until the 0.2 value. An effect size is considered medium at a 0.4 value and large at 0.8. Few of the follow up raw score *t* tests produced statistical significance. For Grade 3, the mathematics effect size was medium at 0.474; in this grade, the mathematics achievement improved from pre- to post-Common Core. Grade 5 produced a small effect in writing achievement for pre- to post-Common Core. In the only grade to complete the Science PSSA, the effect size was also small at 0.289, and in Grade 8, pre- to post-Common Core Science PSSA achievement decreased. The

effect of the increases in Grade 3 mathematics and Grade 5 writing achievement suggests that some curriculum specific to these subject areas in these grades positively influenced achievement following the implementation of the Common Core.

Table 24

Effect Sizes for Mathematics, Reading, and Writing PSSAs by Grade and Across All Grades

	Effect Size *d* by Grade						Pre to Post *d*
PSSA	3	4	5	6	7	8	All Grades
Mathematics	.474**	-0.131	-0.185	-0.0195	0.140	-0.055	-0.002
Reading	.170	0.036	0.040	0.141	-0.080	0.132	0.075
Science						-0.289*	-0.289*
Writing		0.075	0.226*			0.070	0.143

Note. * indicates small effect size. ** indicates medium effect size.

The PSSA scores for 2011 and 2012 preceded the implementation of the Common Core. The PSSA scores for 2013 and 2014 represented the post-Common Core implementation. Because different grades received different PSSA assessments, first, the MANOVA was used for all grades' scale and raw scores to discern if a main effect could be detected. The combined dependent variable was appropriate because the dependent variables did not demonstrate a high relationship to each other, given the Pearson was .65 (see Pallant, 2013). Second, follow-up *t* tests were employed for the raw scores for each grade because the independent variable of before and after Common Core was dichotomous. Additionally, the raw scores included all items on the assessments and provided more nuanced understanding of differences.

Summary

Grade 3 students mathematics PSSA mean fell by 5.05 and the reading mean also fell by a smaller margin. Grade 3 students earned decreased scores on both mathematics and reading after the Common Core was implemented.

Grade 4 students mathematics PSSA mean rose by 1.541 while reading and science means also displayed very small but observable increases in the mean raw scores for the two conditions of before and after Common Core. The means for reading and science were both observationally and statistically unchanged.

The Grade 5 mathematics PSSA mean raw score increased by 2.223, Grade 5 reading mean displayed very little change. The writing mean raw scores for the two conditions of before and after Common Core fell by 1.644. The mean for reading was statistically unchanged.

Grade 6 mathematics PSSA mean raw score increased by 2.342 after the Common Core was instituted and the reading mean raw score decreased by 1.165. The Grade 7 mathematics PSSA mean raw score decreased by 1.757 after the Common Core was instituted while the Grade 7 Reading mean raw score increased marginally by 0.626. The Grade 8 mathematics PSSA mean raw score increased marginally by 0.677 after the Common Core was instituted while the Grade 8 reading mean raw score decreased by 1.036. The Grade 8 science mean raw score increased by 3.297 and the Grade 8 writing mean raw score increased marginally by 0.806 after the implementation of the Common Core. In summary, the common core resulted in a significant overall reduction in

student achievement as measured by PSSA scores at the district in question. When broken down by subject area, that reduction was most pronounced for reading and writing. Mathematics and Science on the other hand showed a small but statistically nonsignificant increase. Table 25 summarizes the direction of each result as up or down.

Table 25

Summary of the Statistically Significant Results Before and After the Common Core Standards

Grade	PSSA Subject	Change Direction
3	Mathematics	Decrease
4	Mathematics	Increase
5	Mathematics	Increase
6	Mathematics	Increase
7	Mathematics	Decrease
3	Reading	Decrease
6	Reading	Decrease
8	Reading	Decrease
8	Science	Increase
5	Writing	Decrease

Section 5: Discussion, Conclusions, and Recommendations

The purpose of this study was to assess whether the Common Core Standards had an influence on the learning of students in Grades 3 through 8. PSSA tests were used to measure whether there was an increase or decrease in students' learning. These scores are beneficial to local Pennsylvania school districts looking to strengthen their curriculum

to enhance student achievement. To perform this assessment, a causal-comparative study design with one factor (before and after Common Core) and two levels (raw scores and scale scores) was employed using independent and dependent variables. The independent variable was the Common Core curriculum and the dependent variables were raw and scale scores for PSSA reading, writing, science, and mathematics achievement tests. This section includes a summary and discussion of the findings, implications for educational leaders, recommendations for future research, and a conclusion.

Discussion of the Findings

The results of the causal–comparative design showed that the Common Core Standards had a mainly negative influence on students' learning. When broken down by grade and subject, the PSSA scores for mathematics, reading, and writing for students in Grades 3 through 8 showed a decrease after the implementation of the standards. However, there were some exceptions to the decrease: There a slight increase in Grades 4, 5 and 6 math, and a marginal increase in Grade 8 math and writing. Science scores increased as well; however, the PSSA science assessment was completed only by eighth grade students.

These scores would be used to justify the additional funding the school district's budget would require to train the staff and educators on implementing and using the standards. The study is important for school districts in northeast Pennsylvania where the local schools faced a $3 million reduction in its 2016-2017 school year budget. In its first 2 years of implementation, the Common Core was associated with a significant overall

reduction in student achievement as measured by PSSA scores. When broken down by subject area, that reduction was most pronounced for reading and writing. Mathematics on the other hand showed a small but statistically nonsignificant increase.

Learning how to teach the Common Core Standards was an important facet of the training received by the school districts' teachers and staff during annual workshops—workshops that required additional funds from school budgets. The Common Core Standards changed the curricula used in all of Pennsylvania's schools; these new standards could be assumed to have influenced parents' enrollment choices for their children.

As discussed, school enrollment fell after the Common Core Standards were implemented, and the curricula might have influenced enrollment (Larson, 2015). As a result, the budget was reduced due to the reduction in school enrollment and a smaller budget for training might have impacted teachers' capacity for teaching the Common Core Standards. The reduction in students' scores that followed implementation of the standards supported the Pennsylvania school administrators who argued that the standards were implemented too quickly (Pennsylvania Board of Education, 2010).

The results of the four subjects' PSSAs in Grades 3 to 8 coincided with Palochko and Tatu's (2015) recent description of statewide declines in PSSA scores. In particular, school districts in urban regions containing the highest percentage of students in poverty and more transient populations suffered the most extreme reductions in PSSA scores compared to the rest of the state (Palochko & Tatu, 2015). Palochko and Tatu reported

Pennsylvania's school administrators, notably those from wealthier areas, believed schools' leaders and teachers need more time for training before the state required schools to implement the standards.

Additionally, the science scores also improved significantly after the implementation of Common Core Standards in PSSA. However, in other subjects, the students' scores decreased after implementation. Children produced the same levels of academic achievement in mathematics across grades both before and after the implementation of the Common Core. This result could also have been affected by implementation of the Pennsylvania Core which was the state's version of the Common Core Standards and already included questions with heightened difficulty and increased rigor, and lesser able students have been able to score generate proficiency.

Implications

The first 2 years of PSSA data following the implementation of Common Core Standards demonstrated more training among teachers is needed. While students in Grade 8 demonstrated similar or better scores since Common Core implementation, this result could have occurred as a result of their existing levels of comprehension. The PSSAs which align with the Common Core Standards contain open-ended and critical thinking questions, as well as higher-level math problems, and nonfiction reading problems that led to overhauling the curriculum to prepare students to answer the high level cognitive questions (Chute et al., 2015).

Based on the current findings, additional studies must be done to prove or disprove the effectiveness of the Common Core Standards on the PSSAs. Further measurements of how PSSA scores are affected by the Common Core over time may show evidence of how teacher training for implementing the Common Core improves student performance. Due to the extremely expeditious implementation of the standards, the local school district was not fully prepared and teachers were not fully trained to introduce the standards into the school district curriculum. Score reductions within all grades occurred, but not all of those differences generated statistical significance. Interestingly, Grade 8 science scores showed an improvement from pre- Core Curriculum to post- Core Curriculum implementation.

On a local level, a study regarding training for teaching staff needs to be completed to help teachers maximize the implementation of the standards. The state education budget must allow for providing additional education to teachers in order to find ways to educate the students using the Common Core Standards. Local school districts need to embrace the Common Core Standards to use them to the students' advantage within the system. The Common Core Standards need to be promoted by the state with students' families in order for parents to understand how to provide help to their students at home. By educating teachers as well as the families of the students around the country, each student may benefit from having a stronger support network in their parents and classroom teachers.

Future Research Recommendations

On a national level, additional studies are needed in various parts of the country regarding the effectiveness of using the Common Core and other states implement them. Such researchers may choose to analyze data between states, teachers' different styles of teaching, use of facilities and technology when implementing the Common Core, and the effect of different levels of education among teachers. More research is needed about how school districts embrace and promote the Common Core Standards to their stakeholders and to better prepare their teaching staff.

The Common Core Standards represent a fairly novel addition to the nation's public schools and were introduced before enough of research and training about them could be made available. The future of the Common Core Standards should be determined by rigorous empirical studies, such as this one. Studies regarding all possible outcomes that may be occurring due to the Common Core Standards need to move forward. Educational leaders need information for choosing appropriately either to maintain or to eliminate the Common Core Standards for educating students in the nation's public schools.

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