2018

Perceptions of Mathematics Teachers Regarding Common Core State Standards and Formative Assessment

Julie Gale Mest
Walden University

Walden University

College of Education

This is to certify that the doctoral dissertation by

Julie Mest

has been found to be complete and satisfactory in all respects,
and that any and all revisions required by
the review committee have been made.

Review Committee
Dr. Wade Smith, Committee Chairperson, Education Faculty
Dr. Danielle Hedegard, Committee Member, Education Faculty
Dr. Bettina Casad, University Reviewer, Education Faculty

Chief Academic Officer
Eric Riedel, Ph.D.

Walden University
2018

Abstract

Perceptions of Mathematics Teachers Regarding Common Core

State Standards and Formative Assessment

by

Julie Mest

MA, Lehigh University, 2001

BS, Lehigh University, 2000

Dissertation Submitted in Partial Fulfillment

of the Requirements for the Degree of

Doctor of Philosophy

Curriculum, Instruction, and Assessment

Walden University

May 2018

Abstract

The adoption of the Common Core State Standards has necessitated a change in the instructional practices used by many mathematics teachers. The new standards encourage problem solving and the development of conceptual understanding rather than rote memorization of formulas and rules. Researchers have demonstrated that formative assessment is a powerful instructional tool that, when implemented properly, can increase student achievement. The purpose of this quantitative study was to determine how mathematics teachers in Pennsylvania perceive the new standards; how they value and use formative assessment practices including involving students in their work, modeling quality work, providing feedback, and providing opportunities for peer and self-assessment; and how these variables are related to each other. The answers to these research questions could potentially guide future professional development for teachers. This study was guided by the theoretical framework of Bloom, Dewey, and Piaget who each stated that a constructivist approach to learning is necessary for student growth. Likert scale surveys were used and Pearson correlational studies were conducted to analyze the data from the 174 respondents. Results revealed that participants were generally not in favor of the Common Core State Standards, and there were few statistically significant relationships between teachers' value and use of the 4 formative assessment practices and their value of the standards. Participants appeared to have some misconceptions about the standards and the instructional practices that support implementation, suggesting a continued need for professional development. Attention to this professional learning could help to promote student achievement.

Perceptions of Mathematics Teachers Regarding Common Core State Standards and Formative Assessment

by

Julie Mest

MA, Lehigh University, 2001

BS, Lehigh University, 2000

Dissertation Proposal Submitted in Partial Fulfillment

of the Requirements for the Degree of

Doctor of Philosophy

Curriculum, Instruction, and Assessment

Walden University

May 2018

Dedication

I dedicate this work to my mother, Gale Paulsen, who has demonstrated throughout my entire life what it means to work hard and to never give up. Your guidance and unwavering support helped me throughout this very long journey, and I am forever grateful for your encouragement to follow my dreams.

I dedicate this accomplishment to my husband, Andrew, who has spent most of our married life supporting me as I worked to achieve this goal. Your constant love and giving of so much of your time to our children has allowed me to complete something I never thought was possible.

To my children, Grace and Nolan, I dedicate this completion of my dream. Although you both came into my life in the midst of this journey, you became the true reason for wanting to see it through to completion. I love you both with all my heart and hope one day you will each have the courage to tackle your own dreams.

"Consult not your fears but your hopes and your dreams. Think not about your frustrations, but about your unfulfilled potential. Concern yourself not with what you tried and failed in, but with what it is still possible for you to do." ~ Pope John XXIII

Acknowledgements

I would like to acknowledge the endless support of my chair and mentor Dr. Wade Smith. You provided unwavering guidance, even in my moments of despair and frustration. Without you, I do not know if I would have completed this journey.

Many Walden faculty members have aided me throughout my program and have helped me to become the student I am today. Dr. William Alvarez, your compassion and guidance was always appreciated. You seemed to understand the struggles of balancing family, career, and being a student, and always provided the much needed encouragement. Dr. Heather Miller, you challenged me as a writer and to think more like a scholar. To my other committee members, Dr. Danielle Hedegard and Dr. Deanna Boddie, thank you for your time and expertise. Your efforts and feedback was always appreciated.

I would also like to thank my family and friends for your constant support through the years. You each contributed to this success, and I am eternally grateful for your love and encouragement.

Table of Contents

Chapter 1: Introduction to the Study....1

Overview....1

Background....3

Problem Statement and Purpose of the Study....8

Research Questions and Hypotheses....10

Theoretical Framework....11

Nature of the Study....13

Definition of Terms....15

Assumptions....17

Scope and Delimitations....18

Limitations....21

Significance of the Study....22

Implications for Social Change....24

Summary....24

Chapter 2: Literature Review....26

Overview....26

Literature Search Strategy....27

Common Core State Standards....28

History....28

Definition....33

Teacher Perceptions....36

Implementation 39
Impact on Student Achievement 42
State-Specific Influence 50
Formative Assessment 52
History and Theoretical Basis 53
Benefits 56
Implementation 67
Conclusion 78
Chapter 3: Research Method 81
Research Design and Rationale 81
Methodology 83
Population 83
Sampling 85
Data Collection 86
Procedures 86
Instrumentation and Operationalization of Constructs 87
Threats to Validity 89
Ethical Considerations 91
Summary 92
Chapter 4: Results 93
Introduction 93
Data Collection 95

Results....99
Perceptions of Common Core....100
Formative Assessment Value and Use....108
Relationships Between Variables....112
Summary....115
Chapter 5: Discussion, Conclusions, and Recommendations 117
Interpretation of Findings....118
Alignment to the Literature....118
Findings Related to the Theoretical Framework....122
Limitations of the Study....123
Recommendations....124
Implications....126
Conclusion....127
References..... 129
Appendix A: Study Instrumentation....153
Appendix B: Permissions....158

Chapter 1: Introduction to the Study

Overview

As state and national governments are mandating proficiency for all students in mathematics, educators and administrators are concurrently examining teaching strategies to determine their effectiveness for improving student achievement on assessments measuring the application of Common Core State Standards (CCSS). One such instructional practice that has received attention from both researchers and educators is known as *formative assessment.* Studies have revealed that, when correctly implemented, this teaching strategy is valued and can be a powerful learning tool for higher levels of academic achievement, improved learning environments, and greater student motivation (Black, 2003; Black & Wiliam, 2010; Brown & Hirschfeld, 2008; Gates Foundation, 2013; Ginsburg, 2009; Harris, 2007; Hwang & Chang, 2011; Lalley & Gentile, 2009; Lee, McInerney, Liem, & Ortiga, 2010; Sadler, 1998, 2010; Tariq, 2013; Yin et al., 2008).

In over 40 studies in which teachers applied formative-assessment practices properly with students ranging from 5 years of age to those enrolled in universities of various countries and across subject areas, significant learning gains resulted (Black & Wiliam, 2010). Gains included effect sizes ranging from 0.4 to 0.7, which are higher than most educational interventions. More notable, the formative-assessment practices significantly improved learning in populations of low-achieving students and students with learning disabilities (Black & Wiliam, 2010). These data support the notion that

formative-assessment practices are, collectively, a vital component to any classroom environment and can raise academic achievement for most learners.

With the adoption of the CCSS in mathematics for public-school students attending kindergarten through Grade 12 (K–12), teachers are required to increase the level of rigor within their classrooms to meet these standards. This necessitates a concurrent change in instructional practice (Ball & Forzani, 2011). Recent research has indicated that formative-assessment practices may improve student outcomes following academic instruction (Tariq, 2013). The Gates Foundation (2013) has provided significant funding to develop formative-assessment tools to research current application of such assessment and to support teachers in determining how to optimally apply formative-assessment practices within their classrooms. Researchers have demonstrated the advantages of this type of assessment for a variety of learners and within diverse settings (Black & Wiliam, 2010; Brown & Hirschfeld, 2008; Gates Foundation, 2013; Ginsburg, 2009; Hwang & Chang, 2011; Lalley & Gentile, 2009; Lee et al., 2010; Tariq, 2013; Yin et al., 2008).

Investigators have also examined teacher perceptions of the CCSS (Cheng, 2012; Choppin, Davis, Drake, & McDuffie, 2013; Davis, Choppin, Drake, & McDuffie, 2014; Editorial Projects in Education [EPE] Research Center, 2013; Nadelson, Pluska, Moorcroft, Jeffrey, & Woodard, 2014; Porter, Fusarelli, & Fusarelli, 2015; Rentner & Kober, 2014). However, no studies have been conducted to specifically examine the relationship between the extent to which mathematics teachers value formative assessment, how they apply the strategy, and their perceptions of the CCSS. Such

perceptions include teacher impressions as to their preparedness to implement these standards, the overall implications of the CCSS for their teaching practices and desired outcomes, and how they perceive the quality and rigor of the standards. A clearer understanding of the relationship between these factors might provide valuable insight into how teacher perceptions of the CCSS influence their instructional practices. My goal for this study was to contribute to the existing knowledge base surrounding formative assessment and identify whether a relationship exists between the extent of the value placed on formative assessment by teachers, their use of formative-assessment practices, and their impressions of the CCSS. Understanding this relationship may lead to positive changes in professional development and other types of support teachers receive throughout the school year.

In the following chapter, I will provide a summary of current research on the CCSS and formative assessment and present a rationale for why this study is important in the field of education. In addition, I will present the research questions and hypotheses and describe the variables and the theoretical foundation and how they relate to the research questions. I will define key terms and variables and explain my assumptions and the limitations of the study. Lastly, I will identify and describe the potential impact the study might have on contributing to positive social change in education.

Background

I conducted this study in the state of Pennsylvania; consequently, I focused my literature review on data relevant to this state. In July 2010, the Pennsylvania state legislature adopted the CCSS in mathematics and English-language arts (ELA). Led by

the National Governors Association (NGA) and the Council of Chief State School Officers (CCSSO), a group of professors, teachers, curriculum writers, and others involved in mathematics education developed the CCSS. The committee designed the standards to identify college and career readiness standards and integrate them into K–12 content standards. Although not intended to serve as a national curriculum, the group developed the CCSS as a framework for states developing curricula and summative assessments (Rothman, 2011). The CCSS support the goal of increased consistency in the content and skills students are expected to learn and at which grade level (Council of Chief State Officers and National Governors Association, 2015). As of December 2016, 43 states had adopted the CCSS in mathematics, as well as the District of Columbia, five U.S. territories, and the Department of Defense Education Activity—a federal agency that manages all schools designed for children of military members (Council of Chief State Officers and National Governors Association, 2016).

In addition to promoting greater uniformity across states, the CCSS in mathematics also encourage teachers to support students in developing conceptual understanding and applying learned skills to solve challenging problems (Phillips & Wong, 2012). Ultimately, the CCSS promote six major shifts in mathematics education that influence instruction delivery. These shifts are: (a) a narrower focus on fewer topics but at a deeper level, (b) greater coherence between topics across subjects and grades, (c) development of fluency in simple calculations, (d) a deeper understanding of topics with less memorization, (e) increased application of topics to real-world situations, and (f) an equal focus on practice and understanding (New York State Department of

Education, 2012). For some educators, the shift from memorization of facts and formula manipulation to deep awareness of how concepts are related and applied has been a struggle (Ball & Forzani, 2011; Phillips & Wong, 2012; Porter et al., 2015). Teachers and administrators at the school level play the most important role in ensuring school reform. Therefore, teachers must believe in the foundation of basic assertions related to the CCSS (Porter et al., 2015).

State education departments quickly recognized that, to implement the CCSS correctly, they would need additional support to ensure that the standards, curricula, assessments, teacher-evaluation systems, teacher-preparation systems, and teacher training were all aligned with the expectations of the CCSS (Rothman, 2011). Kentucky was the first state to adopt the CCSS and the Kentucky Board of Education enlisted help from various organizations, including the Council on Postsecondary Education, the Educator Professional Standards Board, and the Pritchard Committee for Academic Excellence, to institute the changes necessary for statewide implementation of the standards. Many other states followed the lead of Kentucky and identified areas in which significant changes needed to occur to ensure correct implementation of the CCSS (Kober & Rentner, 2011). Although many of these changes were needed at the state level, numerous researchers supported the notion that teachers also need training and professional development to effectively implement the standards (Ball & Forzani, 2011; Bostic & Matney, 2013; Jenkins & Agamba, 2013; Liebtag, 2013; Phillips & Wong, 2012; Porter et al., 2015; Rothman, 2011; Ruchti, Jenkins, & Agamba, 2013; Youngs, 2013).

Teachers are the critical instructional element within classrooms. Consequently, supporting educators for the improvement and enhancement of their instructional practices is pivotal (National Council of Teachers of Mathematics [NCTM], 2014). Based upon positive outcomes associated with formative-assessment practices, teachers are encouraged to frequently implement formative assessment in support of the six described shifts in mathematics instruction (Marzano, 2013; Phillips & Wong, 2010, 2012).

Since 2011, educators, parents, and policy makers have asserted that the CCSS are ineffective in improving student academic achievement within their respective states and districts (Stotsky, 2012; Ujifusa, 2013). Numerous Internet sites have emerged such as Parents against the Common Core, Arizonians Against the Common Core, Californians United Against the Common Core, and Parents and Teachers Against the Common Core. The content of these sites reflects vehement protest to the adoption of the CCSS, arguing that the standards do not raise academic achievement, are harmful to student development, and do not allow teachers professional freedom within the classroom.

Porter et al. (2015) conducted a study of teachers from two schools in the state of North Carolina who implemented the CCSS. The findings revealed that the standards had a significant impact on the personal and professional lives of the teachers. The participating educators equated implementation of the CCSS to that of being a novice teacher. They described the time and energy needed to implement the standards as placing significant demands on them, both professionally and personally. As teachers

grapple with implementing the CCSS, researchers are working to identify those instructional practices that successfully support improved student learning.

As noted earlier, the Gates Foundation has funded numerous projects to aide in teacher training focused on formative-assessment practices (as cited in Phillips & Wong, 2012). The conclusions researchers have made with regard to implementation of the CCSS are similar to those published on formative assessment (Black, 2003; Black & Wiliam, 2003; Brown & Hirschfeld, 2008; Ginsburg, 2009; Guskey, 2007; Heritage, 2007; Heritage, Kim, Vendlinski, & Herman, 2009; Hwang & Chang, 2011; Stull, Varnum, Ducette, Schiller, & Bernacki, 2011; Volante & Beckett, 2011; Webb & Jones, 2009). When teachers receive appropriate training and correctly implement formative-assessment practices, students have demonstrated statistically significant academic gains. Conversely, when teachers struggle to implement these practices, improvement in student achievement and motivation suffers (Yin et al., 2008). Other research in formative assessment has demonstrated that teacher application of these assessments has significantly increased student self-esteem and a sense of competence (Miller & Lavin, 2007). The overall instructional practices of the educators have also improved (Ginsburg, 2009; Lalley & Gentile, 2009). Further, researchers have linked formative assessment to a more positive classroom climate (Morrone, Harkness, Ambrosio & Caulfield, 2004; Walker & Greene, 2009).

There was a need for this study because no researcher conducted a study with a focus on whether a relationship exists between how math teachers perceive the CCSS and their use of formative-assessment practices within their classrooms. Despite the many

benefits of formative assessment and the push for its use by supporters of the standards, researchers have not conducted studies to determine the relationship between the extent to which teachers value this approach and their implementation of the instructional strategy and overall perceptions of the CCSS. Understanding this relationship provides clearer insight into the connection teachers make between the CCSS and formative-assessment practices. The findings of the study might also influence the training teachers, administrators, and education majors receive on both the CCSS and formative assessment.

Problem Statement and Purpose of the Study

Although researchers have documented the many statistically positive outcomes associated with formative-assessment practices, they have also documented that there are no significant gains to instructional practices or student academic achievement following the implementation of such assessment. However, the latter studies often acknowledge that teachers do not use formative assessment regularly or effectively within their classrooms (Black & Wiliam, 2003; Volante & Beckett, 2011; Yin et al., 2008). Although I conducted numerous database searches of existing literature, none revealed studies demonstrating negative student outcomes when teachers incorporate formative-assessment practices into their instruction. Although limited research currently exists on CCSS implementation, researchers have found that teachers and administrators struggle in the integration of the CCSS and in instituting the necessary instructional shifts.

Many teachers have reported awareness of the CCSS (Cogan, Schmidt, & Houang, 2013; Editorial Projects in Education [EPE] Research Center, 2013) and, even

more importantly, approve of the standards (Cogan et al., 2013; Hart Research Associates, 2013). However, current research suggests that these teachers continue to struggle with implementation of the standards due to insufficient training (Nadelson et al., 2014). Although the majority of teachers have received a measure of training, three quarters of the participants in a study conducted by the EPE Research Center (2013) reported 4 days or less of training on the CCSS. Teachers have also expressed a need for more resources aligned with the standards. The implementation of both formative-assessment practices and instructional practices related to the CCSS has been a challenge for many educators. Improved student achievement following adoption of the standards has not been statistically significant (Loveless, 2015). It remains unclear as to which factors might influence student achievement; however, it is apparent that implementation of the CCSS is a struggle for teachers, and the gains supporters anticipated have yet to be evidenced. Administrators, educators, and policy makers have invested significant money, time, and effort in the CCSS and desire more immediate positive gains in student learning.

The purpose of this quantitative study was to determine how mathematics educators perceive the CCSS, the extent to which they value formative-assessment practices and implement those strategies in their classrooms, as well as how these factors relate to one another. I examined the following four specific practices that past research has demonstrated promote significant gains in student achievement: (a) involving students in their learning (Chappuis & Stiggins, 2002; Morrell, Flick, & Wainwright, 2004; Rafferty, 1994), (b) modeling quality work (Hendry & Jukic, 2014; Lipnevich,

McCallen, Miles, & Smith, 2014; Rafferty, 1994), (c) providing feedback to students (Black & Wiliam, 1998; Chappuis & Stiggins, 2002); and (d) providing opportunities for student self and peer assessment.

Research Questions and Hypotheses

The following research questions and corresponding hypotheses guided the study:

Research Question 1 (RQ1): Are mathematics teachers' perceptions of the CCSS positive?

H_0**1:** Mathematics teachers' perceptions of the CCSS are positive.

H_a**1:** Mathematics teachers' perceptions of the CSSS are not positive.

Research Question 2 (RQ2): How do mathematics teachers' perceptions of the CCSS relate to the value they place on formative-assessment practices including involving students in their learning, modeling quality work, providing feedback to students, and/or providing student opportunities for self and peer assessment?

H_0**2:** There is no significant relationship between how mathematics teachers perceive the CCSS and the value they place on formative-assessment practices related to involving students in their learning, modeling quality work, providing feedback to students, and/or providing student opportunities for self and peer assessment.

H_a**2:** There is a significant relationship between how mathematics teachers perceive the CCSS and the value they place on formative-assessment practices related to involving students in their learning, modeling quality work, providing feedback to students, and/or providing student opportunities for self and peer assessment.

Research Question 3 (RQ3): How do mathematics teachers' perceptions of the CCSS relate to their use of formative-assessment practices including involving students in their learning, modeling quality work, providing feedback to students, and/or providing student opportunities for self and peer assessment?

***H_0*3:** There is no significant relationship between how mathematics teachers perceive the CCSS and their use of formative-assessment practices related to involving students in their learning, modeling quality work, providing feedback to students, and/or providing student opportunities for self and peer assessment.

***H_a*3:** There is a significant relationship between how mathematics teachers perceive the CCSS and their use of formative-assessment practices related to involving students in their learning, modeling quality work, providing feedback to students, and/or providing student opportunities for self and peer assessment.

Theoretical Framework

Although formative assessment did not gain momentum until the early 21st century, theorists laid a foundation supporting its use much earlier. Dewey (1916) argued that children must actively participate in their own education to make sense and "take ownership" of their learning. He also supported the notion that students must be trained to think and develop the ability to draw connections between learning and life (Dewey, 1938). The education philosophy advanced by Dewey contributed to the emergence of the progressive-education movement and experiential education programs in which students learned to connect past experiences to current learning. In applying this theory, teachers were responsible for making learning meaningful to students and no longer

provided solely direct instruction. Rather, educators guided learning as they interacted with students.

Bloom (1968) supported the Dewey findings by expressing the idea that all students are capable of learning if provided with appropriate learning conditions. He referred to this theory as mastery of learning or learning for mastery. The primary rationale behind mastery learning is that students must master skills at a particular level before moving on to a more advanced level. This method of instruction requires teachers to have specific knowledge on the learning capabilities of each student, so they can deliver remediation or enrichment as needed.

Piaget (1976) recommended the use of tasks or clinical interviews to determine student capabilities. Teacher design tasks of various forms; from written questions on a quiz to verbal questions within a classroom. These tasks elicit responses that provide information on student capabilities and knowledge. Although they can provide more information than observation, Piaget believed that clinical interviews gather the best knowledge on the thought processes of students. During such interviews, teachers ask students questions related to why they are performing tasks. The teachers are subsequently able to interpret student behavior. After a teacher has developed a clearer view of student knowledge or misunderstandings, he or she can then employ suitable methods of instruction.

Dewey (1916, 1938); Bloom (1968); and Piaget (1976) advanced ideas surrounding learning that sparked the constructivist movement still evident within contemporary classrooms. Educators are interested in encouraging students to be active

learners rather than passive listeners. Teachers expect students to draw meaning from their own learning and apply new knowledge to their lives. In accordance with constructivist philosophy, teachers are now responsible for developing a clearer understanding of the abilities of each student and modifying instruction to make learning meaningful for each student. This form of instruction has led to the development and use of formative assessments within classrooms.

Although teachers do not necessarily interview students, they implement short, quick assessments that provide information on student knowledge and capabilities. Such assessments support the efforts of educators as they guide teaching and learning. Students and teachers become partners throughout the learning process. Because philosophers laid the foundation for formative assessment over 100 years ago, research is abundant within this area of study and provides insight into how students learn best. This study was designed with the aim to add to this knowledge base and draw connections between the extents to which teachers value and implement formative-assessment practices, as well as how they perceive the CCSS in relation to these practices. This framework also served as the theoretical "lens" through which the data collected was analyzed and interpreted.

Nature of the Study

This study was of a quantitative survey design. This approach allowed for me to survey a large sample. This, in turn, allowed for possible generalizations of the results to all teachers within Grades 7 through 9 mathematics classes within the state of Pennsylvania. This research design was more appropriate than interviewing teachers through qualitative study, which would only have allowed for a small sample of teachers,

preventing optimal generalization of the findings. A quantitative approach allowed for all eligible teachers to participate in the study, since I could easily distribute the survey through email. I collected data on the extent to which the participating teachers value and implement formative assessment and their perceptions of the CCSS. I administered two previously created Likert-type surveys to mathematics teachers in Pennsylvania that met the established criteria. To acquire data on teacher perceptions of the CCSS, I used the Likert-type survey questions from a study conducted by Cheng (2012). To acquire data on the value teachers place on formative-assessment practices and their use of each teaching strategy, I administered a survey created by Neesom (2000) and later modified by James, Black, McCormick, Pedder, & Wiliam (2002). Combining these two surveys allowed me to determine if any relationships exist between the study variables. The variables in this study were teacher use and value of formative-assessment practices including; involving students in their learning, modeling quality work, giving student feedback, and providing opportunities for student peer and self-assessment, as well as teacher perceptions of the CCSS. Potentially, each of these variables can be both predictors and outcomes.

In the study, I surveyed middle- and high-school math teachers from Grade 7 through Algebra I from across public schools within the state of Pennsylvania. With the exception of the demographic data, all questions were in a Likert-type format. Demographic data included gender, education level, and years of teaching experience. I used multiple correlation tests to test the null hypothesis, which states that no significant relationship exists between how mathematics teachers perceive the CCSS and their value

and/or use of formative-assessment practices related to involving students in their learning, modeling quality work, providing feedback to students, and/or providing student opportunities for self and peer assessment. To ensure the demographic data did not act as confounding variables, I tested for a significant relationship between the variables using partial correlations. The results of this study added to the knowledge base about teachers' perceptions of the CCSS and their value and use of formative-assessment practices.

Definition of Terms

The following are terms I used throughout the study and are defined for purposes of the research:

Adequate yearly progress: According to the Pennsylvania Department of Education (2012),

> Part of the federal No Child Left Behind Act that holds districts/LEAs accountable to students, their parents, teachers, and the community. The purpose is to ensure that all students have reading and math skills that prepare them for the future. The law states that all students must reach the Proficient level or higher in Reading or Language Arts and Mathematics by 2014. Districts/LEAs and schools must show Adequate Yearly Progress on several measurable indicators: Attendance or Graduation Rate, Academic Performance, and Test Participation. . . . Measuring AYP can prompt schools that consistently miss measures to make drastic improvements. While these improvements are being made, options are available to students, from tutoring to school choice. (p. 1)

Assessment for learning: Teacher and school use of various assessment methods to demonstrate student progress toward achieving various standards. These assessments help provide students, teachers, and parents with useful information on student progression toward mastery (Stiggins, 2005).

Common Core State Standards (CCSS): A set of K–12 standards in mathematics and language arts developed within the United States to increase content consistency across classrooms, as well as to develop standards for college and career readiness. In 2010, states began adopting the CCSS and changing curricula, teaching practices, and summative assessments to reflect the standards.

Formative assessment: According to Black, Harrison, Lee, Marshall, and Wiliam (2004),

> Any assessment for which the priority in its design and practice is to serve the purpose of promoting pupils' learning. It thus differs from assessment designed primarily to serve the purpose of accountability, or of ranking, or of certifying competence. An assessment activity can help learning if it provides information to be used as feedback by teachers, and by their pupils in assessing themselves and each other, to modify the teaching and learning activities in which they are engaged. Such assessment becomes "formative assessment" when the evidence is actually used to adapt the teaching work to meet with learning needs. (p. 10)

High-stakes testing: Standardized assessments in reading and mathematics mandated by state and national governments and intended to measure student

performance against rigorous standards. These assessments are often used for the purpose of accountability (Abbott, n.d.).

Keystone exams: End-of-course assessments administered to students within the state of Pennsylvania to assess proficiency in various subjects. During the 2012-13 school year, exams were administered in Algebra I, literature, and biology. Pending funding, these exams may also be required for other academic subjects. At the high-school level, the Keystone Exams replaced the Pennsylvania System of School Assessments (PSSA) for determining adequate yearly progress during the 2012-13 school year (Pennsylvania Department of Education, 2013a).

Mastery learning: A theory developed by Benjamin Bloom during the 1960s that speculated, "All students can reach higher criteria of learning if the instructional method and time are varied to match students' individual learning needs" (Guskey, 2007, p. 9).

Pennsylvania System of School Assessment (PSSA): A standards-based, criterion-referenced assessment used to measure student achievement within the state of Pennsylvania. Students attending Grades 5, 8 and 11 are assessed in writing. Every Pennsylvania student attending Grades 4, 8 and 11 is assessed in science (Pennsylvania Department of Education, 2013a).

Assumptions

Several major assumptions guided me through the course of this study. I assumed that the study participants would respond to the survey truthfully, because I informed them that their responses would remain confidential. Additionally, because the participants were volunteers, they could choose to withdraw from the study at any time

without consequences. The second assumption was that school and state government employees would continue to value a high set of standards in mathematics. Given the increased attention to mathematics education since 2004 and the desire to remain competitive with other countries, little evidence exists to indicate that the federal government will move its focus away from mathematics education, despite the negative feedback regarding the CCSS. The Pennsylvania state government has also included student performance on state assessments as part of teachers' evaluations. This emphasis on holding teachers and students accountable for student achievement on the state assessments aligned to the new standards reinforces the assumption that this reform is important.

Scope and Delimitations

The CCSS in mathematics are relatively new. Although formative-assessment practices have only gained momentum since 2010, these practices have existed much longer than the CCSS. Therefore, research on formative assessment is abundant with literature on the CCSS less plentiful. Based upon the findings of studies that have indicated that the CCSS requires shifts in instructional strategies (Gates Foundation, 2013), teachers would benefit from embracing practices such as formative assessment to support successful implementation of the standards, which is the focus of the research. To narrow the scope of the study further, I decided to focus solely on teacher perceptions of the CCSS and not data related to actual implementation and outcomes. Because the standards are new, not all teachers have fully integrated them into their courses at all high-school grade levels. Within Pennsylvania, state assessments reflect the new

standards from kindergarten through Algebra I. Students taking courses beyond Algebra I are not yet required to take assessments aligned with the CCSS; however, the state education department has planned to soon initiate expansion of the assessments. Consequently, the study was timely in its examination of related teacher views.

For purposes of the study, I focused solely on four areas of formative assessment, including student involvement in the learning process, modeling of quality student work, the provision of feedback to students, and student self and peer assessment. Although the CCSS does not specifically outline the instructional practices necessary for implementation of the standards, these four forms of formative assessment will support achievement of the standards.

I decided to limit the population sample to middle- and high-school mathematics educators who teach courses through Algebra 1 in Pennsylvania. The rationale for limiting the sample to mathematics teachers is that the CCSS is the predominate influence for mathematics, English, and science curricula. Because I was previously a mathematics teacher, I have a stronger interest in this area over that of English and science. Mathematics has also been a strong focus of the state and federal government for years to support American citizens by remaining competitive within the global economy. Due to the focus on mathematics teachers, I further limited the population sample to middle-school and high-school educators who teach courses through Algebra I, rather than K–12 teachers. As of December 2016, once students have completed Algebra I, they do not take a CCSS-aligned state assessment, so it is unnecessary to include all high-school mathematics teachers.

I eliminated staff identified as working for an Intermediate Unit (IU), charter or cyber charter schools, state juvenile facilities, and career and technical schools from the count. The reason for excluding mathematics teachers from these schools was because some of them offer online classes or hybrid classes, and teachers in these schools do not have the same face-to-face interactions with their students as students in brick and mortar schools. These face-to-face interactions are important to gauge the use of formative assessment strategies in this study. Since I could not distinguish which charter schools have a hybrid model or a brick and mortar school, it made most sense to eliminate them completely from the population. I also eliminated teachers identified as working for IU's, state agencies, and technical schools because it was difficult to determine if these instructors only teach mathematics or other content areas as well. To support the validity of the data, including mathematics teachers employed by public school districts seemed most appropriate.

Although the study sample in the research was limited to a randomly selected group of public middle- and high-school mathematics teachers within the state of Pennsylvania, with a sufficiently large sample, I could potentially generalize the findings to most middle- and high-school mathematics teachers in Pennsylvania. Because the sample included all eligible teachers it allowed for a diverse group of teachers with various education backgrounds, years of teaching experience, philosophies of education, and professional-development experiences related to both formative assessment and the CCSS. To the extent that other variables influenced teachers volunteering for this study, the inferential power could be decreased. It is unclear as to whether the results are

generalizable outside Pennsylvania due to the differences among the states with regard to teacher training, access to materials and resources, and state assessments reflecting the CCSS.

Limitations

The study presented various limitations in both research design and the methodology employed. One limitation was that I did not collect data surrounding how much and to what degree teachers received training on the CCSS and formative assessment. Any previous training the participating teachers may have received could have altered their perceptions of the CCSS and the ways in which they implement formative assessment within their classrooms. If teachers received training, they might be more comfortable with, and have more positive perceptions of the CCSS. They may also feel more at ease implementing formative-assessment practices than teachers who have received no training. With a sufficiently large sample, I expected to minimize this limitation. The sample most likely included both teachers who have and have not received training on formative assessment and the CCSS.

One challenge I encountered during data collection was due to the use of school Web sites to access teacher email addresses. I was limited to the information on these school sites that potentially reflected inaccurate information and outdated lists of staff members.

The data collected in the study was quantitative in nature. Therefore, teacher perceptions of the CCSS, the extent of value they place on formative-assessment practices, and how they implement those practices were determined solely through their

scores on the Likert-type survey. To some degree, these scores reflect a narrow view of how teachers perceive the CCSS and implement formative-assessment practices due to the lack of opportunity to engage in conversation for expanded explanations of their perceptions. Despite this limitation, the original researchers that created and used the survey questions found them to be both valid and reliable in terms of providing information surrounding teacher use and value of formative assessment and their perceptions of the CCSS.

Another limitation of the study could be my beliefs surrounding the CCSS. It is necessary to state that I am a strong supporter of the standards. As a K–12 stem coordinator for a public school district, I work each day to assist teachers in better understanding the standards, as well as providing them with instructional practices that encourage their implementation. Therefore, I recognize my personal biases regarding the use and value of the CCSS. To minimize this bias, I did not disclose my beliefs related to the CCSS to the study participants. During the presentation of the results, I based all conclusions and future recommendations solely upon the findings. Personal biases did not interfere with the study or prevent me from conducting reliable research.

Significance of the Study

The significance of the study is considered in relation to advancing knowledge and improving practice. Educators and administrators within the state of Pennsylvania have been working to incorporate changes to curriculum and instruction based upon the CCSS since 2012. More recently, state assessments are beginning to reflect these new standards and stakeholders are beginning to acknowledge the outcomes. In Pennsylvania,

student-achievement scores on the first assessment that reflected the new CCSS were lower than scores on previous exams (Pennsylvania Department of Education, 2015). For the first 3 years of the Keystone Exams, from 2012 through 2015, the Pennsylvania Department of Education reported that only 64% of students who completed an Algebra I course received a proficient or advanced score. Prior to implementation of these exams, no PSSA exam was administered that tested only Algebra I content; however, of all Grade 8 students who completed the PSSA, 76% passed with proficient or advanced scores. The current Algebra I Keystone Exam incorporates content that teachers use in many Algebra II classes. The decline in scores might reflect the increased rigor associated with the CCSS Keystone Exam or educators may not have aligned their curriculum with the exam or teachers may not have changed their instructional practices to align with the expectations of the CCSS.

With higher expectations for both students and teachers, researchers may need to understand how the implementation of formative-assessment practices relates to the perceptions of teachers regarding the CCSS in mathematics. Higher expectations require change, and true change can only manifest if teachers within the education system believe in the change and are willing to adjust their instructional practices. The results of the study provide insight into how middle- and high-school mathematics teachers within Pennsylvania are embracing the changes required by the CCSS. A clearer understanding of how teachers perceive the CCSS in relation to how they implement, and the extent to which they value, formative-assessment practices may also provide a clearer view of the degree to which teachers are embracing the necessary change.

Implications for Social Change

Fullan (1982) proposed that four key phases comprise the change process—initiation, implementation, continuation, and outcome. Within the initiation stage, various factors affect success including teacher and central-administration advocacy, as well as access to innovation. The adoption of the CCSS requires significant change for all stakeholders within the realm of education, and change must first begin with the teachers. Individual perceptions can be powerful and impede change from occurring. Because I designed the study to identify how teachers perceive the CCSS, as well as how they value and use the instructional practice of formative assessment, the data provides valuable insight into the factors potentially influencing the degree to which Pennsylvania mathematics teachers are open to instituting needed instructional change to align with the standards. Understanding the perceptions and values of teachers with regard to the CCSS and formative-assessment practices may, result in more effective education reform.

Summary

The CCSS in mathematics are changing the way in which administrators, teachers, and policy makers view good instruction. With the stronger focus on problem solving, conceptual understanding, and fluency, mathematics teachers across the state of Pennsylvania must examine their instructional practices to determine the changes needed to support implementation of the standards. Teachers are the "backbone" of education reform; they are in the classrooms on a regular basis, working with students to improve academic achievement. Teacher perceptions of the CCSS influence their instructional practices. An abundance of research exists that indicates formative assessment is a strong

instructional tool toward increased academic achievement; however, many studies have also indicated that the CCSS are often not implemented correctly with sufficient frequency. I designed this quantitative study to support determination of whether a link exists between the extent to which teachers value formative-assessment practices, how frequently they implement them within their classrooms, and how they perceive the CCSS. Understanding whether a relationship exists between these variables might offer insight into how teachers view education reform and the associated challenges.

In the following chapter, I provide a review of literature related to the topic of study providing a detailed history of the CCSS in mathematics, specifically in Pennsylvania. I analyze recent studies on the perceptions and understanding of teachers surrounding the standards, as well as review research on how teachers are implementing the standards and the resultant outcomes as they relate to student achievement. Lastly, I define formative assessment in the review, describing the various types, and discuss the challenges encountered by teachers during implementation of these practices. The literature review is organized to provide insight into relevant gaps in knowledge, as well as the rationale for the study.

Chapter 2: Literature Review

Overview

The problem that I explored in this study was, despite many teachers approving of the CCSS, most have not received adequate training on its effective implementation. Similarly, research has demonstrated that formative assessment is an instructional strategy that can result in positive gains in student achievement and motivation when implemented correctly. Despite the apparent benefits of formative assessment, as well as the need to better equip teachers to implement the CCSS, no research has been conducted to determine whether a relationship exists between formative assessment and implementation of the CCSS. Therefore, one purpose of this study was to determine how mathematics educators value and implement this strategy within their classrooms, as well as how these factors relate to their perceptions of CCSS.

The amount of research on formative assessment is vast; however, in this review, I focused on four themes. I provided a description of the foundational ideas supporting formative assessment, as well as a summary of the education theories that support why formative assessment is a necessary component of all classrooms. I described and analyzed research that illustrates the numerous advantages of formative assessment for students and teachers. These benefits include increased student achievement, motivation, and an improved classroom climate. Implementing formative assessment correctly is pivotal, and scholars have determined that specific strategies are effective. I reviewed research that indicated the significance of teachers that place a high value on this teaching

practice. Lastly, I was able to draw a connection between formative-assessment practices and how this instructional strategy might support implementation of the CCSS.

Literature Search Strategy

Based upon my experiences as an educator, the strategy for this literature review began with my general knowledge of formative assessment and the CCSS. I compiled the review through searches of peer-reviewed sources from multiple databases available at Walden University and the local library. I utilized GALE Cengage Learning, ERIC, ProQuest, Sage, and Science Direct for my searches. An initial search using the key term *formative assessment* yielded hundreds of articles; consequently, to narrow the research, I used combinations of the following terms: *formative assessment, academic achievement, student motivation, summative assessment, classroom climate, teacher preparation, assessment for learning, implementation of formative assessment, benefits of formative assessment,* and *disadvantages/drawbacks of formative assessment.* To identify articles associated with the CCSS, I also conducted a search using combinations of the following terms: *Common Core State Standards, CCSS, teacher perceptions, teacher perspectives, implementation, professional development, training,* and *challenges implementing.*

With regard to research associated with formative assessment, studies conducted by Black and Wiliam (1998) emerged as an important collective foundation; hence, I located additional articles within their bibliographies. Through communication with the committee members and searches online, I identified books and journal articles written by the originators of formative assessment including works by, Bloom (1968), Guskey, (2007), Scriven (1967), and Vygotsky (1978). Lastly, I incorporated any notable works

cited within each article to verify the validity of the content and to provide further information for the literature review. No single individual has yet emerged as a leader in research focused on the CCSS. The Rothman (2011) research was informative in describing the development of the standards, and the Pennsylvania Department of Education (2012, 2013a, 2013b, 2013c, 2015) also proved to be a valuable resource.

Common Core State Standards

In this review, I sought to provide a deeper understanding of the history of the CCSS and to analyze and synthesize recent related research, specifically within the realm of mathematics. Teacher perceptions of the standards, how the standards have influenced teaching practice, how they have been implemented within classrooms, and the impact of the standards on student achievement were all of major interest in the review. The connection between formative-assessment practices and the CCSS is described to highlight the need for the study.

History

Gardner (1983) opined that the education performance of students is "mediocre," noting that only one third of students can solve a mathematical problem requiring several steps. In the early 80's, college remedial courses had increased by 72% over a 5-year period. The Gardner report served to initiate discussion among educators over the need for standards to allow all students to have access to the same education opportunities. This discussion began the development of standards-based reform, which became prominent during the 1980s and 1990s. Although the term *standards-based reform* has held various meanings throughout the decades, some characteristics have remained fairly

constant, including academic expectations for students, alignment of instruction to student expectations, use of assessments to measure student performance on standards, control given to states and local schools for instruction and curriculum, and schools held accountable for student progress (Hamilton, Stecher, & Yuan, 2008). In 1989, the National Council of Teachers of Mathematics (NCTM) released the *Curriculum and Evaluation Standards for School Mathematics,* which quickly became a model for states, in terms of how to develop standards (as cited in Wixson, Dutro, & Athan, 2003).

In the early 1990s, the U.S. Department of Education awarded money to groups that voluntarily developed national standards for English language arts (ELA) science, history, foreign language, and the arts; however, minimal success resulted, and a national set of standards was never created (Hamilton et al., 2008). Much disagreement occurred between professional educators and disciplinary expert groups over what the social studies and ELA standards should entail (Wixson et al., 2003). Recognizing that the developing standards at the national level failed, governors agreed at the 1996 National Education Summit to allow individual states to take the lead on standards development. The notion of developing national standards diminished and, to ensure states had continued to develop rigorous standards, Achieve—a nongovernmental organization—was created to evaluate state standards. This organization works to increase understanding across U.S. states surrounding how instruction correlates to rigorous standards.

National standards did not appear in media headlines until the CCSSO began to discuss the development of a common set of standards at an annual policy forum in

November 2007. One year later, the NGA, the CCSSO, and Achieve released a report (Jerald, 2008). The publication was developed by governors, state education leaders, and education researchers and suggested that states adopt a set of common standards in mathematics and language arts for students attending Grades K–12. The intent of the standards was to ensure these students receive the needed skills to be competitive within a global environment. Only a few months later, during April 2009, the NGA and CCSSO reconvened to develop the CCSS initiative. The group asked states to commit to the development of a common set of standards and, due to sufficient interest, a draft was distributed for review in May 2009. During the process of developing the standards, teachers, educators, researchers, and state officials provided feedback leading to various drafts and revisions of the CCSS (Rothman, 2011).

By early 2010, the CCSSO distributed a revised version of the standards to states for additional feedback. By June 2010, revisions were completed and states received a final version of the standards. Throughout the following year, states reviewed the CCSS, and each state developed their own process for determining whether they would adopt the standard and replace those existing (Rothman, 2011). By February 2016, 42 states, the District of Columbia, four U.S. territories, and the Department of Defense Education Activity had adopted the CCSS and implemented them locally. This number has fluctuated since states began adopting the standards. For example, Indiana, South Carolina, and Oklahoma originally adopted the CCSS, subsequently repealing this adoption (Oklahoma State Department of Education, 2014). Other states, such as Pennsylvania, although still aligned with the CCSS, wrote their own standards, which are

now known as the Pennsylvania Core Standards (PA Core). Four states never chose to adopt any of the CCSS, which included Alaska, Texas, Nebraska, and Virginia.

The NGA and CCSSO advanced a conscientious effort to demonstrate that the CCSS were not a product of the federal government, and leaders often reminded listeners that the effort was state run (Rothman, 2011). In June 2010, the NGA and CCSSO presented the final version of the CCSS at a Georgia high school with no federal-government officials present to emphasize that the initiative was not federally funded. Despite this effort, many people still equated the CCSS with the federal government. Soon after taking office, President Obama applauded the efforts of the NGA and CCSSO and the development of a set of uniformed standards. Similar to the NGA and CCSSO, the federal government attempted to portray this effort as not within their purview. In a speech by the Secretary of Education Arne Duncan (2009), he stated,

> It is especially important that this has started at the state level because some people will raise concerns that common standards across states will lead to federal over-reaching [*sic*]. I am very sensitive to that issue. As I said before, I was a local educator before I came to Washington. Education is a state and local issue. You pay 90 percent of the tab, and our job is to support leaders like you. So let's be clear: this effort is being led by governors and chief state school officers. This is your work and this is your agenda. Federal law does not mandate national standards. It empowers states to decide what kids need to learn and how to measure it. . . . So while this effort is being led at the state level, as it should be, it

> is absolutely a national challenge, which we must meet together or we will compromise our future. (pp. 4–5)

Despite this stance by the federal government that the CCSS were not federally funded, the Race to the Top initiative portrayed a different image.

President Obama began the Race to the Top program, which was part of the American Recovery and Reinvestment Act of 2009. This $4 billion program encouraged states to develop comprehensive plans through which education systems would receive a complete overhaul and grant funds in return (Pennsylvania Department of Education, 2015). Specifically, the Race to the Top initiative required states to do the following: (a) improve standards and assessments, (b) enhance data systems, (c) strengthen teacher quality, and (d) make significant changes within low-performing schools (Rothman, 2011). As part of the standards-improvement component, states were required to demonstrate adoption of the common standards that were internationally benchmarked to support college and career readiness skills. Although Race to the Top never specifically required states to adopt the CCSS, very little time was provided for states to arrive at an alternate set of standards to implement.

In the application process, the U.S. Department of Education awarded 40 out of 50 points to states that chose to adopt the CCSS (Rothman, 2011). Although the states could still earn Race to the Top funds without adopting these standards, the federal government was a strong supporter of CCSS. Ultimately, in 2010, 12 states were awarded the initial $4 billion. In 2011, seven more states split an additional $200 million to implement smaller elements of their initial proposal including Pennsylvania. This

combined energy from both state and federal governments regarding the need for improved standards paved the way toward the current CCSS.

Definition

When the NGA and the CCSSO first convened to begin establishing the CCSS, they set clear guidelines as to the content of the standards and the philosophies they should reflect. The primary goal of the group was to identify skills and knowledge in ELA and mathematics that students need to learn to be college and career ready (Council of Chief State Officers and National Governors Association, 2015). Their aim was fewer and clearer standards that would help drive education policies and instructional practice. In an effort to prepare students to acquire skills and competencies needed for success in the 21st century, the standards needed to be grounded in research and include rigorous content and knowledge application. Thus, the new standards promoted three major shifts in mathematics in the following areas: focus, coherence, and rigor.

In relation to the focus component of the new standards, clearer focus on the following topics was intended for each grade level: (a) addition and subtraction in Grades K–12, (b) multiplication and division in Grades 3 through 5, (c) ratios and proportional relationships in Grade 6, (d) continuation of the Grade 6 focus plus arithmetic with rational numbers in Grade 7, and (e) linear algebra and linear functions in Grade 8 (Rothman, 2011). For Grades 9 through 12, the CCSS focused on various functions and modeling. A content focus for each grade level would allow teachers and students to examine topics more deeply rather than presenting more standards resulting in less depth of understanding (Council of Chief State Officers and National Governors Association,

2015). By developing a more solid understanding of major skills, students could apply these skills to solve mathematical problems related to real-world situations on a more frequent basis (Rothman, 2011). For some states, these new standards introduced many new changes to the scope and sequences of courses and grade-level bandwidths. For example, in New York, students were not exposed to residual plots prior to the CCSS, but now these standards have been included as part of the Algebra I course (New York State Department of Education, 2013).

The second shift toward coherence among the new standards encouraged thinking across grade levels, allowing students to build upon past learning to extend current understanding (New York State Department of Education, 2012). Rather than a disjointed K–12 scope and sequence, the standards build upon each other. Those considered supporting standards were more closely aligned in scope to the primary standards, allowing for more cohesion among all topics (Rothman, 2011).

The final shift of the new standards toward rigor included the following components: conceptual understanding, procedural skill and fluency, and application (New York State Department of Education, 2012). These three components are centered on the notion that students should be able to truly understand the purpose behind the math, rather than solely memorizing formulas and algorithms to solve problems. Students were expected to develop the ability to access concepts from various perspectives, work comfortably with numbers and operations, and ultimately apply learning to other subject areas (Rothman, 2011). In 2010, researchers at the Thomas B. Fordham Institute conducted a study to determine how the standards of each state compared to the CCSS

(Carmichael, Martino, Porter-Magee, & Wilson, 2010). They determined that, within the realm of mathematics, 11 states had standards similar to the level of rigor required for the CCSS, while the other 39 states had standards inferior to the CCSS. The 11 states with similar standards included Indiana and Oklahoma, which both withdrew their adoption of the CCSS. The study conducted by the Thomas B. Fordham Institute left educators and policy makers questioning the actual extent of rigor presented within the CCSS.

Another component of the CCSS in mathematics involved eight standards related to mathematical practice. These standards are a compilation of the NCTM processing standards and mathematical proficiencies drawn from a National Research Council report (Council of Chief State Officers and National Governors Association, n.d.). The eight mathematical practices are

1. Make sense of problems and persevere in their resolution.
2. Reason abstractly and quantitatively.
3. Construct viable arguments and critique the reasoning of others.
4. Model with mathematics.
5. Use appropriate tools strategically.
6. Attend to precision.
7. Look for and make use of structure.
8. Look for and express regularity in repeated reasoning.

The committee that developed the CCSS supported the notion that all mathematics teachers should develop these capacities in their students to enable them to become good mathematicians. States have had to adapt their current standards, curricula, and

instructional practices to better align with the shifts and mathematical practices required of the CCSS.

Teacher Perceptions

Teacher perceptions surrounding the CCSS have evolved over the years, and their perceptions often determine the success of changes within the field of education. Studies on organizational change are often based upon three principal objectives—(a) how to change the attitudes or values of organizational members, (b) how to change the behavior or actions of these individuals, and (c) how to make changes to policies and the organizational structure (Bass & Avolio, 1994). Education reform has been a goal for decades and, nearly always, policy makers, administrators, and state-department educators are driving the change (Ruchti et al., 2013). Bass and Avolio (1994) contended that the beliefs and behaviors of those within the education system must change in order for reforms to be successful. Throughout much of education reform, researchers have found that it is the classroom teachers who must lead reform to reap success (Bybee, 1993; Cronin-Jones, 1991). Pajares (1992) noted, "Few would argue that beliefs teachers hold influence their perceptions and judgements, which, in turn, affect their behavior in the classroom" (p. 307). Developing a clearer understanding of how teachers perceive the CCSS is essential to the success of reform initiatives.

Many states have implemented the CCSS in mathematics for several years now. Throughout the first few years leading up to the adoption and implementation of the standards, teacher perceptions of the standards have greatly varied. Less than 2 years following release of the CCSS in ELA and mathematics, a study was conducted by the

EPE Research Center (2013) to determine the level of awareness of the standards, their perceptions of them, and how teachers might change their practices to support the standards.

The EPE Research Center (2013) study was conducted prior to implementation of the CCSS within many states. The researchers who conducted the study found that 78% of the teachers possessed a baseline understanding of the standards in mathematics; however, teachers also reported being "very familiar" with their pre-CCSS standards. Additionally, the results revealed that teachers felt moderately prepared to teach a curriculum aligned to the CCSS, but were less confident in their abilities to teach this curriculum to English-language learners and students with disabilities.

Choppin et al. (2013) conducted research on the perceptions of 366 middle-school mathematics teachers regarding the CCSS. Of the total population sample, 93% of the participants reported familiarity with the CCSS. Although the study involved a diverse sample, the findings demonstrated that teachers had developed greater awareness surrounding the CCSS. However, a somewhat larger variation existed between the perceptions of the two study groups with regard to the difficulty level of these new standards. In the EPE Research Center (2013) study, 49% of participating teachers believe the CCSS were more rigorous than their current state standards, while 84% of the Choppin et al. sample reported this belief. In both studies, the participants were from a variety of states; consequently, the percentage increase in 1 year is interesting. This finding could potentially be due to a stronger awareness of the content of the standards or a result of having more classroom time to implement the standards. However, a year

later, researchers at the Center on Education Policy (Rentner & Kober, 2014) surveyed school-district leaders, rather than teachers, and reported that approximately 90% believe the CCSS were more rigorous than their previous state standards. With each additional year of implementation, studies seem to demonstrate an increased number of teachers who believe the new standards are more rigorous.

By 2014, many states that had adopted the CCSS were in full implementation mode, while other states who had originally adopted them, including Indiana, Oklahoma, and South Carolina, dropped the standards (Rentner & Kober, 2014). Several more studies were conducted examining educator perceptions and knowledge of the CCSS (Davis et al., 2014; Nadelson et al., 2014). The researchers began to delve a little deeper into their investigations to gain a clearer understanding of these perceptions. Nadelson et al. (2014) found no statistically significant difference between participants filling different education roles or whether those individuals filling administrative positions possessed a different level of knowledge or variant perceptions of the CCSS. These researchers did determine that, as the amount of professional-development hours invested by educators increased, their knowledge and perception of the CCSS also increased. Davis et al. (2014) also reported that increased professional development involving the CCSS positively increases teacher perceptions of the goals of the standards.

The beliefs and knowledge of teachers can be useful information for administrators when planning the implementation of reform within the field of education (Ruchti et al., 2013). Researchers have identified teachers as feeling hesitant and unprepared with the implementation of the CCSS, and many study participants have

expressed a need for more professional development in order to properly implement the new standards (Rentner & Kober, 2014; Ruchti et al., 2013). If educators are feeling unqualified to teach to the CCSS or to particular groups of students, the success of the standards has already been influenced.

Implementation

Standards alone cannot improve student achievement; stakeholders must integrate them into state and district policy and practice to have a successful impact (Rothman, 2011). Guskey and Sparks (2004) suggested that teacher understanding of a reform movement, as well as their ability to initially implement the reform, could affect overall implementation and success. Regardless of whether the standards are more rigorous and require deeper levels of thinking from students, if teachers are unable to implement a curriculum and instructional practices that match the standards, reform may be unsuccessful. Getting the standards from paper to positive change in instructional practice within the classroom is a formidable challenge (Phillips & Wong, 2012).

As noted earlier, teachers and administrators who have received professional development are often more knowledgeable and hold stronger views on the CCSS (Davis et al., 2014; Nadelson et al., 2014). Various levels and types of professional development prepare teachers for effective implementation of the CCSS. Initially, teachers must become aware of the content of the standards and how they differ from the curricula currently taught. If teachers do not provide instruction related to the appropriate content, then assessment data on benchmarks, teacher-created assessments, and state assessments will not accurately reflect the content and skills taught nor how students perform in

relation to that instruction (Hull, Miles, & Balka, 2012). This discrepancy could cause administrators to misunderstand the source of the problem and inaccurately identify student ability, instructional materials, or instructional practices as areas of concern.

One component contributing to whether teachers provide instruction based upon the CCSS is whether their available resources align to the standards. Strong evidence suggests that instructional materials have a significant effect on student learning (Chingos & Whitehurst, 2012). Those materials that support and reflect the philosophy and teaching practices aligned with the CCSS are an important component in the academic achievement of students (Chingos & Whitehurst, 2012; Leifer & Udall, 2014). Since learning occurs primarily through student interaction with teachers and the instructional materials, a balance must be achieved between understanding instructional practice and understanding how to apply instructional resources to effectively implement the CCSS (Chingos & Whitehurst, 2012).

There exists limited research on the effectiveness of various resources claiming to be aligned with the CCSS. Researchers have conducted studies on how closely textbooks are aligned with the standards. Walters, Scheopner Torres, Smith, and Ford (2014) reported that only 38% of the teachers participating in their study reported having access to resources aligned with the CCSS in mathematics. Polikoff (2015) determined that, although textbooks have similar content to that of the CCSS, approximately 10% to 15% of the standards are missing, and the texts often focus on procedures and memorization rather than conceptual understanding and problem solving. Textbooks also lack an emphasis on higher order thinking and cognitive demand from students. Similarly, Cogan

et al. (2013) reported that mathematics textbooks continue to embody the "mile wide, inch deep" philosophy (p. 3).

Although textbooks include topics aligned to the CCSS, many pages and chapters are irrelevant. Cogan et al. (2013) suggested that elementary teachers are more hesitant than secondary teachers to exclude lessons within their textbooks, for fear that their students will be at a disadvantage. If teachers provide instruction from cover to cover that is not aligned to the CCSS, students do not have opportunities to develop conceptual understanding. Rather, teachers must be encouraged to use textbooks as a resource rather than a guidebook. This practice takes time and training on the part of teachers to completely understand those activities and lessons that support the CCSS.

Once teachers become familiar with the content changes of the CCSS and have resources to support the CCSS, they need to develop an understanding of how the CCSS support change in instructional practice. However, such changes require professional development. In 2014, 89% of school-district educators recognized that instructional change was needed to properly implement the CCSS (Rentner & Kober, 2014). In 2011, only 50% of school-district educators believed instructional change should occur, so evidence exists that school officials and educators are beginning to recognize the full impact of the CCSS on instruction. As noted earlier, the CCSS do not dictate to educators how to teach, but rather, what to teach. Educators need guidance and professional development on improving instructional practices to ensure they are supporting the rigor and philosophy behind the standards and related changes to their instructional practices.

The instructional shifts needed to meet the level of rigor associated with the CSSS are guided by research-based instructional practices in mathematics (Hull, Balka, & Miles, 2013). In classrooms where teachers support these mathematical practices, strong evidence exists that students engage in reasoning, thinking, and depth of knowledge. Instructional practices that should be evident in classrooms that support the mathematical practices of the CCSS include the following: (a) discussion and collaboration (Goldman & Pellegrino, 2015; Hull, et al., 2013; Kosko & Gao, 2015; Phillips & Wong, 2010, 2012); (b) teachers as facilitators rather than lecturers (Goldman & Pellegrino, 2015; Hull et al., 2013; Marzano, 2013); (c) frequent use of problem solving (Bostic & Matney, 2013; Hull et al., 2012, 2013; Marzano, 2013); and (d) formative assessment to inform both students and teachers (Goldman & Pellegrino, 2015; Hull et. al., 2012; Hull, Miles, & Balka, 2014; Marzano, 2013). These instructional practices require a paradigm shift for many educators (Porter et al., 2015). The majority of research to date has focused on the instructional practices needed to support implementation of the CCSS, with few studies designed to examine whether these instructional practices reflect improved student achievement, as measured by summative assessments aligned to the CCSS.

Impact on Student Achievement

A major question of policy makers, administrators, educators, parents, and students is whether the CCSS have a positive or negative impact on student achievement. As discussed earlier, implementation has been a challenge for many educators, so the success of the CCSS is of significant concern. Few peer-reviewed research studies were found that examined student achievement in relation to the CCSS; however, an online

search of CCSS and student achievement revealed a wide variety of results both applauding and degrading the standards. The related policy change within education has spurred much public attention; therefore, data published within newspapers and the Internet were not included in the literature review for this study to avoid potential bias surrounding the CCSS and any impact this could have on the reporting of results.

Rigor of standards. Two areas must be considered when attempting to determine whether the CCSS are having a positive or negative impact on student performance. The first indicator is whether the level of proficiency expected by states of their students is considered rigorous; the second indicator is whether students meet rigorous standards. The first indicator has been reported every-other year prior to implementation of the CCSS, with the most recent report published in 2015. To determine the level of rigor in state standards, researchers compare student performance on state assessments with their performance on the National Assessment of Educational Progress (NAEP). The NAEP was founded in 1969 and administers national assessments in mathematics, reading, science, U.S. history, geography, and civics to allow for comparison between students attending Grades 4, 8, and 12. The organization has involved researchers, state education officials, contractors, policy makers, students, and teachers. More recently, researchers have conducted studies comparing the frameworks of the NAEP to the CCSS and have determined the level of rigor to be similar with minor differences (Achieve, 2010). The CCSS provides greater coherence in content expectations at each grade level because the NAEP focuses solely on student achievement in Grades 4, 8, and 12.

Because so many states have adopted the CCSS, it is essential to know whether the level of rigor required is in line with the standards set by other high-achieving countries. Loveless (2015) described the importance of using the NAEP scores to determine the level of rigor because it includes assessments that have remained constant since 2009, regardless of the adoption and implementation of the CCSS. By comparing state assessment scores to scores on the NAEP, it is possible to determine the rigor of the proficiency standards implemented within each state (Peterson & Ackerman, 2015).

Carmichael, Wilson, Finn, Winkler, and Palmieri (2009) conducted a study when the CCSS were in a draft form to compare the content and rigor of the CCSS in mathematics, the NAEP, and the Trends in International Mathematics and Science Study (TIMSS). The researchers provided a letter score for each assessment in mathematics, with the CCSS draft earning a B, the NAEP a C, and the TIMSS an A. In 2009, the NAEP changed the framework of the mathematics assessment to better reflect the ability of students to integrate and apply mathematics within diverse problem-solving contexts (National Center for Education Statistics, n.d.). Gattis et al. (2013) compared the 2011 NAEP findings to the TIMSS findings reflected for students attending Grade 8 mathematics. The report compared the content and cognitive dimensions of the frameworks and revealed that, while some relationship between levels of complexity in the NAEP framework and cognitive demand in the TIMSS framework are evident, the two dimensions are not interchangeable. Peterson and Ackerman (2015) reported that NAEP tests scores were also equivalent to student-proficiency standards set by

international organizations; however, these researchers did not indicate the specific international standards.

Following implementation of the CCSS in 2011, 45 states raised their standards for determining student proficiency levels in both reading and mathematics, with the greatest increases observed between 2013 and 2015 (Peterson, Barrows, & Gift, 2016). Between 2011 and 2013, the average difference between NAEP scores and state scores decreased from 35% to 30% (Peterson & Ackerman, 2015). Peterson and Ackerman (2015) noted that these scores were still far from international standards; however, they found that this gain was larger than that observed between 2009 and 2011. From 2013 to 2015, the average difference decreased by only 11% (Peterson et al., 2016). Peterson et al. (2016) described the campaign to achieve CCSS as a "phenomenal success for states" (p. 9). This decrease in the variance between state scores and NAEP scores verified that the states were meeting the challenge by creating and implementing rigorous standards. Whether students are meeting the established standards remains to be determined.

State results. Determining whether students are achieving at higher levels is a challenge for many policy makers, state officials, and educators as they examine test scores to determine their meaning (Felton, 2015). When states initially adopted the CCSS, they could choose between two testing consortiums—Partnership for Assessment of Readiness of College and Careers (PARCC) or Smarter-Balanced. The intent was for all students to be completing similar exams, whether they lived in Philadelphia or a small rural town in Oklahoma, in order to determine their readiness for college or the workforce. However, states now have the option of using one of these testing

consortiums or creating their own tests. During the 2015-16 school year, 11 states administered the PARCC and 15 states implemented Smarter-Balanced for the evaluation of student performance on the CCSS. Even when states use the PARCC or Smarter-Balanced exams, differences exist in their administration that lead to a lack of testing consistency. For example, students completing the PARCC exams respond to a fixed set of questions, while students completing the Smarter-Balanced exams respond to varied questions based upon the accuracy of their previous responses. These differences introduce difficulty when attempting to clarify student achievement within the United States as a collective whole and student readiness for college or the workplace.

Many researchers, critics, and supporters of the CCSS are expecting specific states to institute an improved measure of the success or failure of the CCSS. Kentucky was the first state to fully adopt and implement the standards and, for this reason, Kentucky educators have the most time invested in their implementation and hence the most potential to provide insight into student achievement. It is noteworthy that Kentucky does not use the exams of PARCC or Smarter-Balanced, but rather, administers a state-developed assessment while concurrently requiring all Grade 11 students to complete American College Testing. Student scores declined considerably during the first year of CCSS implementation (Nelson, 2014). The prior Kentucky state test was last administered in 2011 and approximately 75% of the students scored as proficient in reading and mathematics. The following year, in 2012, less than 50% of students were considered proficient on the new exams aligned with the CCSS. Educators and politicians

argued that the scores dropped because the standards were more rigorous. Kentucky educators expected lower scores and prepared the public for these results.

Despite the decrease in proficiency scores, Kentucky state officials reported a 9% increase from the 2010-11 to the 2011-12 school year to the 2011-12 school year related to the number of students prepared for college and/or career opportunities (Kentucky Department of Education, 2012). Kentucky educators determined college and career readiness using a school-accountability model known as unbridled learning. This construct facilitates the measurement of school performance based upon student achievement and other factors (Xu & Cepa, 2015). Because the state also requires high-school students to complete the American College Testing, student achievement on this assessment could be used as a baseline to determine any future changes in this measure.

Xu and Cepa (2015) conducted a study to investigate whether students were progressing toward college or career readiness during the early stages of CCSS implementation. Researchers found students who experienced changes in instruction due to the CCSS outperformed comparable students who completed the American College Testing prior to CCSS implementation. Xu and Cepa determined that the gains were equivalent to approximately three months of additional learning. To better understand whether the increase was influenced by exposure to the CCSS, these researchers extended their analysis by examining the two subject areas directly influenced by the CCSS—ELA and mathematics. They found that student progress was associated with curriculum-framework changes in these subject areas. Although Kentucky students appear to be more

prepared for college and career, Xu and Cepa acknowledged that strong conclusions between student performance and the new CCSS could not be drawn.

Other states have experienced results similar to those described in Kentucky, with student-performance declines the first year and a slight increase the following year. Carlucci and Case (2013) referred to this phenomenon as the U-shaped learning curve, which is the notion that, when new educational interventions are initially implemented, effects can be negative while participants are learning the new procedures, but then performance increases as understanding increases with greater familiarity of the procedures. This theory would explain the results in Kentucky and other states. New York is another state that adopted and implemented the CCSS early, and the achievement of their students has been scrutinized similarly to that of Kentucky students. Since 2005, researchers within the Program on Education Policy and Governance have graded states on their student-proficiency standards. From 2005 through 2011, New York received letter grades ranging from C to D+ (Peterson et al., 2016). In 2013 and 2015, following adoption and implementation of the CCSS, New York received A's on the NAEP. The NAEP is administered every-other year; therefore, no scores were recorded for 2014. In the 10-year span, the gap between state and NAEP scores has decreased by 31.8%.

It is evident that New York politicians and educators have worked to increase the rigor of testing standards and raise their expectations of students. As in Kentucky, the real question is whether students can rise to this challenge. In the first year that New York required all Algebra I students to complete the state test that aligned with the CCSS, student performance dropped significantly. In 2015, 63% of students were proficient,

whereas in 2014, 72% of students tested as proficient on the prior Algebra I assessment (New York State Department of Education, 2016). In 2016, scores improved with 72% of students achieving a proficient score. During this 2-year period, scores improved and have returned to the proficiency levels prior to implementation of the CCSS. This trend in New York parallels that of Kentucky and has been the norm across much of the United States. Because the study focused on Pennsylvania teachers and student achievement, it is important to understand how students perform in this state following implementation of the CCSS. Although the standards were implemented after adoption in Kentucky and New York, similar trends emerged indicating an initial decrease in student scores.

Researchers have conducted few studies analyzing overall student performance on assessments aligned to the CCSS. In 2014, the Brown Center Report indicated that Grade 4 reading scores improved by 1.11 points in states that had implemented the standards (as cited in Loveless, 2015). This increase is insignificant, equating to .04 standard deviations on the NAEP scale. A standard deviation of 0.20 is considered sufficiently significant to conclude a noticeable change. In mathematics, the report noted a 1.27 difference in student achievement in states that implemented the CCSS versus student scores in states that had not implemented the standards. Although the Brown Center report demonstrated growth in student achievement, the results were not statistically significant. Consequently, improved test scores could be a factor over implementation of the CCSS. It is noteworthy that researchers used 2011 NAEP scores to determine student achievement. Loveless (2015) cautioned that supporters of the CCSS argue that student

results are low because states use new assessments to measure student achievement against standards that are more difficult.

State-Specific Influences

The Pennsylvania State Board of Education officially adopted the CCSS in July 2010; however, the Board made the decision to develop state-specific standards now known as the Pennsylvania Core Standards, which reflect the same rigor and student expectations of the CCSS. The primary rationale behind this decision was to end with similar language as the prior state standards (Pennsylvania Department of Education, 2013b). The Pennsylvania Core Standards still, however, required rigor and a shift in thinking surrounding curriculum and instruction, reflecting the same three shifts described earlier. Throughout the study, the standards will still be referred to as the CCSS because although Pennsylvania has changed the name, the content standards are still very similar with some minor exceptions. Pennsylvania continues to use and reference the mathematical practices as outlined by the CCSS as well.

Implementation of the CCSS within the state of Pennsylvania changed the manner in which the state assessed students. Those attending Grades 3 through 8 continued to be assessed via the PSSA; it was not until 2015 that these tests reflected the Pennsylvania Core Standards. All student assessments between 2011 and 2014 included questions related to the Pennsylvania Core Standards if they were similar to the prior Pennsylvania academic standards (Pennsylvania Department of Education, 2013c). Another significant change that occurred as a result of implementing the CCSS was that the PSSA administered to Grade 11 students was eliminated and replaced with an end-of-year assessment in Algebra I known as the Keystone Exams. This collective exam was

implemented in the 2012-13 school year; however, the new Pennsylvania Core Standards were not reflected on this test until the 2014-15 school year. Students in the graduating class of 2017 were required to receive a proficient score or higher on these exams to graduate; however, as of January 2016, the state passed Senate Bill 880, which delayed this requirement until 2019. This change suggests a disconnect between the CCSS, teacher ability to implement the standards, and the expectations for students.

Although students within the state of Pennsylvania have been completing assessments aligned with the CCSS for a relatively short period of time, data on student achievement do exist. As noted earlier, the first year that student assessment aligned with the Pennsylvania Core Standards was the 2014-15 school year. Student scores dropped significantly from those recorded for the 2013-14 and 2014-15 school years for all grade levels and for both ELA and mathematics (Ujifusa, 2015). Proficiency scores in mathematics for students attending Grade 3 declined from 75% to 49%. In Grade 6, proficiency scores in mathematics declined from 72% to 40%. Students in Grade 8 demonstrated even more drastic results with a drop from 73% to 30%. By the 2014-15 school year, 64% of the students who completed the Algebra I Keystone Exam earned proficiency. The data for each high school reflects student performance on the Algebra I Keystone Exam, regardless of when each student was enrolled in Algebra I. If a student completes the Algebra I exam as a ninth grader, their score is “banked” until their junior year. Consequently, these data are challenging to interpret. Students completing the Keystone Exam during the 2011-12 school year were not assessed with a test aligned to the Pennsylvania Core Standards, rendering these data even less informative.

During the 5 years that the CCSS were introduced and Pennsylvania adopted their new state-specific standards, the state had been providing professional development for teachers (Pennsylvania Department of Education, 2013c). The Department of Education Web site indicated that intermediate units were provided with training on aligning curriculum to meet the new standards, as well as to draw connections between the mathematical and content standards and the instructional practices needed for teachers to be effective. Although these opportunities for professional development are published on the site, it is impossible to know the degree to which teachers attended the development sessions, if at all. As noted earlier, the implementation component is the most challenging aspect of assessment. One reason is that the level of support received by school administrators and teachers from the state is unknown. Based upon past study, it is probable that Pennsylvania teachers have had similar challenges as teachers within other states. Ultimately, the research holds the potential to advance knowledge surrounding teacher understanding of the implementation process supporting the CCSS.

Formative Assessment

Proper implementation of the CCSS is critical for success, and a vital component of the implementation process is the ability of teachers to apply pedagogy aligned with the intentions of the CCSS. Many instructional practices support the philosophy that grounds the CCSS including the engagement of students in the learning process through collaboration and cooperative groups, providing opportunities for problem solving and integrating formative assessment (Marzano, 2013). Formative assessment is an

instructional practice that was instituted long before the CCSS, but it is a practice that can go on to successfully support the CCSS (Marzano, 2013; Phillips & Wong, 2012).

Even before adoption of the CCSS, organizations such as the National Resource Council and the NCTM argued that all students can think mathematically (Hull et al., 2014). For teachers to successfully support mathematical thinking, student thinking must be visible so teachers can provide frequent feedback. Such feedback allows students to monitor their own learning, self-correct as needed, and develop conceptual understanding of learned skills. Because the CCSS requires students to think beyond formulas and encourages deep understanding of concepts, opportunities for collaboration and student discussion are necessary (Phillips & Wong, 2012). Through these opportunities and formative feedback from teachers, students begin to take ownership over their learning.

History and Theoretical Basis

Socrates, a Greek philosopher, encouraged his students to engage in their learning by asking questions, and he would guide his instruction based upon their responses. The practices of Socrates have similar attributes to contemporary educational practices from the 19th and 21st centuries. Collectively known as constructivism, they form a philosophy grounded in the notion that individuals make meaning out of their own learning. Constructivist teachers must regularly assess student learning in a variety of ways to measure background knowledge and adopted viewpoints to determine how this knowledge will impact future learning (Brooks & Brooks, 1999). Many constructivists agree that new concepts are not facts to be memorized, but rather, knowledge requiring structural cognitive changes (Ben-Hur, 2006). This change often occurs through social

interaction with others who are slightly more capable (Vygotsky, 1978). If students have opportunities to collaborate and learn from one another, to question and reflect, and the freedom to think creatively, they tend to develop greater understanding (Brooks & Brooks, 1999). The notion of teachers developing a classroom environment within which students are partners in the learning process is a critical attribute of formative assessment (Jerald, 2008).

Scriven (1967) first coined the term *formative assessment* while he was seeking a more effective means of evaluating curricula and teaching. He argued that using solely evaluation to determine whether an instructional instrument is effective is less meaningful than concurrently implementing evaluations to determine ways of improving the learning environment and/or instructional tools. Scriven claimed that evaluation plays many roles, and the most important goal is to use assessments to improve instructional tools and make changes along the way, rather than waiting for results to determine whether the respective practice has failed.

Shortly after Scriven (1967) introduced the term *formative evaluation,* Bloom, Hasting, and Madaus (1971) embraced the concept and expanded it to student learning. Bloom et al. argued that, although summative assessments were important, they are not sufficient in providing timely information on student achievement, curriculum construction, and teaching practice. If teachers incorporate periodic assessments into their instruction, rather than only at the end of a unit of study, they would receive useful data on the progression of learning occurring for each student.

Despite the beneficial debate surrounding formative assessment, the concept did not gain momentum until Black and Wiliam (1998) published the results of a compilation of studies indicating the positive benefits within classroom settings. Countries within which academic achievement determines the future of many students, such as the United States, Great Britain, Australia, and New Zealand, quickly adopted the concept established by Scriven (1967), Bloom et al. (1971), and Black and Wiliam (1998). Since that time, the term *formative assessment* has become common phraseology within the realm of education and routinely cited by researchers. Although research has indicated significant benefits from formative assessment, a growing number of studies have demonstrated that teachers are not sufficiently trained in the practice and the strategies are being implemented incorrectly (Black & Wiliam, 1998; Furtak et al., 2008; Peterson & Siadat, 2009; Shepard, 2000; Stiggins, 2001, 2002; Wylie & Lyon, 2015). Formative assessment is a compilation of many practices and, for it to be most effective, teachers must embrace all aspects of this form of instruction within their classrooms.

Since the 1990s, researchers have studied various aspects of formative assessment including the advantages of incorporating this strategy within classrooms, the challenges teachers encounter during its implementation, and the role formative assessment plays in high-stakes summative testing. Related research continues to increase, supporting the notion that formative assessment is influential and can change the way students learn and teachers instruct. Based upon the number of studies conducted on this form of assessment, as a teaching strategy, it is of much interest to the education community.

Benefits

Researchers have determined that key advantages of incorporating formative assessment into classroom instruction include increased student achievement, increased student motivation, and improved classroom climate.

Student achievement. Standards of learning continue to increase across the nation, and state and national governments are pushing for greater accountability for student learning. Administrators and educators are seeking effective initiatives that provide teachers with the tools to manage the increasingly demanding responsibilities of maintaining a classroom. An overwhelming amount of data supports the use of formative assessment within classrooms of all types and, for this reason, administrators and teachers are embracing this instructional strategy. Researchers have demonstrated that one of the primary benefits of using formative assessment is increased student academic achievement (Bakula, 2010; Cauley & McMillan, 2010; Orsmond, Merry, & Callaghan, 2004; Ruiz-Primo & Furtak, 2006; Shavelson et al., 2008; Stull et al., 2011; Wang, 2007; Wiliam, Lee, Harrison, & Black, 2004). They have examined various student age-groups within numerous settings and found similar results.

Scholars have noted the academic benefits of formative assessment for students attending middle schools (Bakula, 2010; Hwang & Chang, 2011; Ruiz-Primo & Furtak, 2006; Shavelson et al., 2008; Wang, 2007). Grade 7 students who participated in a Missouri study improved their academic understanding of science topics when their teacher incorporated formative-assessment strategies within their classroom (Bakula,

2010). These students reported having a better understanding of subjects in which they were previously weak, and they enhanced their learning by asking meaningful questions.

In another study, middle-school students across the United States were exposed to formative-assessment practices within their science classes, and the results indicated that, by embedding these teaching techniques, educators could significantly improve student achievement (Shavelson et al., 2008). The Shavelson et al. (2008) study sample of teachers received training in specific formative-assessment practices before implementing them within their classrooms, whereas the teachers who participated in the Bakula (2010) single-case study were self-taught and independently reviewed research. Regardless of the manner in which the teachers received their information on best practices in formative assessment, within a short period, all of the student participants demonstrated improved academic achievement. Whether teachers receive related training or are familiar with formative-assessment strategies, the results of these studies indicated that formative assessment produces improved learning for students.

Despite the apparent congruence across related literature of the academic benefits of formative assessment, researchers differ on what defines formative-assessment practices. Similar to the Bakula (2010) study, Shavelson et al. (2008), as well as Ruiz-Primo and Furtak (2006), examined the impact of formative assessment within middle-school science classes. Their findings supported the notion that teachers who closely model informal assessment practices within their classrooms were able to assist students to achieve higher performance on assessments embedded within the lessons delivered. Ruiz-Primo and Furtak defined informal formative assessment as any interaction between

students and teachers that allows teachers to gain information on the level of understanding possessed by their students.

Bell and Cowie (2001) argued that this idea of informal formative assessment varies slightly from the Black and Wiliam (1998) notion of formative assessment. Bell and Cowie believe that Black and Wiliam actually approached formative assessment more formally in that they focused on collecting information about a class as a whole, rather than on individual students. Ruiz-Primo and Furtak (2006) advanced that, by studying informal formative-assessment practices, "it is possible for teachers to collect information about students' understanding during their everyday interactions . . . which can be linked to increases in students' performance" (pp. 231–232). Although varying definitions of formative assessment exist, it is apparent from these studies that positive benefits result in student academic achievement.

Researchers have also documented the academic advantages of incorporating formative-assessment practices into e-learning situations (Hwang & Chang, 2011; Walker, Topping, & Rodrigues, 2008; Wang, 2007). Students attending Grade 5 within Taiwan demonstrated increased academic achievement when researchers applied a formative-assessment approach to a mobile learning environment (Hwang & Chang, 2011). This approach to e-learning revealed a more challenging environment for students that encouraged problem solving and increased student motivation. Similarly, Wang (2007) examined the effects of incorporating the Formative Assessment Module of the Web-based Assessment and Test Analysis System into Grade 7 classrooms. This system incorporates six strategies including student opportunities to revise their mistakes,

monitoring student-response history and peer progress, periodic animated rewards to encourage students, and immediate teacher feedback on student responses. Wang determined that students who received the Formative Assessment Module of the Web-Based Assessment and Test Analysis System experienced enhanced learning over those who did not receive this system. Although the middle-school participants in both studies were exposed to formative-assessment strategies through electronic means, they still demonstrated the same academic benefits as participants in studies where formative assessment was implemented on a face-to-face basis.

Regardless of how researchers define formative assessment, or the classroom setting within a study is performed, the described research reflects the ability of formative assessment to improve academic achievement for elementary- and middle-school students (Bakula, 2010; Cauley & McMillan, 2010; Orsmond, Merry, & Callaghan, 2004; Ruiz-Primo & Furtak, 2006; Shavelson et al., 2008; Stull et al., 2011; Wang, 2007; William et al., 2004). Although researchers have conducted fewer studies examining the impact of formative-assessment practices on academic achievement with samples of high school and college students, the studies that do exist reflect similar results (Brown & Hirschfeld, 2008; Stull et al., 2011). In studies conducted by Brown & Hirschfeld (2008) and Stull et al. (2011), the goal of the researchers was to examine the perceptions of secondary and postsecondary students surrounding the effects of formative-assessment practices on academic achievement. Although each investigator approached this goal with various methods, the results across studies indicated that formative-assessment practices are influential in improving the academic achievement of older students. Brown

and Hirschfeld evaluated how secondary-school students perceive assessment opportunities and compared these perceptions to reading-comprehension scores. The results indicated that students who view formative assessment as a means of personal accountability improved their academic achievement far more than students who perceived assessment as the responsibility of the teacher or school.

Researchers found that student conceptions of assessment were statistically significant with regard to their academic achievement, accounting for 8% of outcome variance (Brown & Hirshfeld, 2008). Because many of the benefits of formative assessment come from actively involving students in the learning process, students must make more of their own decisions surrounding how they learn best (Popham, 2006). Similarly, Stull et al. (2011) argued that, with formative assessment, students become active participants, interacting with their instructors by sharing goals related to their learning and communicating their progress (p. 30). Stull et al. found that, when professors integrate formative techniques in their teaching delivery, learning and teaching are both improved. The formative techniques used by Stull et al. were applied within large lecture settings, a mathematics class, and a physics class. Regardless of the content or size of the class, researchers recorded significant positive student gains in learning.

The described studies revealed that student learning improves when teachers incorporate formative-assessment techniques into elementary, secondary, and university classes (Brown & Hirschfeld, 2008; Stull et al., 2011). Regardless of the age of the students, the subject taught, or the means by which communication between students and teachers manifest, researchers have repeatedly documented significant increases in

student performance. With the growing desire of governments to ensure teacher accountability by implementing high-stakes summative assessments, formative assessment appears to be a technique that teachers must consider integrating into their classrooms.

Student motivation. As noted earlier, social constructivism influences the foundation of formative assessment. It is a philosophy that fosters student engagement and encourages students to draw meaning from their learning through their interaction with teachers and peers. Researchers have posited that these student-teacher interactions lead to positive affective behavior, and their corresponding studies have demonstrated that formative assessment contributes to increased student motivation (Cassady & Gridley, 2005; Cauley & McMillan, 2010; Corpus, McClintic-Gilbert, & Hayenga, 2009; Miller & Lavin, 2007; Walker & Greene, 2009; Zimmerman & DiBenedetto, 2008). This added benefit renders formative assessment even more desirable as a teaching strategy.

Black et al., (2004) argued that learning is not solely a cognitive activity, but rather, it involves all aspects of a human being. Motivating students is a necessary component to learning, but the question that researchers are now raising is, How can teachers motivate students effectively? Miller and Lavin (2007) conducted a study with a sample of elementary-school students. The findings revealed that student self-esteem, self-worth, and self-confidence all increase, to some degree, when teachers incorporate formative-assessment techniques. Students classified with low ability demonstrated greater gains in self-esteem and self-confidence than the middle-ability group of students;

however, this latter group still displayed growth in these categories. Students within the high-ability group also achieved significant gains in self-esteem and self-competence.

The Miller and Lavin (2007) findings closely aligned with the ideas advanced by Black et al. (2004) who argued that, in systems wherein competition is encouraged, students who perform at lower abilities often blame their performance on their lack of ability, and students who achieve at higher levels attribute their success to effort. In a system that focuses on tasks, learners at all levels attribute their performance to effort and, typically, higher levels of learning manifest for lower ability students within this environment (p. 18). Black et al. indicated that constructive teacher feedback supports student motivation to invest effort, whereas if rewards are the focus, low achieving students focus on their ability, which can damage their self-esteem.

Stiggins (2005) argued that the emotional environment that surrounds assessment must change from the belief that only some students can be successful to the belief that all students can achieve, especially low achievers. Within classrooms and schools where teachers rank students against each other, someone must fail, the emotional needs of many students are ignored, and students begin to feel hopeless and relinquish effort. Stiggins advanced that the essential characteristics students should be demonstrating within a classroom are confidence, hopefulness, and determination from an environment wherein all can be successful if effort is invested. Bandura (1994) argued that self-efficacy often influences how individuals feel, behave, think, and self-motivate. Those who doubt their capabilities avoid challenging tasks, and those who possess a strong sense of efficacy are committed to accomplishing difficult tasks. With regard to

education, students with low self-efficacy tend to avoid challenging tasks and give up rather quickly on the behavior needed to be successful. To help boost positive beliefs in students, teachers could integrate more formative-assessment techniques within their classrooms (Cauley & McMillan, 2010; Stiggins, 2005, 2007).

The research will highlight important reasons for implementing formative-assessment practices within classrooms. Students appear to be more invested in their studies and more positive in relation to their abilities. These feelings of confidence transfer to improved academic achievement. One of the goals of the research was to determine whether teachers who focus on task-oriented learning help students to improve their performance on standardized summative assessments within Pennsylvania high schools. The findings are expected to reflect results similar to past related research.

Teacher feedback is a specific formative technique. Constructive feedback contributes to a mastery of goals that emphasizes learning, confronting challenges, providing student opportunities to improve and apply lessons learned by mistakes, and encouraging mastery of skills rather than memorization (Cauley & McMillan, 2010). Various researchers have examined the relationship between the mastery of goals and motivation (Corpus et al., 2009; Coutinho & Neuman, 2008; Koskey, Karabenick, Woolley, Bonney, & Dever, 2010; Lee et al., 2010; Mansfield, 2010; Meyer, McClure, Walkey, Weir, & McKenzie, 2009; Morrone et al., 2004; Patrick, Kaplan, & Ryan, 2011; Walker & Greene, 2009). They investigated the mastery of goals within various settings and sample age-groups.

Mansfield (2010) identified the mastery of goals as an important motivating factor among populations of secondary students. Motivating students is challenging at all ages, but especially challenging during adolescence when a decline in engagement in academic activities is observed among many students within this age-group who are not reaching their scholastic potential. Determining what motivates teenagers becomes an important task for teachers and administrators. Participants in the Mansfield study reported that mastery would improve their understanding of the material while other participants equated mastery to earning good grades, making their parents proud, or having options for their futures. Regardless of the results, mastery of goals was a motivating factor for the students participating in the study.

There is reason to believe that teachers have influence over the goals of students, as well as an influence over their personal motivators (Morrone et al., 2004). Morrone et al. (2004) conducted a study of elementary-school students that supported the notion that a social-constructivist classroom promotes the mastery of goals. The participating instructor integrated scaffolding questions, pushed for deeper understanding, and encouraged higher order thinking. The students were willing to participate in the challenging discourse because the instructor communicated a belief that they could be successful and honored their contributions to the class. When participating in formative assessment, students do not only learn the content of the standards, but rather, "they come to see and understand the scaffolding they will be climbing as they approach those standards" (Stiggins, 2005, p. 327). Students partner with their teachers to continuously monitor their current level of attainment in relation to the agreed-upon expectations so

they can set goals for what to learn next" (p. 327). Put simply, teacher actions toward their students largely contribute to how students perceive their learning environments.

The described studies indicated that a mastery approach to learning contributes to increased student motivation. Lee et al. (2010) conducted research on the future goals of secondary students in relation to their current achievement goals. Their findings supported the belief that a mastery approach is appropriate for students with intrinsic goals; however, the study also revealed that classroom teachers should incorporate a combination of mastery and performance goal orientations into their lessons. Lee et al. noted,

> A mastery-approach goal orientation may become a source of motivation for students to engage in a learning task out of the passion about and interest in the task. Nevertheless, these students are also motivated to engage in the task by the idea that their achievement should surpass, or at least should not be worse than, those of their classmates. (p. 275)

It is noteworthy that the participants in the Lee et al. study were Singaporean secondary-school students. In Singapore, the education system is competitive and examination driven. The findings may therefore not be indicative of results from other countries where students do not focus on examinations to earn the chance to further their studies.

Outside factors contribute to the motivational levels of students including the role of the teacher, pressure placed on students from parents and governments, and the focus of the school and classroom. The motivational levels of students are not constant, and research has demonstrated that they change over the course of a given school year

(Corpus et al., 2009). In a sample of Grades 3 and 8 students, both intrinsic and extrinsic motivators decreased from fall to spring; however, this decrease was more noticeable in the older student participants. The Corpus et al. (2009) study also revealed that a schoolwide focus on mastery skills may contribute to minimizing the decrease in intrinsic motivators. Intrinsically motivated students are more likely to complete tasks for the sake of learning and for the increased sense of self-growth, and they are typically enthusiastic about their learning and strive for excellence (Lee et al., 2010). These ideas closely model the goals of formative assessment.

As student motivation increases, classroom climate and student attitudes often concurrently improve. Researchers have demonstrated how formative assessment and mastery learning practices are linked to improved climate within the classroom and to more favorable student attitudes surrounding learning (Patrick et al., 2011; Walker & Greene, 2009). Patrick et al. (2011) examined the relationship between the classroom goal structure and social climate and proposed that these two classroom elements are intertwined, and the quality of the teacher-student relationship plays a significant role. Their findings revealed that a strong positive correlation exists between classrooms wherein teachers implement a mastery goal structure and provided emotional and academic support. Similarly, Walker and Greene (2009) found that classroom teachers who support a mastery approach promote a sense of belonging that relates to student motivation. These researchers noted,

> When students believe that they are valued members of their classroom community, feel supported by both teachers and peers, and believe that the current

> work is instrumental to their future, they are more likely to focus on the development of understanding . . . and use cognitive strategies that support each aim. (p. 470)

These findings indicate that classroom environment is a motivator, which in turn, affects student learning. Therefore, teachers must embrace techniques that encourage a more positive classroom environment in order to motivate and support their students.

Implementation

The described benefits of formative assessment have caught the attention of administrators and teachers. Consequently, educators are promoting formative assessment at conferences, in-service sessions, within articles published by education magazines, and at school forums. Researchers have begun to document the outcomes of formative-assessment practices within classrooms and have reported that, when these practices are implemented correctly, both teaching and learning improves (Bakula, 2010; Blanchard, 2008; Brookhart, Moss, & Long, 2010; Davis & McGowen, 2007; Ruiz-Primo & Furtak, 2006; Stull et al., 2011). Strategies that promote teacher effectiveness are important because, as teaching improves, student achievement increases (Black & Wiliam, 1998). Studies have also revealed that, when teachers do not implement formative-assessment correctly, the benefits described earlier, such as improved academic achievement and student motivation, are less evident (Gijbels & Dochy, 2006; Peterson & Siadat, 2009; Wylie & Lyon, 2015; Yin et al., 2008). Incorporating formative assessment into classroom instruction is only useful if teachers use the strategies as intended.

As noted earlier, various definitions for formative assessment exist; however, several key strategies are necessary for successful practice. These include involving students in the learning process, modeling good and bad student work, providing useful feedback, and requiring students to participate in peer and self-assessments (Black et al., 2004; Black & Wiliam, 1998, 2009; Guskey, 2007; Leahy, Lyon, Thompson, & Wiliam, 2005; Wylie & Lyon, 2015). In this study, I surveyed teachers specifically on the extent to which they value and use these four formative-assessment practices. Although I described each strategy separately, it is important to note that many of these strategies actually occur in unison and require mutual components to be effective.

Student involvement in learning process. When students are involved as partners in the learning process, instruction improves and student learning is enhanced (Fluckiger, Vigil, Pasco, & Danielson, 2010). In relation to formative assessment, every task in which the teacher and student engage should have meaning and purpose that relates to a specific goal. When teachers share learning expectations with students to enable them to monitor their own progress, students become more accountable for their learning (Wylie & Lyon, 2015). Teachers must create a climate within which the focus is on student learning rather than earning grades (Fluckiger et al., 2010). Teachers can encourage student involvement in the learning process in many ways such as helping to define learning targets, implementing questioning strategies, and activating students as mutual instructional resources.

For students to gain awareness of teacher expectations and learning outcomes, Blanchard (2008) suggested teacher transparency with regard to the purpose, method, and

criteria of lessons. He also advanced that a classroom within which teachers expect and enable students to take an active role in determining the purpose, methods, and criteria of lessons, is a classroom that is more responsive to the needs of learners. Similarly, Harris (2007) suggested that, when teachers share their learning targets at the beginning of lessons, students tend to have an increased focused on learning throughout the day. Students also tend to support each other in the learning process. Webb and Jones (2009) noted that, in classrooms where teachers effectively implement formative assessment, a shared belief between teachers and students develops in student responsibility for their own learning and mutual support among all stakeholders.

One specific technique that contributes to involving students in the learning process is effective questioning. When classroom teachers embrace formative assessment, they must use every conversation with their students to gather information surrounding student capabilities (Black & Wiliam, 1998). According to Black and Wiliam (1998), "Dialogue between pupils and a teacher should be thoughtful, reflective, focused to evoke and explore understanding, and conducted so that all pupils have an opportunity to think and to express their ideas" (p. 86). Questions that require little thought or memorization are unproductive questions. The goal of asking questions is to guide student learning and enhance their understanding of a topic of study (Black et al., 2004).

Teachers who incorporate questioning techniques can increase student achievement. Ruiz-Primo and Furtak (2006) conducted a study with a sample of teachers who incorporated effective formative-assessment questioning techniques into four

middle-school science classes. These researchers instructed the teachers to employ a four-step cycle for questioning. This strategy involves the teacher posing a question to the class, a student responding, the teacher addressing the student response, and the teacher evaluating student learning based upon the student responses. The findings indicated that teachers who closely followed these questioning techniques helped students achieve higher scores on embedded assessments and posttests than those with teachers who did not follow the questioning guide. The teachers who incorporated the most discussion within their classrooms, asked the most focused questions, and used the information gained from the discussion to create diverse activities also obtained the highest test results from their students. This strategy supports the concept advanced by Black and Wiliam (1998) and Black et al. (2004) that proper teacher questioning can elicit ongoing student understanding and learning.

A challenge related to questioning techniques is that many teachers believe they are already using these techniques within their classrooms; many fail to recognize its full potential to develop cognitive thinking (Webb & Jones, 2009). One way to ensure teachers are implementing questioning effectively is to instruct them to provide appropriate time for students to think about questions before expecting a response (Black, 2003; Black et al., 2004; Egan, Cobb, & Anastasia, 2009; Harris, 2007). Researchers have demonstrated that most teachers allow only 1 second for students to respond to a question. If a student does not have an immediate answer, teachers will often ask another student for a response (Black et al., 2004). This type of questioning only elicits memorized facts void of in-depth thought. When classroom teachers embrace formative-

assessment techniques, they must learn to incorporate time for student thought prior to their responses to questions. This allows more students to become involved in class discussion because all participants are given sufficient time to arrive at a response (Egan et al., 2009; Harris, 2007). Students are also thus enabled to provide more elaborate responses that typically require higher order thinking.

If teachers begin to increase time for student thought after posing class questions, they will need to create a climate supportive of this type of learning (Black, 2003). For example, teachers involved in a program known as Keeping Learning on Track participated in learning communities that met monthly to discuss and share formative-assessment practices (Egan et al., 2009). Teachers who embraced more time for student thought in their classes reported that students became more respectful of their peers and recognized that all classroom participants played important roles. Students no longer interrupted their peers while answering questions, but rather, worked through their own solutions to enable them to assist their peers as needed. In this classroom climate, teachers must expect all students to answer a question, whether or not the answer is correct. When students elicit an incorrect response, teachers should follow up their questions and attempt to understand where student misconceptions occurred (Black, 2003). Through more meaningful questioning and time for student thought, students begin to learn that the goal is not always a correct answer; the ability to express their understanding is of greater importance. Wrong answers become essential to the learning process to promote deeper understanding (Harris, 2007), and students are more willing to give and receive criticism (Webb & Jones, 2009).

Modeling quality work. One way for teachers to gain greater transparency with regard to their expectations for students is to provide both good and poor exemplars of student work (Handley & Wiliams, 2011; Hendry, Bromberger, & Armstrong, 2011; Lipnevich et al., 2014; Newlyn, 2013; Orsmond, Merry, & Reiling, 2002; Sadler, 1998; Scoles, Huxham, & McArthur, 2013). Sadler (1987) defined exemplars as "key examples chosen so as to be typical of designated levels of quality or competence. The exemplars are not standards themselves but are indicative of them" (p. 200). Sadler (2010) contended that students must be exposed to various qualities of work—both good and poor—in order to judge the quality of their own work. Exemplars of low and high quality work provide clarity in terms of the criteria for success (Hendry et al., 2011; Orsmond et al., 2002).

Benefits of providing students with exemplars (i.e., models of work) are they allow students to judge their own performance and use them to improve their work (Hendry et al., 2011; Lipnevich et al., 2014; Orsmond et al, 2002). Lipnevich et al. (2014) conducted a pilot study, providing students with exemplars, rubrics, or both. Students within all three groups demonstrated significant improvement in their work, with effect sizes ranging from 1.04 to 1.54. Students within the exemplar group indicated they preferred the strong examples to the weak examples because they offered guidance on the expectations for their own work.

Hendry et al. (2011) conducted a similar study during which students reflected upon various forms of feedback including exemplars, individual and class feedback, and teacher comments on sheets of work. The majority of the student sample identified

exemplars as useful in completing assignments. They also reported that exemplars increased their confidence in their ability to complete an assignment with high-quality work. Exemplars differ from most teacher feedback in that teachers often present them prior to beginning instruction or midway through an assignment so students can reflect upon them and have an opportunity to improve their work. This characteristic of modeling quality work is essential because feedback solely upon completion of an assignment introduces a lost opportunity for improvement (Newlyn, 2013). Providing students with exemplars early in the learning process also encourages invaluable dialogue between teachers and students (Handley & Williams, 2011; Scoles et al., 2013).

Another positive outcome of introducing exemplars to teaching practice is the improvement in student performance (Scoles et al., 2013). Mean student scores on examinations were significantly higher for students who accessed exemplars compared to those not exposed to these tools. Conversely, Handley and Williams (2011) found that students viewed exemplars positively; however, their scores on assignments did not increase compared to a previous cohort. These researchers suggested that this result was perhaps due to some students misinterpreting the feedback provided on the exemplars and not taking the time to engage in discussion surrounding their interpretations. The Handley and Williams findings support the notion that various forms of formative assessment must be implemented concurrently to achieve maximum student potential. Providing students with exemplars is an important component in modeling criteria that support expectations of students; however, a constant dialogue between teachers and students must also exist to ensure accurate understanding.

Teacher feedback. A major component of formative assessment is useful and timely teacher feedback (Black, 2003; Black et al., 2004; Black & Wiliam, 2009; Bloom et al., 1971; Guskey, 2007; Harris, 2007; Lalley & Gentile, 2009; Wylie & Lyon, 2015). Guskey (2007) argued that teacher feedback must be both diagnostic and prescriptive. This implies that students must be able to recognize from teacher feedback what they did well and what they need to improve. Bloom et al. (1971) indicated that this form of teacher feedback provides students with necessary information to determine whether they will progress to the next grade level or could potentially need to remediate to obtain mastery of the expected objectives.

The type and quality of feedback students receive from teachers is important. Black et al. (2004) supported the notion that the amount of feedback is not as important as the quality. Students should receive both oral and written teacher feedback that focuses on productive comments rather than nebulous scores (Black, 2003; Black et al., 2004; Butler, 1988). Butler (1988) determined that, when teachers provide feedback to students in the form of scores and comments, students tend to ignore the comments and focus solely on the grades. Providing students with a numerical score produces a negative effect and students tend to subsequently have less desire to improve in weak areas (Black et al., 2004). Butler reported that teachers who incorporate feedback with comments only and no grades observed positive student results. Both high- and low-performing student groups who received formative feedback demonstrated significantly higher achievement than students who received solely grades and comments. Although teachers had initial fears of negative reactions from parents and students to not receiving scores, this fear

proved to be unwarranted. Rather, parents and students felt more informed on areas of learning needing greater attention, and students were more inclined to apply teacher feedback as they made necessary changes to improve their learning (Black, 2003).

Supporting the notion that teacher feedback is a crucial component to advance learning, Harris (2007) argued that a balance must exist between positive teacher feedback and comments emphasizing weaknesses. She believes students can handle a limited amount of feedback that focuses on improvement goals; consequently, teachers should offer feedback that is positive rather than that aimed solely at developmental needs. This philosophy closely links learning to the self-worth and self-esteem of students.

To examine how college students perceive instructor feedback, Higgins, Hartley, and Skelton (2002) conducted a 3-year study with students who reported routinely reading the feedback but they were left with many negative feelings surrounding the comments. The feedback was often overly vague and did not provide sufficient useful information to further their learning, was not legible, or the language used was not understandable. Participants in the Higgins et al. study reported that, when the feedback included meaningful information, students could use it to improve their learning. Important forms of feedback identified by the participants were those that explained student mistakes, focused on critical analysis, and/or provided an overall impression of the work submitted. Despite reporting these forms of feedback as most important, participants also highly rated feedback based upon grades. This finding contradicts the result reported by Black et al. (2004) of students ignoring feedback when it teachers

provided it in the form of a score. Participants desire both forms of information; however, Black et al. did not identify the degree to which students used the feedback to improve their learning.

Providing feedback that is constructive and avoids scoring varies significantly from traditional teaching practice, and teachers must extend conscientious effort to accurately and effectively deliver feedback. Many are accustomed to providing students with a numerical or percentage score as their sole form of feedback. Black (2003) believed that feedback ultimately needs to encourage students to think more deeply; therefore, comments that fail to improve learning are useless. Useful feedback requires practice and collaboration on behalf of teachers. Wylie and Lyon (2015) investigated the breadth and quality of the formative-assessment practices of mathematics and science teachers who were engaged in a 2-year professional-development program. Their findings supported much of the Black et al. (2004) results. Many teachers provide feedback less frequently than other formative-assessment practices (Wylie & Lyon, 2015). Teachers often offer the feedback upon completion of the learning process rather than throughout the process. Ongoing feedback can be a time-consuming practice for teachers, and teachers still need additional training on how to construct meaningful comments that students can internalize and apply to their work.

Self and peer assessment. As teachers begin to incorporate formative techniques, they create a sense of community built upon trust and respect (Black et al., 2004). This environment supports other critical components of formative assessment, which are self and peer assessment. Prior to formative assessment, students knew only whether they

were mastering teaching material based upon scores received on summative assessments. This information was often attained when it was too late to take action to reverse poor performance and teachers had moved on without allowing for remediation. With incorporation of formative assessments within classrooms, teachers provide frequent feedback to students on their progress toward meeting instructional goals. When students begin to recognize their own abilities in relation to the goals and objectives of the class, they can develop personal plans toward improving weak areas (Black & Wiliam, 1998). Ultimately, self and peer assessments can improve student ownership of their academic performance (Black, 2003; Cartney, 2010; Ibabe & Jauregizar, 2010; Webb & Jones, 2009).

Students who self-assess their learning must first have a solid understanding of the learning goals of the instruction, knowledge surrounding how the teacher will assess mastery, and request opportunities to reflect upon their progress and attempt to demonstrate mastery (Black & Wiliam, 1998, 2010). Self and peer assessments are often accomplished using rubrics, marking guides, or a set of norms. When students reflect upon their own learning, they provide valuable information for themselves and their teachers. Students gain greater awareness of learning expectations, take ownership over their own progress, and are better able to articulate steps they need to take to improve their learning. Teachers learn where they might need more time to readdress topic areas not well understood by students, areas in which students are the most comfortable in their abilities, and how they can develop shared learning experiences with students (Black

et al., 2004). As students are invited to share in tasks previously performed only by teachers, they become increasingly aware of the assessment process (Mills, Glover, & Stevens, 2006).

Despite the apparent benefits of self and peer assessments, teachers reportedly struggle with implementing this practice (Volante & Beckett, 2011). They report challenges with being objective and not wanting to hurt the feelings of their friends. Similarly, students have reported feeling anxious with the request to review the work of other students, particularly when the work is in need of major revisions. They also report a sense of discomfort with other students viewing their own work (Cartney, 2010). Despite this anxiety, they also recognize peer review as invaluable. Teachers may struggle with integrating self and peer assessments into their teaching practice because they have not established an appropriate classroom climate to support this strategy. Webb and Jones (2009) determined that several characteristics of a classroom culture foster such assessment practice including (a) the willingness of students to make and learn from mistakes, (b) mutual support among students for learning, (c) trust in others for support, (d) believing that others will be honest, (e) a willingness to give and receive criticism, and (f) a shared language related to assessment and teacher feedback.

Conclusion

Several themes emerged from this review of literature related to this study. The first is that the implementation of new practices and ideas within education are a challenge. The CCSS have received criticism, resistance, and skepticism from teachers, parents, and educators. Improper training and insufficient resources to properly

implement the CCSS as they were intended was a perception of many stakeholders. Formative-assessment practices, despite an abundance of positive related research, are not always implemented effectively. The literature review revealed that both the CCSS and formative assessment often lack the professional development and support needed for proper integration into teaching practice.

The second theme that emerged from this literature review was that proper implementation of the CCSS evidences improved student and teacher performance. As teachers increase the level of rigor and raise their expectations of students, student performance increases. Students develop a deeper conceptual understanding of the content and, specifically in math, can communicate and collaborate with others about their learning. Students become less focused on algorithms and memorization, developing a number sense and drawing connections between topics. The third theme was that, when teachers implement formative assessment correctly, it is a powerful instructional tool. Regardless of the age-group of students, the content of the courses, or even course format, students regularly demonstrate academic gains when formative-assessment practices are evident within the classroom.

Several gaps also emerged in this review of literature related to the study. Although numerous studies have demonstrated the advantages of incorporating formative-assessment practices, there is no existing research that has examined the relationship between this instructional strategy and how teachers perceive the CCSS in mathematics. Knowing that the standards have shifted the ways in which teachers instruct and students learn, having a clearer understanding of teacher perceptions and their

instructional practices might provide new insight into how to increase the performance of both students and teachers within the classroom. The research method for this study facilitated addressing this gap in knowledge.

Chapter 3: Research Method

The purpose of this quantitative study was to determine how public middle and high school mathematics educators perceive the CCSS, their value and use of various formative assessment practices, and whether a relationship exists between these variables. The following chapter outlines the methods used to answer the research questions and hypotheses. The methodology and research design are discussed in this chapter as well as the target population, selection of the sample, and the instrumentations used. The data collection is described as well as an overview of the statistical methods employed to analyze the data from this study.

Research Design and Rationale

I employed a quantitative approach to survey research. Such design allows for the collection of large amounts of numerical data surrounding attitudes and opinions in order to generalize the findings to other populations (Creswell, 2009). The research question and related hypotheses for this study are based on this design.

RQ1: Are mathematics teachers' perceptions of the CCSS positive?

$\boldsymbol{H_0}$**1:** Mathematics teachers' perceptions of the CCSS are positive.

$\boldsymbol{H_a}$**1:** Mathematics teachers' perceptions of the CSSS are not positive.

RQ2: How do mathematics teachers' perceptions of the CCSS relate to the value they place on formative-assessment practices including involving students in their learning, modeling quality work, providing feedback to students, and/or providing student opportunities for self and peer assessment?

$H_0$2: There is no significant relationship between how mathematics teachers perceive the CCSS and the value they place on formative-assessment practices related to involving students in their learning, modeling quality work, providing feedback to students, and/or providing student opportunities for self and peer assessment.

H_a2: There is a significant relationship between how mathematics teachers perceive the CCSS and the value they place on formative-assessment practices related to involving students in their learning, modeling quality work, providing feedback to students, and/or providing student opportunities for self and peer assessment.

RQ3: How do mathematics teachers' perceptions of the CCSS relate to their use of formative-assessment practices including involving students in their learning, modeling quality work, providing feedback to students, and/or providing student opportunities for self and peer assessment?

$H_0$3: There is no significant relationship between how mathematics teachers perceive the CCSS and their use of formative-assessment practices related to involving students in their learning, modeling quality work, providing feedback to students, and/or providing student opportunities for self and peer assessment.

H_a4: There is a significant relationship between how mathematics teachers perceive the CCSS and their use of formative-assessment practices related to involving students in their learning, modeling quality work, providing feedback to students, and/or providing student opportunities for self and peer assessment.

Although the original proposal did not include the question pertaining to how participants perceived the CCSS, I found upon analysis of the data collected that it was

important to include this analysis, so the research question was added. The variables within this study include (a) mathematics teachers' perceptions of the CCSS, (b) the value mathematics teachers place on the formative-assessment practices of involving students in their learning, modeling quality work, providing feedback, and providing opportunities for peer and self-reflection, and (c) mathematics teachers' use of these four formative-assessment practices. The variables studied allowed for correlational research because I solely intended to analyze the relationship between the variables rather than attempting to determine cause and effect (Field, 2009). The survey design allowed for a larger sample size than with qualitative research.

Methodology

Population

The target population for this study was middle- and high-school teachers who provide mathematics instruction to students through Algebra I in schools within the state of Pennsylvania. The sample of teachers selected was from public schools that were not charter or cyber schools, and was approximated to be 4,448. This number excludes any long-term substitutes or per diem employees. I determined there was approximately this number of teachers using a report published by the Pennsylvania Department of Education (2016) during the 2015-16 school year. Each year, this agency compiles data on the employees within the state. In Pennsylvania, the last state assessment of the CCSS is administered to Algebra I students. Most schools require students to complete Algebra I by Grade 9. Identifying which Grade 10 teachers teach Algebra I courses would be impossible; consequently, I limited the study sample to teachers of Grades 7 through 9.

Staff identified as working for an Intermediate Unit, charter or cyber charter schools, state juvenile facilities, or career and technical schools were eliminated from the count for the sample size.

The rationale for excluding mathematics teachers from charter schools in the study sample for the research was because some of these schools offer online classes or hybrid classes, and teachers in these schools do have not the same face-to-face interaction with their students. Additionally, their students do not have face-to-face interaction with other students, as do those attending "brick and mortar" schools. Face-to-face interaction is important in measuring teacher integration of formative-assessment strategies within their classrooms. Because I could not distinguish which charter schools operate on a hybrid model or brick-and-mortar design, it was prudent to eliminate teachers within charter schools completely from the study population. Teachers identified as working for intermediate units, state agencies, and technical schools were excluded because it is difficult to determine whether these instructors teach solely mathematics or other content areas as well. To support the validity of the data, including mathematics teachers employed by public school districts seemed appropriate. Although the Pennsylvania Department of Education (2016) report provides data from only the 2015-16 school year, the number of teachers working within Pennsylvania public schools remains relatively similar.

All participants in the study were required to hold a secondary mathematics certification in Grades 7 through 12 and must have passed numerous examinations to earn their state certifications. They have earned varying degrees in education, some with

a bachelor's degree and others with masters and/or doctoral degrees. Variables such as race, religion, and socioeconomic status were not relevant to the study. The sample also varied in relation to the number of years they have been working within the teaching profession. For some participants, the year of the study might be have been their first few year of teaching; others may have been preparing to retire after a lifetime of teaching.

Sampling

To ensure I achieved a large enough sample, I emailed all 4,436 eligible participants. I intended to employ random sampling in the study, because it was unlikely that all 4,448 Grade 7 through 9 mathematics teachers in Pennsylvania would respond to the survey. I was going to assign numbers to the respondents based upon their total number of responses and subsequently use an online random number generator to select and identify teachers to participate in the study (Traffic Names, n.d.). This would have ensured that each teacher had an equal probability of selection. Creswell (2009) suggested that random sampling allows for a better representation of the target population, which could potentially allow for increased generalizability. Random sampling was not needed because there were fewer respondents than the needed sample size. I conducted a power analysis using the website http://www.abraxasenergy.com/energy-resources/toolbox/samples-ze/ to determine an appropriate sample for the study. Approximating that there are 4,436 public, non-charter, grades 7-9 mathematics teachers in Pennsylvania, with a 95% confidence level and a 5% margin of error, the sample size needed was 354 participants. I estimated an effect size of 0.50.

For purposes of the study, the only criteria for participation was participants needed to be certified as a secondary-school mathematics teacher within the state of Pennsylvania with a minimum of 1 year of teaching experience. I included all public secondary-school mathematics teachers, regardless of whether they are working part time or full time, teach honors or remedial classes, or work within high- or low-performing schools. The only exclusion was if teachers had less than 1 year of experience in classroom teaching. Research has indicated that new teachers do not receive the necessary training in their preparation programs to effectively implement practices learned (Chesley & Jordan, 2012; Gainsburg, 2012).

Chesley and Jordan (2012) conducted a study of first-year teachers and reported that this population of educators received little training on how to implement formative-assessment practices to determine student needs or create differentiated lessons. Gainsburg (2012) did not directly study formative-assessment practices but noted that many new teachers have difficulty translating their learning from credential programs into the mathematics classroom. To ensure that the inexperience of new teachers does not influence the results of the research, I excluded new teachers from the study sample. Although I value their perceptions of the CCSS and their input surrounding the extent to which they value formative assessment, their responses could potentially skew the findings.

Data Collection

Procedures

All eligible mathematics teachers of students attending Grades 7 through 9 received an email explaining the purpose of the study, its significance, and inviting them to participate in the research. The communication was addressed to each potential participant rather than using a general salutation. Research has reported that this personal approach may increase response rates **(**Dillman, Smyth, & Christian, 2009). Within the body of the email, I included all necessary consent form information. At the conclusion of the email, I provided a link to the survey. After 2 weeks, I emailed the link again to all eligible participants, with a gentle reminder encouraging them to participate, to increase the response rate. Based upon Dillman et al. (2009) recommendations, I sent only one reminder. After 3 weeks, I withdrew access to the survey by disabling the link.

To increase the survey response rate in the study, I offered an incentive of a free Redbox one-night movie rental to the first 200 participants. The survey included a link to the movie Web site where eligible participants could access their rewards. Each redeemed reward equated to a $2.49 expense. Although a small reward, Dillman et al. (2009) suggested that such incentives contribute to improved response rates.

Instrumentation and Operationalization of Constructs

The questionnaire I distributed in the study was a compilation of two Likert-type surveys developed by other researchers (Cheng, 2012; James et al., 2002). The first instrument was created by Cheng (2012) for his thesis intended to elicit teacher perceptions surrounding the CCSS (see Appendix A). I received permission via email to use the survey (see Appendix B). Prior to his administration of the tool, Cheng conducted a pilot study with a group of five teachers who commented on the readability, user

friendliness, and experiences related to completing the survey. Based upon these comments, Cheng modified his original survey to increase its validity and render the instrument easier to complete. Participants in the Cheng study were teachers from two neighboring school districts within the state of California. The sample included high-school, middle-school, and elementary-school teachers. The Cheng instrument has six possible responses that include, *strongly agree, agree, neutral, disagree, strongly disagree, and don't know*. His survey was administered prior to implementation of the CCSS so questions are worded in future tense. I needed to change the verb tense within these questions since teachers are currently implementing the standards. For example, the first question states, "The Common Core will have little impact on my everyday practice." The question was revised to state, "The Common Core has little impact on my everyday practice." These verb changes should not impact the reliability or validity of the instrument.

To acquire data on the value and use of formative assessment, I administered a modified version of the Formative Assessment Questionnaire (FAQ), originally created by the Qualifications and Curriculum Authority (Neesom, 2000). This organization developed and maintained the national curriculum and associated assessments for schools within England. I received permission to use the tool for the study via an email from Mary James, deputy director of the Teaching and Learning Research Programme in England and director of the Learning How to Learn Project (see Appendix B).

The questionnaire used for the study was modified by James et al. (2002). This instrument has been validated by the Learning How to Learn Project, which was funded

by the Economic and Social Research Council. The questionnaire has been used in several studies commissioned by the Qualifications and Curriculum Authority and its reliability and validity has been established after repeated use. The modified version was designed to differentiate four components of formative assessment to determine how teachers involve students in their own learning, how student work can be used as exemplars during instruction, how teachers employ various types of feedback, and how they incorporate student self and peer assessment (see Appendix A). Within each formative assessment component, participants respond to both their value of that practice and how often they use this practice within their classroom. For example, within the component of giving feedback, participants are asked to identify their value and use of "showing students a range of other students' work to make a judgement about performance."

The Cheng (2012) survey included six possible responses on a Likert scale, while the James et al. instrument has five possible responses. The responses for value of a formative assessment include, *very valuable*, *valuable*, *no strong view*, *of little value*, and *of no value*. The responses for use of formative assessment include, *most lessons*, *most days*, *weekly*, *quarterly*, *never*. Cheng included an option of "I don't know" that does not appear in the James et al. survey. For consistency, I utilized similar response for survey questions on the value and use of formative assessment.

Threats to Validity

Several factors could have threatened the external and internal validity of the study. Those potentially affecting internal validity include the history of the participants

and the survey response rate. The only criteria established for teachers within Pennsylvania to be included in the study is that they taught math to students attending Grade 7, 8, or 9 within a public school, have a minimum of 1 year classroom-teaching experience, and not teach within charter or online schools. All other teachers were eligible to participate. Because the survey was optional for the teachers, those choosing to respond may have had similar beliefs. Teachers with strong positive or negative opinions surrounding the CCSS might have been more inclined to respond to the survey than those with opinions that are more neutral. Similarly, teachers who regularly integrate formative-assessment practices within their classrooms might have been more inclined to respond to the survey because it is a topic of interest. Teachers who do not implement formative assessment might believe their input is not of value and chose not to respond. To address this threat to validity, the recruitment email also expressed that the input of each respondent has value and is appreciated. I assured participants that their responses would remain confidential and that I would not share with anyone.

The history of each participant is another threat to the internal validity of the study. The ways in which teachers perceive the CCSS or implement formative-assessment practices could be influenced by various other factors including the amount and type of training or professional development received or the level of administrative support. These historical components are not within my control and might influence whether a teacher responds to an invitation to participate and, if they do, the manner in which they respond. To address this threat, a few survey questions will pertain to the amount of training time respondents have received on the Common Core and formative

assessment. Although this is not a focus of the study, it will allow me to determine if this is a variable influencing the results.

Factors that might affect the external validity of the study include schools that have only been using the CCSS for a few years because the perceptions of teachers are likely to change over time. As teachers become more comfortable and familiar with the standards and the supporting instructional practices, their beliefs and practices will likely change as well. This threat will render the results difficult to generalize over time. However, the findings intend to provide insight only into the current state of teachers and hold no predictive value for future perceptions and practice.

Ethical Considerations

In compliance with the Walden University Institutional Review Board, I addressed ethical issues at each stage of the study. Initially, I submitted an application to the Board and did not proceed with data collection until I received approval. I communicated with participants at several stages including during recruitment and data collection. At each stage, I addressed ethical concerns and communicated them to the participants.

Throughout the study, all participants and the data they provide remained completely confidential and this was clearly communicated to all study participants upon solicitation of their involvement. I will store all data on my personal computer and back it up on a flash drive; other than my committee members, no one else will have access to the data. I will destroy all data 5 years following completion of the study. Because I emailed all eligible teachers within Pennsylvania, there was the possibility that teachers within the school district for which I am currently employed, responded to the survey. I

treated these teachers in the same manner as those unfamiliar to me and received the same information on the study.

Summary

Mathematics teachers of Grades 7 through 9 across public schools within the state of Pennsylvania will be surveyed in the study. The purpose of the research was to determine how mathematics educators perceive the CCSS, how they value and implement formative-assessment practices, and how these factors relate to their perceptions of the CCSS. A Likert-type survey was distributed via email. I processed and analyzed the data using Google tools and SPSS. The findings of the statistical analysis will be clearly presented.

Chapter 4: Results

Introduction

The purpose of this study was to determine how Grade 7-9, public school, mathematics teachers in Pennsylvania perceived the CCSS, how they value and use various formative-assessment practices, and determine how these variables are related. In this quantitative study, which was approved by Walden's Institutional Review Board (#06-23-17-0153553), I used previously used Likert scale surveys to collect data on each variable. There are three variables that guided this study were: (a) teacher perceptions of the CCSS, (b) teacher use of various formative-assessment practices including; involving students in their learning, modeling quality work, giving student feedback, and providing opportunities for student peer and self-assessment, and (c) teacher value of these same four formative-assessment practices. Survey items used to measure each of these three variables will be described later within the chapter. Demographic data collected included gender, education level, and years of teaching experience. The research questions and hypotheses used for this research design were as follows:

RQ1: Are mathematics teachers' perceptions of the CCSS positive?

$\boldsymbol{H_0}$**1:** Mathematics teachers' perceptions of the CCSS are positive.

$\boldsymbol{H_a}$**1:** Mathematics teachers' perceptions of the CSSS are not positive.

RQ2: How do mathematics teachers' perceptions of the CCSS relate to the value they place on formative-assessment practices including involving students in their learning, modeling quality work, providing feedback to students, and/or providing student opportunities for self and peer assessment?

$H_0$2: There is no significant relationship between how mathematics teachers perceive the CCSS and the value they place on formative-assessment practices related to involving students in their learning, modeling quality work, providing feedback to students, and/or providing student opportunities for self and peer assessment.

H_a2: There is a significant relationship between how mathematics teachers perceive the CCSS and the value they place on formative-assessment practices related to involving students in their learning, modeling quality work, providing feedback to students, and/or providing student opportunities for self and peer assessment.

RQ3: How do mathematics teachers' perceptions of the CCSS relate to their use of formative-assessment practices including involving students in their learning, modeling quality work, providing feedback to students, and/or providing student opportunities for self and peer assessment?

$H_0$3: There is no significant relationship between how mathematics teachers perceive the CCSS and their use of formative-assessment practices related to involving students in their learning, modeling quality work, providing feedback to students, and/or providing student opportunities for self and peer assessment.

H_a4: There is a significant relationship between how mathematics teachers perceive the CCSS and their use of formative-assessment practices related to involving students in their learning, modeling quality work, providing feedback to students, and/or providing student opportunities for self and peer assessment.

This chapter includes the results of this study and an analysis of the described variables to answer the research questions. The following sections in the chapter contain

information about data collection, the results of the study, an analysis of the data, and a summary of the findings.

Data Collection

Potential participants were determined using a report conducted by the Pennsylvania Department of Education called the *Professional Personal Individual Staff Data* (Pennsylvania Department of Education, 2016). Filters were used to identify teachers from non-charter, non-cyber public schools teaching mathematics in Grades 7-9. The population was determined to be 4,436 teachers meeting these initial requirements. I tried to locate email addresses for each of these possible participants using school district websites. There were some schools that did not post teacher email addresses on their website while some schools that did were missing some teachers identified within the Professional Personal Individual Staff Data report. Specifically, Philadelphia School District had numerous schools that did not post teacher email addresses. In an attempt to access as many teachers' emails as possible, I reached out to administrators in the Philadelphia School District and was informed she would have to submit a proposal and go through their review board. After discussions with my committee, we made the decision to exclude all teachers from the Philadelphia School District, even those in which school websites listed email addresses. Upon an exhaustive review of school websites, a total of 3,546 possible participants were determined.

Although Walden's Institutional Review Board approved the study in June 2017, I determined sending surveys in the middle of the summer might produce a low response rate, as many teachers do not check email over summer break. For this reason, I did not

email the surveys to teachers until the first week in August. The email was sent to possible participants and approximately 600 of these emails were returned as being undeliverable. I made an attempt to determine if these emails were undeliverable due to incorrect email addresses. I corrected approximately 150 of these email addresses and resent the survey. The remaining 450 teacher contacts were either incorrect on school websites or these teachers were no longer employed by the district identified within the report. For this reason, approximately 3,092 people received the email inviting them to participate within the study. These individuals received a reminder email 2 weeks later reiterating the invitation and informing them they had 1 additional week to respond. After 3 weeks, the I deactivated the survey.

I intended to provide an incentive of a voucher to a RedBox Movie rental to the first 354 respondents. A week prior to sending the surveys, I attempted to set up an account with txtmovies.com. Unfortunately, either their website was under construction or they went out of business. I tried contacting the company through phone messages and email but had no return communication. I tried to find an alternative similar priced incentive, but had no success finding something that would allow participants to remain anonymous. For this reason, I did not offer the incentive to any respondents.

A total of 179 teachers responded to the survey, a response rate of approximately 6%. One of the criteria to be included within the study was that participants needed to teach a math class to 7th, 8th or 9th grade students through Algebra I. It was impossible to know if any teachers listed within the *Professional Personal Individual Staff Data Report* (Pennsylvania Department of Education, 2016) might not teach one of these

courses. Of teachers that responded, three identified themselves as never having taught a math course for 7th, 8th, or 9th graders through Algebra I, and for this reason, their data was eliminated from the analysis. One respondent only completed the demographic data and nothing else, and another respondent only completed the portion about perceptions of the Common Core. Because these two participants had incomplete data, I excluded their responses from further analysis. The following data is a summary of the remaining 174 participants' responses.

Within the survey, respondents identified some descriptive characteristics about themselves including gender (Table 1), highest level of education (Table 2), years of teaching experience (Table 3), and the math course in which they primarily taught (Table 4). The following tables provide a summary of the descriptive statistics of the respondents as compared to the population as defined by the *Professional Personal Individual Staff Data Report* (Pennsylvania Department of Education, 2016).

Table 1

Gender Breakdown for Sample and Population

	# in Sample	% of Sample	# is Population	% of Population
None Identified	1	0.6	0	0
Female	107	61.5	2148	60.6
Male	66	37.9	1397	39.4

Table 2

Level of Education Breakdown for Sample and Population

	# in Sample	% of Sample	# in Population	% of Population
Bachelors	37	21.3	1404	39.6
Masters	63	36.2	2132	60.1
Graduate work beyond Masters	72	41.4	*	*
Doctorate	2	1.1	10	0.3

Note. * The *Professional Personal Individual Staff Data Report* did not delineate Masters and graduate work beyond masters, so values for Masters represent both groups.

Table 3

Years of Teaching Experience Breakdown for Sample and Population

	# in Sample	% of Sample	# in Population	% of Population
1-3 Years	4	2.3	237	6.7
4-8 Years	25	14.4	571	16.1
9-15 Years	60	34.5	1302	36.7
16 + Years	85	48.9	1436	40.5

Table 4

Primary Math Course Taught for Sample

	# in Sample	% of Sample	# in Population
7th Grade Math Class	54	31.0	*
8th Grade Math Class	29	16.7	*
Pre-Algebra	19	10.9	*
Algebra I	62	35.6	*
Prep Course for Keystone Algebra I	10	5.7	*

Note. * The *Professional Personal Individual Staff Data Report* did not provide this information.

The sample of teachers that responded to the survey was representative of the population in regards to gender because the percentage breakdown was within 1.5% of the actual population. The years of teaching experience for the sample was also fairly similar to that of the population; however those with one to three years of teaching experience were slightly under-represented in the sample and those with greater than 16 years of teaching experience were slightly over-represented in the sample. The level of education of respondents having their Bachelor's degree was lower than the population. This could be because the *Professional Personal Individual Staff Data Report* was a year old and it is possible some of the respondents completed their masters in the time period from when the report was released to the time the surveys were sent; this was over a year. Although this cannot be stated with certainty, the time delay could be one possible explanation for the percentage difference in level of education. Overall, the sample was fairly representative of the population with minor differences.

Results

I imported data collected from the Google forms into SPSS for analysis. Participants responded to Likert scale questions in which there were six responses for each. Within SPSS all responses were labeled with a numerical value from 0 -- 5. All questions associated with perceptions of the Common Core Standards were labeled as follows: strongly agree = 5, agree = 4, neutral = 3, disagree = 2, strongly disagree = 1, I don't know = 0. Similarly, all questions pertaining to the value of various formative-assessment practices had six possible responses and were coded with the following values; very valuable = 5, valuable = 4, no strong view = 3, of little value = 2, of no value

= 1, I don't know = 0. Likewise, the responses for use of these formative-assessment practices were coded with the following: I use in most lessons = 5, I use this most days = 4, I use weekly = 3, I use quarterly = 2, I never use = 1, I am not familiar with this strategy = 0. Responses of *I don't know* and *I am not familiar with this strategy*, were included in the analysis that follows, unless otherwise stated and were not considered missing data points. For perceptions of the CCSS, there were very few participants that responded in this way for each item. For use and value of the various formative assessment practices, there was occasionally a greater percentage of participants responding not being familiar with a strategy. In future sections, I describe how this was addressed in the data analysis.

Perceptions of the Common Core

Participants were asked 21 questions that related to their perceptions and understanding of the Common Core State Standards. I explored the responses of participants' perceptions of the Common Core State Standards to get a general sense of attitude towards this educational reform and to provide data relevant to research question one, which aimed to determine if mathematics teachers' perceptions of the CCSS are positive. Responses in which participants strongly agreed and agreed both represent a positive perception of the CCSS. I determined that although a response of strongly agree indicates a clearer understanding of the position of a participant than a response of agrees, both responses still represents a positive position. For this reason, to determine a general understanding of participant perceptions, responses for strongly agree and agree are often combined. Similarly, I determined responses of strongly disagree and disagree

both represent a similar perception of the CCSS and these values were also combined at times during the analysis. The instances where I chose to do this are indicated within the presented statistics. In each of these instances, the distribution of the data between strongly agree and agree and strongly disagree and disagree did not warrant keeping the responses separate. The following is a brief analysis.

Participants within this study had mixed perceptions about the CCSS. The majority of respondents, 88.5%, indicated feeling well informed about the CCSS by responding strongly agree or agree; however, slightly less, 60.3% felt prepared through professional development opportunities to teach the new standards. Even fewer participants agreed or strongly agreed, 13.8% that the new standards are easier to understand than previous state standards, while only 19.5% identified the CCSS as being a welcome change. When asked whether the CCSS was a more positive step in the right direction, respondents were more split with 37.4% agreeing or strongly agreeing, while 44.3% disagreed or strongly disagreed. While many participants seem to be adjusting to the changes, they are still uncertain as to whether or not the changes will improve or harm education.

This uncertainty about the value of the CCSS was also evident in how participants responded to whether the CCSS were helping to raise student achievement. While only 29.3% strongly agreed or agreed that the standards are helping, 19.5% responded neutrally, while 49.4% disagreed. A similar breakdown was evident for whether the standards are helping to make students college and career ready with 27% agreeing, 25% neutral, and 44.2% disagreeing. Since approximately a fifth of participants are responding

neutrally, it could be they are still transitioning and learning about how to implement these standards. For each of these items, there were two participants or fewer that responded “I don’t know”. This indicates that participants generally have an opinion about the CCSS.

As stated in Chapter 2, the standards required a shift from teaching about procedures to rather conceptual understanding and problem solving. For each of the following reported statistics, percentages reflect response of strongly agree and agree combined. Participants overwhelmingly, 90.8%, responded that the standards have required new or substantially revised materials and lessons. Similarly, 80.5% indicated the CCSS has an impact on their everyday practice. While a majority feels the standards impacts practice, a similar percentage, 81.6%, responded that the standards restrict their creativity and the instructional strategies they utilize in class. Only 27.6% of the participants believe the CCSS enables higher-order thinking while 44.8% believes they do not. This response was of particular interest, in that the CCSS was intended to support higher-order and critical thinking, but a large percentage of teachers perceive them differently. For each of the items no one responded with “I don’t know”, except for one participant indicated this response for the CCSS restricting his or her creativity. Again, the small number of participants responding “I don’t know” to questions pertaining to perceptions of the CCSS reveals that most have an opinion about this educational reform.

To further analyze participants’ perceptions of the CCSS and to have a measure for this variable for the correlational tests, I wanted to calculate a sum of the responses for each participant to serve as a score to represent this variable. First, it was necessary to

determine the reliability of the scale. The section of the survey that asked participants about the perceptions of the CCSS was previously created and used by another researcher, Cheng. Being that teachers' perceptions of the CCSS might change and evolve over time as they receive more training and have more experience implementing the standards, this study provides a snapshot into the participants' perceptions. To help increase the reliability, I obtained a large sample to identify general trends.

In Cheng's study, he was trying to better understand teacher perceptions of the CCSS, but also wanted to gain understanding of the participants overall morale and understanding of the standards. There were several questions I believed were not relevant to the research questions, so I conducted an exploratory factor analysis using principal components method. Results of the exploratory factor analysis with four factors are depicted in table 5.

Results indicated there were five factors with Eigen values greater than one; however, there were two questions that loaded equally on two factors each. For this reason, I re-ran the exploratory factor analysis in SPSS set with four factors forced to extract. Although double-loading was still an issue with the four factor construct, the same survey questions that appeared to be measuring something different from the rest of the questions were consistent. The results revealed the six questions that loaded to factors three and four could potentially be measuring something other than the participants' perceptions of the CCSS, and I decided to eliminate and not include in the sum score. I determined that the responses to these questions might possibly not be reflective of the participants' perceptions of the CCSS but rather knowledge and preparedness for the

standards or outcomes of the standards. These questions included (a) I have a voice in creating and responding to new educational policy legislation, such as the Common Core Standards, (b) I look unfavorably upon the amount of time students currently spend on standardized tests, (c) transitioning to the Common Core has required new or substantially revised curriculum materials and lesson plans, (d) the Common Core has little impact on my everyday practice, (e) I am well-informed regarding what the Common Core Standards are, f.) I am sufficiently prepared through professional development to teach the Common Core Standards.

Table 5

Summary of Exploratory Factor Analysis

Item	Factor 1	Factor 2	Factor 3	Factor 4
The Common Core has little impact on my everyday practice	.008	.184	-.058	**.804**
The Common Core is helping to raise student achievement	**.781**	-.244	.091	.026
The Common Core is a more positive step in the right direction than a negative one	**.735**	-..343	-.050	.108
The Common Core is more effective than previous standards at preparing students to be college-career ready upon high school graduation	**.807**	-.102	.170	-.029
The work that I have put into preparing and transitioning to the Common Core has been worthwhile	**.728**	-.304	-.117	-.102
I am well-informed regarding what the Common Core Standards are	.136	.092	**.726**	-.196
I am sufficiently prepared through professional development to teach the Common Core Standards	.034	-.122	**.804**	-.039
The Common Core is helping me to become a more effective teacher	**.764**	-.245	.142	-.005
The Common Core makes me feel more like a professional	**.594**	-.152	.209	.182

Table continued on next page

Item	Factor 1	Factor 2	Factor 3	Factor 4
Especially with the emergence of the Common Core, I feel that I am spending more effort to comply with mandates rather than to teach students to the best of my ability	-.352	**.722**	-.109	-.104
I would encourage others to enter the teaching profession at the time	.093	**-.628**	.244	-.039
I am concerned that the Common Core restricts my creativity and the types of instructional strategies that I use	-.394	**.665**	.068	-.066
I am concerned that under the Common Core, I spend too much time preparing students for testing	-.228	**.770**	-.007	-.126
I would like more decision making power over the curriculum than what the Common Core permits	**-.493**	**.496**	-.035	-.075
Transitioning to the Common Core has required new or substantially revised curriculum materials and lesson plans	.011	.338	.035	**-.675**
I look unfavorably upon the amount of time students currently spend on taking standardized test	-.038	**.352**	.195	**-.364**
The Common Core enables me to spend more time teaching higher level thinking skills	**.626**	-.021	.134	.138
The Common Core is a welcome change	**.823**	-.298	.021	.085
The Common Core, as a single common set of curricular standards - helps to make collaboration and sharing of instructional materials more efficient	**.447**	-.038	.069	-.082
The Common Core Standards are easier to understand than previous standards	**.353**	-.151	**.358**	.219
I have a voice in creating and responding to new education-policy legislation, such as the Common Core Standards	.262	-.241	**.364**	.346

Note: Factors loading over .35 appear in bold.

I used the remaining 15 questions to calculate a sum score for each participant, which then served as a value to measure the variable of perceptions of the CCSS. Table 6 lists all the items used to calculate the sum score for participants' perceptions of the CCSS.

Table 6

Items Used to Measure Perceptions of the Common Core State Standards

Survey Questions
I believe that the Common Core is helping to raise student achievement.
The implementation of the Common Core is a more positive step in the right direction than a negative step in education reform.
I believe that the Common Core is more effective than previous standards at preparing students to be college-career ready upon high school graduation.
The work that I have put in to incorporate the Common Core Standards has been worthwhile.
The Common Core is helping me to become a more effective teacher.
The Common Core makes me feel more like a professional.
Especially with the emergence of the Common Core, I feel that I am spending more effort to comply with mandates rather than to teach students to the best of my ability.
I would encourage others to enter the teaching profession at the time.
I am concerned that the Common Core restricts my creativity and the types of instructional strategies that I use.
I am concerned that under the Common Core, I spend too much time preparing students for testing.
I would like more decision making power over the curriculum than what the Common Core permits.
The Common Core enables me to spend more time teaching higher level thinking skills.
The Common Core is a welcome change.
The Common Core, as a single common set of curricular standards - helps to make collaboration and sharing of instructional materials more efficient.
The Common Core Standards are easier to understand than previous standards.

Prior to calculating the sum score for CCSS perceptions, I needed to reverse code four questions to ensure negatively keyed items were recorded as positively keyed items. These questions included (a) especially with the emergence of the Common Core, I feel that I am spending more effort to comply with mandates rather than to teach students to the best of my ability, (b) I am concerned that the Common Core restricts my creativity and the types of instructional practices that I use, (c) I am concerned that under the Common Core, I spend too much time preparing students for testing, (d) I would like more decision-making power over the curriculum than what the Common Core permits.

I then calculated the sum score for perceptions of the CCSS for each participant. I examined the spread of the data to determine distribution of the values as well as to

determine if any outliers existed. First, I calculated the z-scores for the sum score of perceptions of the CCSS. The absolute value of all z-score values were less than 3.29, indicating no outliers for this variable. The spread of data representing perceptions of the CCSS revealed responses were normally distributed with skewness of .389 (SE = .184) and kurtosis of -.357 (SE = .366). This data indicates a slight skew to the left indicating participants generally responded less favorably about the Common Core. If a participant took a neutral stance on all questions, he or she would acquire a sum score of 45. Of all the respondents, 74.7% had a sum score of 45 or less. This indicates that the participants generally felt neutral or less than favorable about the CCSS. The response rates for items related to perceptions of the CCSS were adequate to provide an analysis. For each item, either all participants responded to the question, or at most two participants failed to respond. The descriptive statistics for the perceptions of the CCSS is represented in table 7.

Table 7

Descriptive statistics for sum scores of Common Core perceptions

Descriptor	Value
Mean	37.66
Median	36.0
Mode	34.0
Standard deviation	11.27
Variance	126.97
Percentiles	
25	29.0
50	36.0
75	46.0

Note: The minimum possible sum score was 0 and the maximum possible score was 75

In the following section, I describe the process for determining a value to measure the remaining two variables, value and use of formative-assessment practices. I also describe the descriptive statistics for these two variables.

Formative Assessment Value and Use

There were four formative-assessment practices that participants rated their value and use of; involving students in their learning, modeling quality work, providing feedback, and self-assessments. For each of these formative-assessment practices, there were numerous questions to gauge value and use. The frequency of responses were investigated to determine if any questions were unclear and might need to be removed from further analysis. Based on the responses of the participants, I determined several questions should be eliminated prior to further analysis due to greater than 5% of the respondents indicating unfamiliarity with an instructional practice or skipping the question altogether. These questions included use of providing formats and structures for writing or recording findings (5.2%), value and use of giving rewards only when achievement is satisfactory for that student with specific comments referring to student's success (Value = 5.7%, Use = 9.8%), use of making a conscious decision to avoid saying a student is wrong (7.5%), use of negotiating a way to improve some piece of work (10.4%). I also excluded the value of negotiating a way to improve some piece work even though only 4% did not know or left the question incomplete. The reason for this exclusion was that since the percentage of respondents was so high for not being familiar with this strategy (10.4%) some respondents were inconsistent in response to value and use of this strategy.

Another reason for excluding these questions is that to simplify further analysis, I calculated an average of the sum scores for each participant for value and use of each of the four formative-assessment practices. By eliminating these questions, a value of zero would not greatly impact a large number of participants' sum scores. For questions that I did not exclude, responses with values of zero remained and were used when calculating the sum scores. Table 8 lists the survey items used to calculate a numerical value to measure how participants valued the formative assessment practices of involving students in their learning, modeling quality work, providing feedback, and providing opportunities for peer and self-assessment. I used the same survey items when calculating participant's use of these four formative assessment practices, except the items noted with a star within table 8.

Table 8

Items Used to Measure Participant's Use and Value of Formative-Assessment Practices

Survey Questions (Formative assessment practice in italics)
Involving students in their learning
Telling students what you hope they will learn and (sometimes) why they are learning it.
Inviting and building on students' contributions.
Setting up tasks designed to enable students to work independently.
Getting students to collaborate in groups on joint assignments.
Spurring students on by making encouraging but specific, focused comments.
Getting one student to help another.
Modeling Quality Work
Choosing and showing students examples of other students' work for learning purposes.
Getting a student to show you how s/he has attempted something so you can diagnose an error.
Getting a student to demonstrate to the class how s/he did something.
Getting a student to suggest ways something can be improved.
Providing formats and structures for writing or recording findings. *
Showing students a range of other students' work to make a judgement about performance.
Showing students a range of other students' work to make a judgement about progress.
Showing students a range of other students' work to model or exemplify criteria.

Table continued on the next page

Survey Questions (Formative assessment practice in italics)
Giving Feedback
Using probing questions to diagnose the extent of the students' learning.
Analyzing completed work to figure why a student has or has not achieved.
Expressing approval when achievement is satisfactory.
Making a conscious decision to avoid saying a student is wrong. *
Telling students what they have achieved with specific references to their learning.
Telling students what they have not achieved with specific references to their learning.
Describing why an answer is correct.
Specifying a better/different way of doing something.
Writing an evaluative note on student's work for the student.
Self and Peer Assessment
Getting students to suggest ways they can improve.
Negotiating a way to improve some piece of work.
Providing time for students to reflect and talk about their learning.
Getting students to review their own work and record their progress.
Providing opportunities for students to assess their own and one another's work and give feedback to one another.

Note: *These questions were only used when calculating value of practice, not use.

Next, I calculated scores for each participant for their value and use of each of the four formative-assessment practices. Since there was not an equal amount of questions for each formative assessment practice for value and use, I calculated an average, so all the scores remained on the same scale. I determined these eight average sum score measures were reliable with $\alpha = .833$.

I then created Q-Q plots to visualize if the data was normally distributed. For each plot, the majority of the points fell on the line with only one or two points above or below. Fowlkes (1987) indicated this point pattern might indicate a possible outlier in the data. To further explore whether the average scores for the various formative-assessment practices had any outliers, I viewed the histograms and distribution of the values. None of these models revealed any data points drastically different from the rest. Lastly, all z-scores for each of these measures produced values less than 3.29. Based on the Q-Q plots, the mean and median values being similar; which can be seen in tables 9 and 10,

and no indication of any outliers, I determined the data to be normally distributed, with six of the eight measures having a slight skew to the right. Skew statistics are also depicted in tables 9 and 10.

The data distributions revealed the following descriptive statistics about how the participants both value and use the four formative-assessment practices. Table 9 provides a summary of the descriptive statistics about the value participants place on the four formative-assessment practices. Table 10 provides a summary of the descriptive statistics about the degree of use of the formative-assessment practices by the participants.

Table 9

Descriptive Statistics – Participant's Value of Formative Assessment Practices

Formative Assessment Practice	Mean	Median	Standard Deviation	Variance	Percentiles			Skewness	
					25	50	75	Statistic	Std. Error
Involving students in their learning (n=174)	4.312	4.333	.470	.221	4.000	4.333	4.667	-.888	.184
Modeling quality work (n=174)	3.633	3.625	.516	.267	3.250	3.625	4.000	.079	.184
Providing feedback (n=171)	3.988	4.000	.406	.165	3.778	4.000	4.222	-.224	.186
Opportunities for peer and self-assessment (n=171)	4.047	4.000	.627	.393	3.750	4.000	4.500	-.365	.186

Note: Minimum possible value is zero and maximum possible value is 5

Table 10

Descriptive Statistics – Participant's Use of Formative Assessment Practices

Formative Assessment Practice	Mean	Median	Standard Deviation	Variance	Percentiles			Skewness	
					25	50	75	Statistic	Std. Error
Involving students in their learning (n=174)	4.012	4.000	.483	.233	3.667	4.000	4.333	-.196	.184
Modeling quality work (n=173)	2.980	2.857	.658	.433	2.429	2.857	3.429	.314	.185
Providing feedback (n=172)	3.674	3.625	.512	.262	3.375	3.625	4.094	-.351	.185
Opportunities for peer and self-assessment (n=170)	2.891	2.750	.863	.745	2.250	2.750	3.500	-.004	.186

Note: Minimum possible value is zero and maximum possible value is 5

Relationships Between Variables

The previous sections provided insight into how values were calculated to represent each variable and also how participants responded to questions pertaining to each variable. Within this section, I explored whether a relationship existed between these variables, addressing the remaining research questions. To determine if a relationship exists between the participants' perceptions of the CCSS, and their value and use of the four formative-assessment practices, I conducted multiple correlation tests. The following section includes these results and findings as well as an analysis.

I conducted a total of eight correlation tests. There are several statistical assumptions that must be met in order to run correlation tests. These assumptions include that the variables are at the interval or ratio level, the variables are approximately normally distributed, and there is an absence of any significant outliers (Field, 2009). All

of the variables are at the interval level because they have been assigned a numerical value and can be measured along a continuum. The variables are approximately normally distributed. Evidence for this can be seen in the spread of the each data set and the skew statistics included in tables 7, 9, and 10. Distributions and z-scores also revealed the absence of outliers for each variable.

Since the assumptions for conducting a Pearson's correlation were met, two tests were run for each of the four formative-assessment practices; one for participant value and one for use of each practice. In all eight tests, value or use was correlated to participant perceptions of the CCSS. As described in the previous sections, I calculated sum scores for each participant to measure their perceptions of the CCSS. For value and use of each formative-assessment practice, I calculated an average score of the participants' responses. I used these values when running the correlation tests.

The results of the Pearson Correlation tests provided information to help answer research questions two and three. For H_2, the test revealed only one of the four relationships relating perceptions of the CCSS and value of formative assessment was statistically significant. The relationship between participants' perceptions of the CCSS and the value they place on involving students in their learning was statistically significant, $r\ (174) = .149$, $p \leq .05$ allowing for H_{20} to be rejected. These variables have a positive relationship indicating as participants' perceptions of the Common Core increases, their value they place on involving students in their learning increases as well. However, despite this correlation being statistically significant, the strength of the association was weak ($r < .2$). The Pearson correlation tests revealed that the participants'

perceptions of the CCSS had no relationship to how participants valued modeling quality work, providing feedback or providing opportunities for self and peer-assessments ($p > 0.05$). The results of the correlational analysis between participants' perceptions of the CCSS and their value of formative-assessment practices are presented in Table 11. It can be concluded for H_2 that although there is a weak, positive relationship between participants' perceptions of the CCSS and the value they place on involving students in their learning, there is no relationship in how participants perceive the CCSS and their value of the other formative assessment practices.

Table 11

Pearson Correlation Tests – CCSS Perceptions and Value of Formative Assessment

Variable	1
1.Common Core perceptions	---
2.Value of involving students in their learning	.149*
3.Value of modeling quality work	.143
4.Value of providing feedback	.135
5.Value of providing opportunities for peer and self-assessment	.069

Note: * Correlation is significant at the 0.05 level

For H_3, all four of the correlation tests examining perceptions of the CCSS and participants use of the four formative-assessment practices were not statistically significant preventing $H_{3o}$from being rejected ($p > 0.05$). These tests reveal that there is no relationship between how the participants' perceive the CCSS and their use of the four

formative-assessment practices. The results of these correlational tests can be viewed in Table 12. It can be concluded that mathematics teachers' use of various instructional strategies do not appear to be related to their perception of the CCSS.

Table 12

Pearson Correlation Tests – CCSS Perceptions and Use of Formative Assessment

Variable	1
1.Common Core perceptions	---
2.Use of involving students in their learning	.048
3.Use of modeling quality work	.033
4.Use of providing feedback	.015
5.Use of providing opportunities for peer and self-assessment	.060

Lastly, I collected demographic information about the participants, including gender, years of teaching experience, and education level. I conducted partial correlation tests while controlling for each of these demographic variables. Because $p>.05$ for each partial correlation test, I determined none of these demographic variables produced any different relationships between the variables. For this reason, I did not include any further analysis.

Summary

The purpose of this study was to determine how math teachers' perceive the Common Core State Standards, how they value and use four formative-assessment

practices, and the relationship between these variables. I determined participants generally did not perceive the CCSS positively, confirming H_{1a}. The results also suggested there was a significant, but weak relationship between perceptions of the CCSS and the value participants placed on involving students in their learning. For this reason, I rejected H_{2o}. Results also revealed there was no significant relationship between how participants valued and used the other formative-assessment practices and perceived the CCSS allowing for acceptance of H_{30}. All teachers self-reported their use of each practice. In Chapter 5, I explain the interpretation of the findings and describe the limitations, recommendations, implications, and conclusion.

Chapter 5: Discussion, Conclusions, and Recommendations

The adoption of the CCSS in mathematics has required teachers to shift the ways in which they provide instruction. A focus on rigor, problem solving, and conceptual understanding requires a mind shift for many educators. Although previous studies have explored how teachers perceive the CCSS and numerous studies exist around the instructional practice of formative assessment, no study had examined the relationship between these variables. The purpose of this quantitative study was to explore how math teachers in Pennsylvania perceived the new state standards and how this related to their use and value of four formative-assessment practices: involving students in their learning, modeling quality work, providing feedback, and using peer and self-assessments.

The theoretical framework of this study was guided by the work of Dewey (1916,1938), Bloom (1968), and Piaget (1976), who each suggested that students should be active learners and teachers need to provide meaningful experiences for each student based on their needs. These theories supported further exploration into the emphasis teachers place on the value and use of formative-assessment practices and how this related to their perception of the CCSS.

The results of the study revealed that, in general, teachers were not positive in their perceptions of the CCSS. For this reason, I rejected the null hypothesis for RQ1. In addition, as teachers' perceptions of the CCSS increased, so did the value they place on involving students in their learning. This statistically significant result led me to reject the null hypothesis for RQ2. Despite participants appearing to value this formative-assessment practice, the amount of use of all these practices was not statistically

significant in relationship to their perceptions of the CCSS, resulting in a failure to reject the null hypothesis for RQ3.

This chapter includes a summary and interpretation of the key findings as well as the limitations of the study. Additionally, I provide some recommendations for future research as related to formative assessment and the CCSS and provide potential implications for social change based on the results of the study.

Interpretation of Findings

In the following sections, I will interpret the results of the study to determine if they align with previous research and the theoretical frameworks that guided the study. I will describe findings that confirm or dispute previous literature as well as how this study has potentially extended previous knowledge.

Alignment to the Literature

The literature review in Chapter 2 focused on research associated with the CCSS as well as formative assessment practices. The literature suggested that the majority of teachers were familiar with the CCSS (Choppin, Davis, Drake, & McDuffy, 2013), which is in line with the results of this study. Teachers have been implementing these standards for approximately 4 years now in Pennsylvania, so it seems reasonable that with each year, teachers develop a greater comfort level with the expectations of the new standards. Previous literature determined teachers perceived the new standards to be more rigorous than the old standards (Center on Education Policy, 2014); however, the results of this study suggested that teachers perceive the new standards to be less effective in helping students to be college and career ready. A large emphasis within the literature was the

role that professional development played in influencing perceptions of the CCSS. Both Davis et al. (2014) and Nadelson et al. (2014) determined that teachers that partook in more professional development about the CCSS had increased knowledge and perceptions of the standards. In this study, only 60.3% of participants felt prepared through professional development to implement the standards. After so many years of implementation, it would seem this percentage should be higher, but could also explain why so few felt the standards were a step in the right direction.

Once teachers become familiar with the standards and have received training, proper implementation of them becomes the next challenge. Previous literature suggested that teachers' ability to implement the standards properly determines a great deal of whether this educational reform is successful (Hull et al., 2012; Phillips & Wong; 2012; Rothman, 2011). Proper implementation should include using instructional practices that promote frequent use of problem solving and students engaging in reasoning and thinking tasks (Hull et al., 2013). In this study, only 27.6% of participants felt that the standards allowed them to incorporate higher-order thinking. These results are interesting in that the literature suggests that the CCSS should promote higher order thinking, but participants are responding that the standards do not support this. Similarly, the results indicated that almost 82% of teachers felt their creativity was restricted because of the standards. These results suggest that training could be a factor in why the participants have the perceptions they do of the standards.

Part of successful implementation is having access to resources that support and reflect the philosophy of the standards (Chingo & Whitehurst, 2012; Leifer & Udall,

2016). Previous research suggested only 38% of teachers believed they had resources that aligned with the new standards (Walters et al., 2014). In this study, 90.8% of teachers reported needing new or substantially revised materials and lessons. The scope of this study did not examine whether teachers believe they have all these resources at this point in time or if these resources have been acquired since implementation. Regardless, results within this study are similar to previous research in that teachers indicated needing new resources for proper implementation of the standards. It is still unknown as to where teachers in Pennsylvania are at in this process. Overall, the results of the study were similar to the literature in some aspects of teachers' perceptions of the CCSS, but different in others.

The literature suggested there is a strong link between proper implementation of the CCSS and the instructional practices that teacher implement to support the philosophy of the standards (Hull et al., 2013). Formative assessment is an instructional practice that can support the success of the CCSS (Marzano, 2013; Phillips & Wong, 2012). The literature suggested that teachers need to implement formative assessment practices properly to see the benefits such as student achievement and student motivation (Gijbels & Dochy, 2006; Peterson & Siadat, 2009; Yin et al., 2008; Wylie & Lyon, 2015). Because this study relied solely on participants' self-reporting of their value and use of formative assessment, it is not possible to determine if implementation of these instructional strategies is being done correctly. However, the degree to which participants value and use the formative assessment practices provides some insight.

There were four formative assessment practices incorporated in this study including involving students in their learning, modeling quality work, providing feedback, and providing opportunities for peer and self-assessment. The literature indicated involving students in the learning process could help to enhance student learning (Fluckiger et al., 2010). Within this study, participants valued and used this practice more than the other three formative assessment practices, and had a statistically significant relationship to participants' perceptions of the CCSS. The literature suggested teachers should provide clear objectives and provide learning related to specific goals so that students become more accountable for their learning (Blanchard, 2008; Wylie & Lyon, 2015). The results of this study indicate participants feel most comfortable in this area.

The formative assessment practice that teachers in the study used the least was providing opportunities for peer and self-assessments. The results also suggested participants valued this practice more than they implemented them. Similarly, the literature suggested that teachers struggle with implementing these practices because they believe students struggle with being objective (Volante & Beckett, 2011) and students have reported being anxious about reviewing their classmates' work (Cartney, 2010). Providing students opportunities for peer and self-assessments were not statistically significant in their relationship to how participants perceived the CCSS either suggesting, teachers might need further training on how to implement this practice. Because no previous research had related teachers' value and use of formative assessment practices to their perceptions of the CCSS, this study has helped to enhance knowledge in this area.

Findings Related to Theoretical Framework

This study was guided by the work of Dewey (1916), Bloom (1986), and Piaget (1976), who had constructivist views of education and learning. Dewey (1916) established that students must actively participate in their learning and take ownership of it. This was evident in participants' value and use of involving students in their learning. As stated earlier, of the four formative assessment practices, participants responded more favorably to valuing and using this practice more than others did. Similarly, Bloom's (1986) theory of mastery of learning and Piaget's (1976) use of clinical interviews encouraged teachers to have specific knowledge about what each student can do to be able to make recommendations on future goals. Their ideas closely align to proving feedback to student.

Within the study, I asked participants to rate how they value and use probing questions to diagnose learning, analyzing student work to determine why a student has not achieved, and telling students what they have achieved with specific reference to their learning. Each of these items, along with a few others, comprised participants' value and view of the formative assessment of providing feedback. In the study, participants utilized this practice more than modeling quality work and providing opportunities for peer and self-assessment. However, this practice had no relationship to how participants perceived the CCSS. It is evident that the work of these theorists is still prevalent in education today and can continue to guide future learning in the field of education.

Limitations of the Study

As stated in Chapter 1, there were several limitations within this study. Participants within this study were limited to teachers identified in the *Professional Personal Individual Staff Data Report* (Pennsylvania Department of Education, 2016). The report was a year old at the time of the study, and it is possible that there were additional teachers not represented within the report. I was also limited to inviting teachers in which their schools listed emailed addresses on their websites. This method for accessing contact information prevented me from inviting all eligible participants from the population.

Another limitation of the study was that the proposal was approved by Walden's Institutional Review Board at the end of a school year. I decided to wait until August to send invitations to participate, rather than sending invitations at the start of the summer. It is unknown as to whether some teachers did not receive the email until they started back to school, some which may have been in September. This timeframe may have excluded some teachers from participating.

This was a quantitative study in which participants responded to Likert scale questions. Limiting the data to numerical responses could have provided a narrower scope of perceptions; however, other researchers had used all Likert scale questions in previous studies and deemed them valid and reliable. This limitation could provide opportunities for future research with a qualitative or mixed method study. Also, to determine a value to measure each of the variables, sum scores for perceptions of the CCSS and the average of sum scores for value and use of the four formative assessment

practices were used. By combining the Likert scale responses into a single value for each variable, I was limited to some of the analysis conducted.

Lastly, researcher bias is always a limitation within any study. The methodology described in Chapter 3 helped to diminish this prejudice, including procedures for contacting potential participants, guidelines for what information was shared with participants, and also a reliance on the literature to guide the purpose of the study. Each of these limitations influences the generalizability of the results.

Recommendations

The strengths and limitations of this study provide insight into ways future studies might advance knowledge in the area of instructional practices to support the effective implementation of CCSS. Based on the strengths of this study, it was evident a relationship existed between teachers' perceptions of the CCSS and also how they valued involving students in their learning. The stronger the view that teachers had of the CCSS the more positive the relationship with the value they placed on this formative-assessment practice. Future research could closer examine this relationship to determine if other variables were influencing teacher value of these practices or perceptions of the CCSS, such as teacher preparation. This study did not examine the amount or level of training that teachers received in regards to the new standards. Future research could investigate further to see if teacher training influences the relationship between the variables examined within this study.

The results of this study also revealed that the value that participants placed on the four formative-assessment practices was often higher than how they rated their use of

these practices. Although this study did not include a research question around the relationship between value and use, future research could explore this further. It would be helpful to know what variables are preventing teachers from using the instructional practices that they have stated that they value.

Future studies should also examine how administrators perceive the CCSS and the value they place on various formative-assessment practices. Although participants suggested they feel knowledgeable about the new standards many less felt prepared to teach these standards. Participants generally were negative in their perceptions of the new standards, but I believe teachers are still not completely informed, as self-reported by the participants. Over 81% of participants stated that the new standards restrict their creativity and the types of instructional strategies they use within the classrooms. The standards do not tell teachers how to teach, but rather what to teach. This misconception continues to persist, and teachers need more support in understanding how the standards should impact or influence instruction. The understanding level of teachers may be influenced by the level of understanding of their building administrators. Studying a big picture view of a school system might provide more insight into what supports teachers need in implementing the CCSS.

Because this study was solely quantitative, participants did not have the opportunity to expand on their numerical ratings. Future studies could continue to explore the relationship between the variables tested through use of a qualitative or mixed method approach. A study of this nature might provide more understanding of why teachers

generally perceive the CCSS negatively, and what influences their use of various formative-assessment practices.

Implications

This study helped to contribute to Walden University's mission to provide social change by better understanding the relationship between how mathematics teachers perceived the Common Core State Standards and also how they value and use various formative-assessment practices. It is evident through the results of this study that a large majority of the participants perceive the CCSS negatively. There has been little evidence to indicate that officials in Pennsylvania will be changing the standards for mathematics in the near future. Porter et al. (2015) suggested teachers must believe in the foundation of basic assertions related to the CCSS, because teachers and administrators play a vital role in determining the success of school reform. If teachers do not believe in the CCSS, past research has indicated that this reform will likely fail. The results of this study indicated that a large number of mathematics teachers within the state of Pennsylvania do not agree with the direction the new state standards are taking them. However, results also indicated teachers still have some misconceptions about what the CCSS mandates and what teachers still have control over in the classrooms. Teachers and administrators need additional supports and training in this area. Within this training, teachers should learn how they can still be creative within the parameters of the new standards, and understand that the standards only dictate their curriculum, not the instructional component.

Results revealed that there was a significant positive relationship between how teachers viewed the CCSS and the value they placed on involving students in their learning. The results also suggested that teachers value these practices more than they actually implement them within their classrooms. Previous research, as described in Chapter 2, emphasized that formative assessment is a powerful instructional tool, but only when implemented correctly. Numerous researchers suggested when teachers have not received proper training then they do not implement formative assessment correctly. It is not possible to make an accurate determination as to why teachers value these instructional strategies more than they use them, because I did not collect data on the training that participants received on formative-assessment practices. These results suggest math teachers need more training so they can better understand how to utilize these formative-assessment practices within their own classrooms. Teacher training could lead to greater teacher use, which could potentially lead to increased student achievement. Supporting teachers to better understand instructional strategies that promotes thinking skills needed by students, can only help to ensure teachers and students are better prepared for the expectations of the CCSS.

Conclusion

Mathematics education in the United States was in need of a change in which students focused on conceptual understanding of topics rather than rote memorization of formulas and rules. The adoption of the CCSS by many states was intended to encourage this change as well as bring uniformity to what students were learning in schools. After adoption of the CCSS, initial research indicated teachers were feeling unprepared for the

standards and early assessment results revealed student performance was not growing as expected. Prior to the CCSS, research surrounding formative-assessment practices was abundant. Studies revealed the many benefits of this instructional practice including academic achievement; however, improper implementation was often a factor in student success.

This research aimed at determining how participants perceive the standards, how they value and use various formative-assessment practices, and if a relationship existed between formative assessment use and value and how math teachers perceived the CCSS. Results revealed public school mathematics teachers in grades 7-9 in Pennsylvania overwhelmingly had negative perceptions about the new standards, although some responses indicated that teacher understanding of the CCSS might still be limited. Results also suggested there is little to no relationship between how teachers perceive the CCSS and how they value and use various formative-assessment practices, except for how participants valued involving students in their learning, which had a positive relationship. Participants typically valued the formative-assessment practices more than they use the instructional practices, suggesting a need for teacher training. Both teachers and administrators need continued support in understanding the Common Core as well as what instructional strategies might benefit conceptual understanding in mathematics. If students within the United States are to improve in the area of mathematics, teachers need to feel positively about this educational reform and have training to know what instructional strategies might support this effort.

References

Abbott, S. E. (n.d.) *The glossary of education reform.* Retrieved from http://edglossary.org/high-stakes-testing/

Achieve (2010). *Comparing the common core state standards in mathematics and the NAEP framework.* Retrieved from http://www.achieve.org/files/CCSSMathandNAEP.pdf

American Recovery and Reinvestment Act of 2009. *Helping middle class families.* Retrieved from https://www.gpo.gov/fdsys/pkg/PLAW-111publ5/html/PLAW-111publ5.htm

Bakula, N. (2010). The benefits of formative assessments for teaching and learning. *Science Scope, 34*(1), 37–43. Retrieved from http://link.galegroup.com.ezp.waldenulibrary.org/apps/doc/A235194569/EAIM?u=minn4020&sid=EAIM&xid=29607af8

Ball, D. L., & Forzani, F. M. (2011). Building a common core for learning to teach and connecting professional learning to practice. *American Educator, 35*(2), 17–21. Retrieved from https://eds-a-ebscohost-com.ezp.waldenulibrary.org/eds/pdfviewer/pdfviewer?vid=1&sid=28d47f80-c0c3-413e-8e85-2f8accaebc92%40sessionmgr4006

Bandura, A. (1994). Self-efficacy. In V. S. Ramachaudran (Ed.), *Encyclopedia of human behavior* (Vol. 4, pp. 71–81). New York, NY: Academic Press.

Bass, B., & Avolio, B. (1994). *Improving organizational effectiveness through transformational leadership.* Thousand Oaks, CA: Sage.

Bell, B., & Cowie, B. (2001). The characteristics of formative assessment in science education. *Science Education, 85*(5), 536–553. doi:10.1002/sce.1022

Ben-Hur, M. (2006). *Concept-rich mathematics instruction: Building a strong foundation for reasoning and problem solving.* Alexandria, VA: ASCD.

Black, P. (2003). The nature and value of formative assessment for learning. *Improving Schools, 6*(7), 7–22. doi:10.1177/136548020300600304

Black, P., Harrison, C., Lee, C., Marshall, B., & Wiliam, D. (2004). Working inside the black box: Assessment for learning in the classroom. *Phi Delta Kappan, 86*(1), 8–21. doi:10.1177/003172170408600105

Black, P., & Wiliam, D. (1998). Assessment and classroom learning. *Assessment in Education, 5*(1), 7–74. doi:10.1080/0969595980050102

Black, P., & Wiliam, D. (2003). In praise of educational research: Formative assessment. *British Educational Research Journal, 29*(5), 623–637. doi:10.1080/0141192032000133721

Black, P., & Wiliam, D. (2009). Developing the theory of formative assessment. *Educational Assessment Evaluation and Accountability, 21*(1), 5–31. doi: 10.1007/s11092-008-9068-5

Black, P., & Wiliam, D. (2010). Inside the black box: Raising standards through classroom assessment. *Phi Delta Kappan, 92*(1), 81–90. doi:10.1177/003172171009200119

Blanchard, J. (2008). Learning awareness: Constructing formative assessment in the classroom, in the school and across schools. *Curriculum Journal, 19*(3), 137–150.

doi:10.1080/09585170802357454

Bloom, B. (1968). Learning for mastery. *Center for the Study of Evaluation of Instructional Programs, 1*(2), 1–12. Retrieved from http://programs.honolulu.hawaii.edu/intranet/sites/programs.honolulu.hawaii.edu.intranet/files/upstf-student-success-bloom-1968.pdf

Bloom, B. S., Hasting, J. T., & Madaus, G. F. (1971). *Handbook on formative and summative evaluation of student learning.* New York, NY: McGraw-Hill.

Bostic, J., & Matney, G. T. (2013). Overcoming a common storm: Designing professional development for teachers implementing the Common Core. *Ohio Journal of School Mathematics, 67,* 12–19. Retrieved from http://scholarworks.bgsu.edulteach_learn_bub/1

Brookhart, S. M., Moss, C. M., & Long, B. A. (2010). Teacher inquiry into formative assessment practices in remedial reading classrooms. *Assessment in Education: Principles, Policy & Practice, 17*(1), 41–58. doi:10.1080/09695940903565545

Brooks, M. G., & Brooks, J. G. (1999). The courage to be constructivist. *Educational Leadership, 57*(3), 18–24. Retrieved from http://www.ascd.org/publications/educational-leadership/nov99/vol57/num03/The-Courage-to-Be-Constructivist.aspx

Brown, G. T., & Hirschfeld, G. H. (2008). Students' conceptions of assessment: Links to outcomes. *Assessment in Education: Principles, Policy & Practice, 15*(1), 3–17. doi:10.1080/09695940701876003

Butler, R. (1988). Enhancing and undermining intrinsic motivation: The effects of task-

involving and ego-involving evaluation on interest and performance. *British Journal of Educational Psychology, 58*(1), 1–14. doi:10.1111/j.2044-8279.1988.tb00874.x

Bybee, R. W. (1993). *Reforming science education. Social perspectives & personal reflections.* New York, NY: Teachers College Prep.

Carlucci, L., & Case, J. (2013). On the necessity of U-shaped learning. *Topics in Cognitive Science, 5*(1), 56–88. doi:10.1111/tops.12002

Carmichael, S. B., Martino, G., Porter-Magee, K., & Wilson, W. S. (2010). *The state of state standards and the Common Core in 2010.* Retrieved from https://eric.ed.gov/contentdelivery/servlet/ERICServlet?accno=ED516607

Carmichael, S. B., Wilson, W. S., Finn, C. E., Winkler, A. M., & Palmieri, S. (2009). *Stars by which to navigate? Scanning national and international education standards in 2009: An interim report on common core, NAEP, TIMSS and PISA.* Retrieved from http://www.math.jhu.edu/~wsw/papers/20091008_NationalStandards.pdf

Cartney, P. (2010). Exploring the use of peer assessment as a vehicle for closing the gap between feedback given and feedback used. *Assessment & Evaluation in Higher Education, 35*(5), 551–564. doi:10.108/02602931003632381

Cassady, J. C., & Gridley, B. E. (2005). The effects of online formative and summative assessment on test anxiety and performance. *Journal of Technology, Learning, and Assessment, 4*(1), 1–30. Retrieved from https://ejournals.bc.edu/ojs/index.php/jtla/issue/view/187

Cauley, K. M., & McMillan, J. H. (2010). Formative assessment techniques to support student motivation and achievement. *Clearing House: A Journal of Educational Strategies, Issues, and Ideas, 83*(1), 1–6. doi:10.1080/00098650903267784

Chappuis, S., & Stiggins, R. (2002). Classroom assessment for learning. *Educational Leadership, 60*(1), 40–43. Retrieved from http://www.ascd.org/publications/educational-leadership/sept02/vol60/num01/Classroom-Assessment-for-Learning.aspx

Cheng, A. (2012). *Teacher perceptions of the Common Core State Standards* (Master's thesis). Retrieved from https://files.eric.ed.gov/fulltext/ED532796.pdf

Chesley, G. M., & Jordan, J. (2012). What's missing from teacher prep. Beginning teachers and their mentors voice discontent about what their teacher preparation programs left out. *Educational Leadership, 69*(8), 41–45. Retrieved from http://www.ascd.org/publications/educational-leadership/may12/vol69/num08/What's-Missing-from-Teacher-Prep.aspx

Chingos, M. M., & Whitehurst, G. J. (2012). *Choosing blindly: Instructional materials, teacher effectiveness, and the Common Core.* Retrieved from https://www.brookings.edu/research/choosing-blindly-instructional-materials-teacher-effectiveness-and-the-common-core/

Choppin, J., Davis, J., Drake, C., & McDuffie, A. R. (2013). *Middle school teachers' perceptions of the Common Core State Standards for mathematics and related assessment and teacher evaluation systems.* Retrieved from https://www.warner.rochester.edu/files/warnercenter/docs/commoncoremathreport2.pdf

Cogan, L., Schmidt, W., & Houang, R. (2013). *Implementing the Common Core State Standards for mathematics: What we know about teachers of mathematics in 41 states.* Retrieved from www.education.msu.edu/epc

Corpus, J. H., McClintic-Gilbert, M. S., & Hayenga, A. O. (2009). Within-year changes in children's intrinsic and extrinsic motivational orientations: Contextual predictors and academic outcomes. *Contemporary Educational Psychology, 34,* 154–166. doi:10.1016/j.cedpsych.2009.01.001

Council of Chief State Officers and National Governors Association. (n.d.). *Standards for mathematical practices.* Retrieved from http://www.corestandards.org/Math/Practice/

Council of Chief State Officers and National Governors Association. (2015). *Common Core State Standards initiative: Preparing America's students for college and career.* Retrieved from http://www.corestandards.org/about-the-standards/

Council of Chief State Officers and National Governors Association. (2016). *Common Core State Standards initiative: Preparing America's students for college and career.* Retrieved from http://www.corestandards.org/standards-in-your-state/

Coutinho, S. A., & Neuman, G. (2008). A model of metacognition, achievement goal orientation, learning style and self-efficacy. *Learning Environments Research, 11*(2), 131–151. doi:10.1007/s10984-008-9042-7

Creswell, J. W. (2009). *Research design: Qualitative, quantitative, and mixed methods approaches* (3rd ed.). Thousand Oaks, CA: Sage.

Cronin-Jones, L. L. (1991). Science teacher beliefs and their influence on curriculum implementation: Two case studies. *Journal of Research in Science Teaching, 28*(3), 235–250. doi:10.1002/tea.3660280305

Davis, G. E., & McGowen, M. A. (2007). Formative feedback and the mindful teaching of mathematics. *Australian Senior Mathematics Journal, 21*(1), 19–29. Retrieved from http://www.aamt.edu.au/Journals/Journals-Index/Australian-Senior-Mathematics-Journal/ASMJ-21-1-19

Davis, J. D., Choppin, J., Drake, C., & McDuffie, A. R. (2014). Factors underlying middle school mathematics teachers' perceptions about the CCSSM and the instructional environment. *Middle Grades Research Journal, 9*(3), 11–25. Retrieved from http://www.infoagepub.com/middle-grades-research-journal

Dewey, J. (1916). *Democracy and education: An introduction to the philosophy of education.* New York, NY: Free Press.

Dewey, J. (1938). *Experience and education.* New York, NY: Touchstone.

Dillman, D. A., Smyth, J. D., & Christian, L. M. (2009). *Internet, mail, and mixed-mode surveys: The tailored design method* (3rd ed.). New York, NY: John Wiley & Sons.

Duncan, A. (2009). *Remarks at the 2009 Governors Education Symposium.* Retrieved from http://www2.ed.gov/news/speeches/2009/06/06142009.html

Editorial Projects in Education Research Center. (2013). *Findings from a national survey of teacher perspectives on the Common Core.* Retrieved from http://www.edweek.org/media/epe_survey_teacher_perspctives_common_core_2013.pdf

Egan, T. M., Cobb, B., & Anastasia, M. (2009). Think time: Formative assessment empowers teachers to try new practices. *Journal of Staff Development, 30*(4), 40–45. Retrieved from http://www.nsdc.org/news/articleDetails.cfm?articleID=1945

Felton, E. (2015). *With all the tests scored, policymakers are grappling with what Common Core test results mean.* Retrieved from http://www.hechingerreport.org/with-all-the-tests-scored-policymakers-are-grappling-with-what-common-core-test-results-mean/

Field, A. (2009). *Discovering statistics using SPSS* (3rd ed.). Los Angeles, CA: Sage.

Fluckiger, J., Vigil, Y. T., Pasco, R., & Danielson, K. (2010). Formative feedback: Involving students as partners in assessment to enhance learning. *College Teaching, 58,* 136–140. doi:10.1080/87567555.2010.484031

Fowlkes, E. B. (1987). *A Folio of Distributions: A Collection of Theoretical Quantile-Quantile Plots*. New York: Marcel Dekker.

Fullan, M. (1982). *The meaning of educational change.* New York, NY: Teachers College Press.

Furtak, E. M., Ruiz-Primo, M. A., Shemwell, J. T., Ayala, C. C., Brandon, P. R., Shavelson, R. J., & Yin, Y. (2008). On the fidelity of implementing embedded formative assessments and its relation to student learning. *Applied Measurement in Education, 21,* 360–389. doi:10.1080/08957340802347852

Gainsburg, J. (2012). Why new mathematics teachers do or don't use practices emphasized in their credential program. *Journal of Mathematics Teacher Education, 15*(2), 1–21. doi:10.1007/s10857-012-9208-1

Gardner, D. (1983). *A nation at risk. The imperative for educational reform: A report to the nation and the secretary of education, United States Department of Education.* Washington, DC: National Commission on Excellence in Education. Retrieved from http://www2.ed.gov/pubs/NatAtRisk/risk.html

Gates Foundation. (2013). *Teaching and learning for college readiness: The role of standards, feedback and support.* Retrieved from http://k12education.gates foundation.org/wp-content/uploads/2015/10/LetsTalk-College-Readiness1.pdf

Gattis, K., Rosenberg, S., Neidorf, T., Zhang, J., Guile, S., & McNeely, M. (2013). *A comparison of the 2011 Grade 8 NAEP and TIMSS mathematics and science frameworks.* Retrieved from https://nces.ed.gov/nationsreportcard/subject/ about/pdf/naep_timss_framework_comparison.pdf

Gijbels, D., & Dochy, F. (2006). Students' assessment preferences and approaches to learning: Can formative assessment make a difference? *Educational Studies, 32*(4), 399–409. doi:10.1080/03055690600850354

Ginsburg, H. P. (2009). The challenge of formative assessment in mathematics education: Children's minds, teachers' minds. *Human Development, 52*(2), 109–128. doi:10. 1159/000202729

Goldman, S. R., & Pellegrino, J. W. (2015). Research on learning and instruction: Implications for curriculum, instruction, and assessment. *Behavioral and Brain Sciences, 2*(1), 33–41. doi:10.1177/2372732215601866

Guskey, T. R. (2007). Closing achievement gaps: Revisiting Benjamin S. Bloom's *Learning for Mastery. Journal of Advanced Academia, 19*(1), 8–31.

doi:10.4219/jaa-2007-704

Guskey, T. R., & Sparks, D. (2004). Linking professional development to improvements in student learning. In E. M. Guyton & J. R. Dangel (Eds.), *Research linking teacher preparation and student performance: Teacher Education Yearbook XII* (pp. 3–9). Lanham, MD: Rowman & Littlefield Education.

Hamilton, L. S., Stecher, B. M., & Yuan, K. (2008). *Standards-based reform in the United States: History, research, and future directions.* Retrieved from https://eric.ed.gov/contentdelivery/servlet/ERICServlet?accno=ED503897

Handley, K., & Williams, L. (2011). From copying to learning: Using exemplars to engage students with assessment criteria and feedback. *Assessment & Evaluation in Higher Education, 36*(1), 95–108. doi:10.1080/02602930903201669

Harris, L. (2007). Employing formative assessment in the classroom. *Improving Schools, 10*(3), 249–260. doi:10.1177/1365480207082558

Hart Research Associates. (2013). *Teachers assess implementation of the Common Core*. Retrieved from http://www.aft.org/sites/default/files/news/ppt_ccss-pollresults2013.pdf

Hendry, G. D., Bromberger, N., & Armstrong, S. (2011). Constructive guidance and feedback for learning: The usefulness of exemplars, marking sheets and different types of feedback in a first year law subject. *Assessment & Evaluation in Higher Education, 36*(1), 1–11. doi:10.1080/02602930903128904

Hendry, G. D., & Jukic, K. (2014). Learning about the quality of work that teachers expect: students' perceptions of exemplar marking versus teacher explanation.

Journal of University Teaching & Learning Practice, 11(2), 1–10. Retrieved from http://ro.uow.edu.au/jutlp/vol11/iss2/5

Heritage, M. (2007). Formative assessment: What do teachers need to know and do? *Phi Delta Kappan, 89*(2), 140–145. doi:10.1177/003172170708900210

Heritage, M., Kim, J., Vendlinski, T., & Herman, J. (2009). From evidence to action: A seamless process in formative assessment? *Educational Measurement: Issues and Practice, 28*(3), 24–31. doi:10.1111/j.1745-3992.2009.00151.x

Higgins, R., Hartley, P., & Skelton, A. (2002). The conscientious consumer: Reconsidering the role of assessment feedback in student learning. *Studies in Higher Education, 27*(1), 53–64. doi:10.1080/03075070120099368

Hull, T. H., Balka, D. S., & Miles, R. H. (2013). Mathematical rigor in the Common Core. *Principal Leadership, 14*(2), 50–55. Retrieved from http://ezp.waldenulibrary.org/login?url=https://search.ebscohost.com/login.aspx?direct=true&db=edb&AN=90639447&site=eds-live&scope=site

Hull, T. H., Miles, R. H., & Balka, D. S. (2012). The Common Core mathematics standards. Transforming practice through team leadership. Thousand Oaks, CA: Corwin.

Hull, T. H., Miles, R. H., & Balka, D. S. (2014). *Realizing rigor in the mathematics classroom.* Thousand Oaks, CA: Corwin.

Hwang, G., & Chang, H. (2011). A formative assessment-based mobile learning approach to improving the learning attitudes and achievements of students. *Computers & Education, 56,* 1023–1031. doi:10.1016/j.compedu.2010.12.002

Ibabe, I., & Jauregizar, J. (2010). Online self-assessment with feedback and metacognitive knowledge. *Higher Education, 59,* 243–258. doi:10.1007/s10734-009-9245-6

James, M., Black, P., McCormick, R., Pedder, D., & Wiliam, D. (2002). Learning how to learn in classrooms, schools, and networks: Aims, design, and analysis. *Research Papers in Education, 21*(2), 101−118. doi:10.1080/02671520600615547

Jenkins, S., & Agamba, J. J. (2013). The missing link in the CCSS initiative: Professional development for implementation. *Academy of Educational Leadership Journal, 17*(2), 69–79. Retrieved from http://eds.b.ebscohost.com.ezp.waldenulibrary.org/eds/pdfviewer/pdfviewer?sid=ea2d605e-42f3-4260-9e60-0ef387d13518%40sessionmgr104&vid=2&hid=114

Jerald, C. D. (2008). *Benchmarking for success: Ensuring U.S. students receive a world-class education.* Retrieved from http://www.corestandards.org/assets/0812BENCHMARKING.pdf

Kentucky Department of Education. (2012). *First results from unbridled learning accountability model released college/career readiness as a bright spot in data* (News Release No. 12-077). Retrieved from http://www.education.ky.gov/comm/Documents/R077data.pdf

Kober, N., & Rentner, D. S. (2011). *States' progress and challenges in implementing Common Core State Standards.* Retrieved from https://www.cep-dc.org

Koskey, K. L. K., Karabenick, S. A., Woolley, M. E., Bonney, C. R., & Denver, B. V. (2010). Cognitive validity of students' self-reports of classroom mastery goal

structure: What students are thinking and why it matters. *Contemporary Educational Psychology, 35,* 254–263. doi:10.1016/j.cedpsych.2010.05.004

Kosko, K. W., & Gao, Y. (2015). Mathematical communication in state standards before the Common Core. *Educational Policy, 29*(5), 1–28. doi:10.1177/0895904815595723

Lalley, J. P., & Gentile, J. R. (2009). Classroom assessment and grading to assure mastery. *Theory Into Practice, 48,* 28–35. doi:10.1080/00405840802577577

Leahy, S., Lyon, C., Thompson, M., & Wiliam, D. (2005). Classroom assessment: Minute by minute, day by day. *Educational Leadership, 63*(3), 19–24. Retrieved from http://www.ascd.org/publications/educational-leadership/nov05/vol63/num03/Classroom-Assessment@-Minute-by-Minute,-Day-by-Day.aspx

Lee, J. Q., McInerney, D. M., Liem, G. A., & Ortiga, Y. P. (2010). The relationship between future goals and achievement goal orientations: An intrinsic-extrinsic motivation perspective. *Contemporary Educational Psychology, 35,* 264–279. doi:10.1016/j.cedpsych.2010.04.004

Leifer, R., & Udall, D. (2014). Support the Common Core with the right instructional materials. *Phi Delta Kappan, 96*(1), 21–26. doi:10.1177%2F0031721714547857

Liebtag, E. (2013). Moving forward with Common Core State Standards implementation: Possibilities and potential problems. *Journal of Curriculum and Instruction, 7*(2), 56–70. doi:10.3776/joci.2013.v7n2p56-70

Lipnevich, A. A., McCallen, L. N., Miles, K. P., & Smith, J. K. (2014). Mind the gap!

Students' use of exemplars and detailed rubrics as formative assessment. *Instructional Science, 42,* 539–559. doi:10.1007/s11251-013-9299-9

Loveless, T. (2015*). Measuring effects of the Common Core: Part II of the 2015 Brown Center Report on American Education.* Retrieved from https://www.brookings.edu/research/measuring-effects-of-the-common-core/

Mansfield, C. F. (2010). Motivating adolescents: Goals for Australian students in secondary schools. *Australian Journal of Educational & Developmental Psychology, 10,* 44–55. Retrieved from https://www.newcastle.edu.au/__data/assets/pdf_file/0016/100294/V10_mansfield.pdf

Marzano, R. J. (2013). *The art and science of teaching the Common Core State Standards.* Retrieved from http://www.marzanocenter.com/files/Robert_Marzano_Common_Core_handout_20130604.pdf

Meyer, L. H., McClure, J., Walkey, F., Weir, K. F., & McKenzie, L. (2009). Secondary student motivation orientations and standards-based achievement outcomes. *British Journal of Educational Psychology, 79,* 273–293. doi:10.1348/000709908x354591

Miller, D., & Lavin, F. (2007). But now I feel I want to give it a try: Formative assessment, self-esteem and a sense of competence. *Curriculum Journal, 18*(1), 3–25. doi:10.1080/09585170701292109

Mills, J., Glover, C., & Stevens, V. (2006). Using assessment within course structures to drive student engagement with the learning process. *Proceedings of the 2005 13th*

International Symposium Improving Students Learning: Improving Student Learning Through Assessment, 358–367. Retrieved from https://www.open.ac.uk/fast/pdfs/Mills%20et%20al%20(2006)%20Using%20assessment.pdf

Morrell, P. D., Flick, L., & Wainwright, C. (2004). Reform teaching strategies used by student teachers. *School Science and Mathematics, 104*(5), 199–213. doi:10.1111/j/1949-8594.2004.tb18243.x

Morrone, A. S., Harkness, S. S., Ambrosio, B., & Caulfield, R. (2004). Patterns of instructional discourse that promote the perception of mastery goals in a social constructivist mathematics course. *Educational Studies in Mathematics, 56*(1), 19–38. doi:10.1023/B:EDUC.0000028401.51537.a5

Nadelson, L. S., Pluska, H., Moorcroft, S., Jeffrey, A., & Woodard, S. (2014). Educators' perceptions and knowledge of the Common Core State Standards. *Issues in Teacher Education, 22*(2), 47–66. Retrieved from https://www.itejournal.org/back-issues/fall-2014/09nadelsonetal.pdf

National Center for Education Statistics. (2006). *Documentation to the NCES Common Core of data public elementary/ secondary school locale code file: School Year 2003-04.* Retrieved from https://nces.ed.gov/ccd/pdf/sl031agen.pdf

National Council of Teachers of Mathematics. (2014). *Principles to actions: Ensuring mathematical success for all.* Reston, VA: Author.

Neesom, A. (2000). *Report on teachers' perceptions of formative assessment.* London, England: Qualifications and Curriculum Authority. Retrieved from http://www.qca.org.uk/

Nelson, L. (2014). *How Kentucky became a rare Common Core success story.* Retrieved from http://www.vox.com/2014/10/28/7082599/kentucky-common-core-college-career-ready-act

Newlyn, D. (2013). Providing exemplars in the learning environment: The case for and against. *Universal Journal of Educational Research, 1*(1), 26–32. doi:10.13189/ujer.2013.010104

New York State Department of Education. (2012). *Common Core shifts.* Retrieved from https://www.engageny.org/resource/common-core-shifts

New York State Department of Education. (2013). *Grades 9-12 mathematics curriculum map and course overviews: Algebra I course overview.* Retrieved from https://www.engageny.org/resource/grades-9-12-mathematics-curriculum-map-and-course-overviews

New York State Department of Education. (2016). NY state - school report card data. Retrieved from https://data.nysed.gov/reportcard.php?instid=800000081568&year=2016&createreport=1&regents=1&secondMATH=1

Oklahoma State Department of Education**.** (2014). *2014 **p**ermanent and **e**mergency **r**ules**:** Title 210.* Retrieved from http://sde.ok.gov/sde/sites/ok.gov.sde/files/210-15-4-3%20Proposed%20Text.pdf

Orsmond, P., Merry, S., & Callaghan, A. (2004). Implementation of a formative assessment model incorporating peer and self-assessment. *Innovations in Education and Teaching International, 41*(3), 273–290. doi:10.108/14703290410001733294

Orsmond, P., Merry, S., & Reiling, K. (2002). The use of exemplars and formative feedback when using student derived marking criteria in peer and self-assessment. *Assessment & Evaluation, 27*(4), 309–323. doi:10.1080/0260293022000001337

Pajares, M. F. (1992). Teacher beliefs and educational research: Cleaning up a messy construct. *Review of Educational Research, 62*(3), 307–332. doi:10.3102%2F00346543062003307

Patrick, H., Kaplan, A., & Ryan, A. M. (2011). Positive classroom motivational environments: Convergence between mastery goal structure and classroom social climate. *American Psychological Association, 103*(2), 367–382. doi:10.1037/a002 3311

Pennsylvania Department of Education. (2012). *2012 student achievement fast facts.* Retrieved from http://www.portal.state.pa.us/portal/server.pt/community/news_ and_media/7234/p/1237291

Pennsylvania Department of Education. (2013a). *PA Core standards leadership fact sheet.* Retrieved from http://static.pdesas.org/content/documents/PA%20Core%20 Standards% 20Fact%20Sheet%20for%20Leadership%2012.1.2013.pdf

Pennsylvania Department of Education. (2013b). *PA core standards teacher fact sheet.* Retrieved from http://static.pdesas.org/content/documents/PA%20Core%20 Standards%20Fact%20Sheet%20For%20Teachers%2012.1.2013.pdf

Pennsylvania Department of Education. (2013c). *Pennsylvania core standards timeline.* Retrieved from http://static.pdesas.org/content/documents/PA%20Core%20 Standards%20Timeline.pdf

Pennsylvania Department of Education. (2015). *PSSA and keystone results.* Retrieved from http://www.education.pa.gov/Data-and-Statistics/PSSA/Pages/default.aspx#tab-1

Pennsylvania Department of Education. (2016). *Professional personal individual staff data.* Retrieved from http://www.education.pa.gov/Data-and-Statistics/Pages/Professional-and-Support-Personnel.aspx#tab-1

Peterson, E., & Siadat, M. V. (2009). Combination of formative and summative assessment instruments in elementary algebra classes: A prescription for success. *Journal of Applied Research in the Community College, 16*(2), 92–102. Retrieved from http://ezp.waldenulibrary.org/login?url=https://search-proquest-com.ezp.waldenulibrary.org/docview/214824385?accountid=14872

Peterson, P. E., & Ackerman, M. (2015). States raise proficient standards in the math and reading: Commitments to Common Core may be driving the proficiency bar upward. *Education Next, 15*(3), 16–21. Retrieved from http://educationnext.org/states-raise-proficiency-standards-match-reading/

Peterson, P. E., Barrows, S., & Gift, T. (2016). After Common Core, states set rigorous standards: Forty-five states raise the student proficiency bar. *Education Next, 16*(3), 9–15. Retrieved from http://educationnext.org/after-common-core-states-set-rigorous-standards/

Phillips, V., & Wong, C. (2010). Tying together the Common Core of standards, instruction, and assessments. *Phi Delta Kappa, 91*(5), 37–42. doi:10.1177/003172171009100511

Phillips, V., & Wong, C. (2012). Teaching to the Common Core by design, not accident. *Kappan, 93(7),* 31–37. doi:10.1177/003172171009100511

Piaget, J. (1976). *The child's conception of the world.* Totowa, NJ: Littlefield, Adams.

Polikoff, M. S. (2015). How well aligned are textbooks to the Common Core standards in mathematics? *American Educational Research Journal, 52(6),* 1185–1211. doi: 10.3102/0002831215584435

Popham, W. J. (2006). *Defining and enhancing formative assessment.* Paper presented at the annual Large-Scale Assessment Conference, Council of Chief State School Officers, San Francisco, CA. Retrieved from http://www.cpre.org/ccii/images/stories/ccii_pdfs/defining%20formative%20assessment_popham.pdf

Porter, R. E., Fusarelli, L. D., & Fusarelli, B. C. (2015). Implementing the Common Core: How educators interpret curriculum reform. *Educational Policy, 29*(1), 111–139. doi:10.1177/0895904814559248

Rafferty, C. D. (1994). *Portfolio assessment and secondary methods classes: What happens when the twain meet?* Paper presented at the annual meeting of the Association of Teachers Educators, Atlanta, GA. Retrieved from https://eric.ed.gov/contentdelivery/servlet/ERICServlet?accno=ED367608

Rentner, D. S., & Kober, N. (2014). *Common Core State Standards in 2014: Districts' perceptions, progress, and challenges.* Retrieved from https://eric.ed.gov/contentdelivery/servlet/ERICServlet?accno=ED555389

Rothman, R. (2011). *Something in common: The Common Core Standards and the next chapter in American education.* Cambridge, MA: Harvard Education Press.

Ruchti, W. P., Jenkins, S. J., & Agamba, J. (2013). Critical supports for secondary educators in Common Core State Standard implementation. *Clearing House, 86,* 246–254. doi:10.1080/00098655.2013.826494

Ruiz-Primo, M. A., & Furtak, E. M. (2006). Informal formative assessment and scientific inquiry: Exploring teachers' practices and student learning. *Educational Assessment, 11*(3-4), 205–235. doi:10.1080/10627197.2006.9652991

Sadler, D. R. (1987). Specifying and promulgating achievement standards. *Oxford Review of Education, 13,* 191–209. doi:10.1080/0305498870130207

Sadler, D. R. (1998). Formative assessment: Revisiting the territory. *Assessment in Education, 5*(1), 77–84. doi:10.1080/0969595980050104

Sadler, D. R. (2010). Beyond feedback: Developing student capability in complex appraisal. *Assessment & Evaluation in Higher Education, 35*(5), 535–550. doi:10.1080/02602930903541015

Scoles, J., Huxham, M., & McArthur, J. (2013). No longer exempt from good practice: Using exemplars to close the feedback gap for exams. *Assessment & Evaluation in Higher Education, 38*(6), 631–645. doi:10.1080/02602938.2012.674485

Scriven, M. (1967). The methodology of evaluation. In R. W. Tyler, R. M. Gagné, & M. Scriven (Eds.), *Perspectives of curriculum evaluation* (pp. 39–83). Chicago, IL: Rand McNally.

Shavelson, R. J., Young, D. B., Ayala, C. C., Brandon, P. R., Furtak, E. M., & Ruiz-Primo, M. A. (2008). On the impact of curriculum-embedded formative assessment on learning: A collaboration between curriculum and assessment

developers. *Applied Measurement in Education, 21,* 295–314. doi:10.108/089573 40802347647

Shepard, L. A. (2000). The role of assessment in a learning culture. *Educational Researcher, 29*(7), 4–14. doi:10.3102/0013189X029007004

Stiggins, R. (2001). *Student involved classroom assessment* (3rd ed.). Columbus, OH: Merrill.

Stiggins, R. (2002). Assessment crisis: The absence of assessment for learning. *Phi Delta Kappan, 83*(1), 758–765. doi:10.1177/003172170208301010

Stiggins, R. (2005). From formative assessment to assessment for learning: A path to success in standards-based schools. *Phi Delta Kappan, 87*(4), 324–328. doi:/10.11 77/003172170508700414

Stiggins, R. (2007). Assessment through the student's eye: Rather than sorting students into winners and losers, assessment for learning can put all students on a winning streak. *Educational Leadership, 64*(8), 22–26. Retrieved from http://www.ascd. org/publications/educational-leadership/may07/vol64/num08/Assessment-Through-the-Student's-Eyes.aspx

Stotsky, S. (2012). *Common Core Standards' devastating impact on literary study and analytical thinking.* Retrieved from https://www.heritage.org/education/report/common-core-standards-devastating-impact-literary-study-and-analytical-thinking

Stull, J. C., Varnum, S. J., Ducette, J., Schiller, J., & Bernacki, M. (2011). The many faces of formative assessment. *International Journal of Teaching and Learning in*

Higher Education, 23(1), 30–39. Retrieved from http://www.isetl.org/ijtlhe/pdf/IJTLHE851.pdf

Tariq, M. A. (2013). Engaging professionals: Investigating in service teachers use of formative classroom assessment. *Universal Journal of Educational Research, 1*(4), 318–322. doi:10.13189/ujer.2013.010407

Traffic Names. (n.d.). *Customize random number generator.* Retrieved from http://www.randomnumbergenerator.com/custom.asp

Ujifusa, A. (2013). *Pressure mounts in some states against common core.* Retrieved from http://www.edweek.org/ew/articles/2013/02/06/20commoncore_ep.h32.html

Ujifusa, A. (2015). *Common Core's big test: Tracking 2014-15 results.* Retrieved from http://www.edweek.org/ew/section/multimedia/map-common-core-2015-test-results.html#pennsylvania

U.S. Department of Education. (2015). *Fundamental change: Innovation in America's schools under race to the top.* Retrieved from http://www2.ed.gov/programs/racetothetop/performance.html

Volante, L., & Beckett, D. (2011). Formative assessment and the contemporary classroom: Synergies and tensions between research and practice. *Canadian Journal of Education, 34*(2), 239–255. Retrieved from http://journals.sfu.ca/cje/index.php/cje-rce/article/view/407/1014

Vygotsky, L. S. (1978). *Mind in society.* Cambridge, MA: Harvard Press.

Walker, C. O., & Greene, B. A. (2009). The relations between student motivational beliefs and cognitive engagement in high school. *Journal of Educational*

Research, 102(6), 463–471. doi:10.3200/JOER.102.6.463-472

Walker, D. J., Topping, K., & Rodrigues, S. (2008). Student reflections on formative-assessment: Expectations and perceptions. *Learning, Media and Technology, 33*(3), 221–234. doi:10.1080/17439880802324178

Walters, K., Scheopner Torres, A., Smith, T., & Ford, J. (2014). *Gearing up to teach the Common Core State Standards for mathematics in rural northeast region schools.* Washington, DC: U.S. Department of Education, Institute of Education Sciences, National Center for Education Evaluation and Regional Assistance, Regional Educational Laboratory Northeast & Islands. Retrieved from http://ies.ed.gov/ncee/edlabs.

Wang, T. H. (2007). What strategies are effective for formative assessment in an e-learning environment? *Journal of Computer Assisted Learning, 23,* 171–186. doi:10.1111/j.1365-2729.2006.00211.x

Webb, M., & Jones, J. (2009). Exploring tensions in developing assessment for learning. *Assessment in Education: Principles, Policy & Practice, 16*(2), 165–184. doi:10.108/09695940903075925

Wiliam, D., Lee, C., Harrison, C., & Black, P. (2004). Teachers developing assessment for learning: impact on student achievement. *Assessment in Education, 11*(1), 49–65. doi:10.1080/0969594042000208994

Wixson, K. K., Dutro, E., & Athan, R. G. (2003). The challenge of developing content standards. *Review of Research in Education, 27*(1), 69–107. doi:10.3102/0091732X027001069

Wylie, E. C., & Lyon, C. J. (2015). The fidelity of formative assessment implementation: Issues of breadth and quality. *Assessment in Education: Principles, Policy & Practice, 22*(1), 140–160. doi:10.1080/0969594x.2014.990416

Xu, Z., & Cepa, K. (2015). *Getting college and career ready during state transition toward the Common Core State Standards* (Working Paper 127). Washington, DC: National Center for Analysis of Longitudinal Data in Education Research. Retrieved from https://eric.ed.gov/contentdelivery/servlet/ERICServlet?accno=ED557605

Yin, Y., Shavelson, R. J., Ayala, C. C., Ruiz-Primo, M. A., Brandon, P. R., & Furtak, E. M. (2008). On the impact of formative assessment on student motivation, achievement, and conceptual change. *Applied Measurement in Education, 21*(4), 335–359. doi:10.1080/08957340802347845

Youngs, P. (2013). *Using teacher evaluation reform and professional development to support Common Core assessment.* Retrieved from https://eric.ed.gov/contentdelivery/servlet/ERICServlet?accno=ED539747

Zimmerman, B. J., & DiBenedetto, M. K. (2008). Mastery learning and assessment: Implications for students and teachers in an era of high-stakes testing. *Psychology in the School, 45*(3), 206–216. doi:10.1002/pits.20291

Appendix A: Study Instrumentation

Teacher Perceptions of the Common Core State Standards Questionnaire

Instructions: Indicate your level of agreement with the following statements. Simply answer based on your current understanding about the Common Core Standards – even if it may not be much – and what you believe about them. However, if you absolutely do not know what to think then, select "Don't know." (Choices: Strongly agree, Agree, Neutral, Disagree, Strongly Disagree, Don't Know).

- The Common Core will have little impact on my everyday practice.
- I believe that the Common Core will help to raise student achievement.
- The implementation of the Common Core is more of a positive step than a negative step in education reform.
- I believe that the Common Core will be more effective than current standards at preparing students to be college- or career-ready upon high school graduation.
- The work that I will put into preparing and transitioning to the Common Core will be worthwhile.
- I am well-informed regarding what the Common Core Standards are.
- I am sufficiently prepared through professional development to transition from teaching current standards to teaching the Common Core.
- The Common Core will help me become a more effective teacher.
- The Common Core makes me feel more like a professional.
- Especially with the emergence of the Common Core, I feel that I am spending more effort to comply with mandates rather than to teach students to the best of my ability.
- I would encourage others to enter the teaching profession at this time.
- I am concerned that the Common Core will restrict my creativity and the types of instructional strategies that I may use.
- I am concerned that under the Common Core, I will spend too much time preparing students for testing.

- I would like more decision-making power over the curriculum than what I believe the Common Core will permit.
- Transitioning to the Common Core will require new or substantially revised curriculum materials and lesson plans.
- I look unfavorably upon the amount of time students currently spend on taking standardized tests.
- In hindsight, No Child Left Behind was more of a positive step than a negative step for education reform.
- The Common Core will enable me to spend more time teaching higher-level (i.e. critical and creative) thinking skills.
- The Common Core is a welcome change to the status quo.
- The Common Core – as a single, common set of curricular standards – will help to make collaboration and sharing of instructional materials more efficient.
- The Common Core standards are easier to understand than current standards.
- I have a voice in creating and responding to new education-policy legislation, such as the Common Core standards.

Formative Assessment Questionnaire

Questionnaire for Teachers

Part One

Please circle the letter **and** number that most closely matches your opinion of the following strategies:

	VALUE Please circle how highly you **value** the following: A = very valuable, B = valuable, C = no strong view, D = of little value, E = of no value	**USE** Please circle how often you **use** the following: 5 = most lessons, 4 = most days, 3 = weekly, 2 = quarterly, 1 = never
Involving students in their learning		
1. Telling students what you hope they will learn and (sometimes) why they are learning it	A B C D E	1 2 3 4 5
2. Inviting and building on students' contributions	A B C D E	1 2 3 4 5
3. Setting up tasks designed to enable students to work independently	A B C D E	1 2 3 4 5
4. Getting students to collaborate in groups on a joint assignment	A B C D E	1 2 3 4 5
5. Spurring students on by making encouraging but specific, focused comments	A B C D E	1 2 3 4 5
6. Getting one student to help another	A B C D E	1 2 3 4 5
Modeling quality		
1. Choosing and showing students examples of other students' work for learning purposes	A B C D E	1 2 3 4 5
2. Getting a student to show you how s/he has attempted something so you can diagnose error	A B C D E	1 2 3 4 5
3. Getting a student to demonstrate to the class how s/he did something	A B C D E	1 2 3 4 5
4. Getting a student to suggest ways something can be improved	A B C D E	1 2 3 4 5

		VALUE A = very valuable B = valuable C = no strong view D = of little value E = of no value	USE 5 = most lessons 4 = most days 3 = weekly 2 = quarterly 1 = never
5.	Providing formats and structures for writing or recording findings	A B C D E	1 2 3 4 5
6.	Showing students a range of other students' work to make a judgment about performance	A B C D E	1 2 3 4 5
7.	Showing students a range of other students' work to make a judgment about progress	A B C D E	1 2 3 4 5
8.	Showing students a range of other students' work to model or exemplify criteria	A B C D E	1 2 3 4 5
Giving feedback			
1.	Using probing questions to diagnose the extent of the students' learning	A B C D E	1 2 3 4 5
2.	Analyzing completed work to figure why a student has or has not achieved	A B C D E	1 2 3 4 5
3.	Giving rewards only when achievement is satisfactory for that student with specific comments referring to student's success	A B C D E	1 2 3 4 5
4.	Expressing approval when achievement is satisfactory	A B C D E	1 2 3 4 5
5.	Making a conscious decision to avoid saying a student is wrong	A B C D E	1 2 3 4 5
6.	Telling students what they have achieved with specific reference to their learning	A B C D E	1 2 3 4 5
7.	Telling students what they have not achieved with specific reference to their learning	A B C D E	1 2 3 4 5
8.	Describing why an answer is correct	A B C D E	1 2 3 4 5
9.	Specifying a better / different way of doing something	A B C D E	1 2 3 4 5
10.	Writing an evaluative note on student's work for the student	A B C D E	1 2 3 4 5

	VALUE A = very valuable B = valuable C = no strong view D = of little value E = of no value	**USE** 5 = most lessons 4 = most days 3 = weekly 2 = quarterly 1 = never
Self assessment		
1. Getting students to suggest ways they can improve	A B C D E	1 2 3 4 5
2. Negotiating a way to improve some piece of work	A B C D E	1 2 3 4 5
3. Providing time for students to reflect and talk about their learning	A B C D E	1 2 3 4 5
4. Getting students to review their own work and record their progress	A B C D E	1 2 3 4 5
5. Helping students to understand their achievements and know what they need to do next to make progress	A B C D E	1 2 3 4 5
6. Providing opportunities for students to assess their own and one another's work and give feedback to one another	A B C D E	1 2 3 4 5

Appendix B: Permissions

Permission to Use Teacher Perceptions of Common Core Questionnaire

On Sun, Sep 13, 2015 at 8:58 PM, Julie Mest wrote:
Hello Mr. Cheng,

Please allow me to take a moment to introduce myself. My name is Julie Mest, and I am pursuing my PhD in Education.

During my research I came across your thesis; Teacher Perceptions of the Common Core. This is in line with my dissertation topic and the Likert scale questions that you asked your participants would be useful in my study. Would you allow me to use your questions in my study?

Thank you for your consideration.

Respectfully,

Julie Mest

From: **Albert Cheng**
Date: Mon, Sep 14, 2015 at 9:01 AM
Subject: Re: permission to use survey questions
To: Julie Mest

Hi Julie,

Yes. Please feel free to use the survey. Good luck with your dissertation.

Albert

Permission to Use Formative Assessment Questionnaire

Julie Mest Jan 26, 2016

Hello Professor James,
Please allow me to take a moment to introduce myself. I am a doctoral student embarking on my dissertation. The focus of my topic is formative assessment use and value and how this compares to teacher value of the Common Core State Standards. I came across the survey that you created for the L2L Project and I was wondering if I could use this to collect some of my data for the dissertation.
Thanks for your time and I look forward to hearing from you.
-Julie Mest

Mary James to you Jan 26, 2016

Dear Julie. Yes, I am very happy for you to use this questionnaire - it was developed using public money for the common good. All we ask is that you attribute it in the usual way, and perhaps send us a brief summary of your results. Good luck with your dissertation. With best wishes, Mary James

Julie Mest Jan 27, 2016

Thank you very much Professor James.
Julie