TEACHERS' PERSPECTIVES AND DEVELOPMENT OF ACADEMIC RIGOR:

AN ACTION RESEARCH STUDY

Ian M. Banner

BS, University of Bridgeport, 1998

MS, University of Bridgeport, 1999

PCA, Sacred Heart University, 2008

Chair
Thomas W. Christ, Ph.D.

Reader
Gail Prelli, Ed.D.

Reader
Keith Smolinksi, Ed.D.

Director, Education Leadership Doctoral Program
Thomas W. Christ, Ph.D.

Dean, School of Education
Allen Cook, Ph.D.

A DISSERTATION
SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS
FOR DEGREE OF DOCTOR OF EDUCATION IN
THE SCHOOL OF EDUCATION
UNIVERSITY OF BRIDGEPORT

Bridgeport, CT

2016

University of Bridgeport

Committee Approval of a Dissertation

Dissertation Title:
Teachers' Perspectives and Development of Academic Rigor: An Action Research Study

Submitted by: Ian M. Banner.

I have read this dissertation and have found it to be of satisfactory quality for a doctoral degree.

5/2/16
_____
5/2/16

_____
Thomas W. Christ, Ph.D.
Chair, Dissertation Committee

I have read this dissertation and have found it to be of satisfactory quality for a doctoral degree.

5/2/16
_____
5/2/16

_____
Gail Prelli, Ed.D.
Member, Dissertation Committee

I have read this dissertation and have found it to be of satisfactory quality for a doctoral degree.

5/2/16
_____
5/2/16

_____
Keith Smolinski, Ed.D.
Member, Dissertation Committee

I have read this dissertation and have found it to be of satisfactory quality for a doctoral degree.

5/2/16
_____
5/2/16

_____
Thomas W. Christ, Ph.D.
Director Education Leadership Doctoral Program

I have read this dissertation and have found it to be of satisfactory quality for a doctoral degree.

5/2/16
_____
5/2/16

_____
Allen Cook, Ph.D.
Dean of School of Education, and
Member, Dissertation Committee

Abstract

A multiphase action research study of academic or instructional rigor was conducted using semi-structured and focused group interviews, classroom observations, participant logs, a weekly rigor planning Matrix, and a unit planning process to ensure rigor (UPPER). Phase I was conducted to determine 15 public middle school teachers' perspectives about the term academic rigor and how it related to their planning and praxis. Phase II included a teacher-oriented intervention that aimed to develop teachers' capacity to design and implement classroom tasks that demanded higher-level student thinking. Fourteen teachers utilized the Hess Cognitive Rigor Matrix (Hess, 2013) within a three-step planning process that provided a framework for identifying the task to be assigned to the students, determining the level of cognitive rigor of the task using the Hess (2013) Matrix, and selecting the methods for implementing the task throughout the lesson in order to increase the level of thinking associated with the task. Five teachers participated in Phase III that focused on situating the development of rigor within a concept-based unit planning process that emphasized learning for understanding and unpacking relevant content standards. The teachers reported that both interventions positively impacted their understanding of rigor, and their capacity to design and implement rigorous tasks and two rigorous concept-based unit plans, which was verified by the classroom observation and unit plans scores. The findings suggest the value of utilizing teacher perspectives, along with the intervention tools and the structured framework, as well as the planning processes employed when seeking to increase academic rigor.

Keywords: academic rigor, instructional practice, conceptual understanding, teacher perspectives, student tasks.

To my wonderful family: Cheryl, Hayden, CJ, Cameron, Codi, to my Parents long passed, but never forgotten and always missed, and to my brother and sisters, Darren, Lynda, Denise, and Kerry.

I dedicate this work to you all for the unwitting help you so often provided that shaped my beliefs, perspectives and the work in which I have chosen to engage.

I love you all, immeasurably.

ACKNOWLEDGMENTS

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

Teachers' Perspectives and Development of Academic Rigor: An Action Research Study

CHAPTER 1: INTRODUCTION

Background

Academic rigor is a prevalent topic of discussion and debate in education (Miller & Shih, 1999). It is also a term frequently used to describe standards (Duncan, Range, & Hvidston, 2012) and goals of numerous K-12 initiatives and reforms (National High School Alliance, 2006). Rigor is also referred to as the measure of a school's capacity to prepare its students for success in college and the 21st century world of work (Boser & Rosenthal, 2012; National High School Alliance, 2006; Savitz-Romer, Jager-Hyman, & Coles, 2009). Politicians have called for the term rigor to be included in education reform efforts, and between 2000 and 2009, according to Snider (2009), 12% of state governors in their State of the State speeches referenced the term. Snider also noted that in 2006, 20% of the governors "spoke of the need for greater academic rigor" in classrooms (p. 6).

Rigor, according to the National High School Alliance, is an important component of a high-performing school system (National High School Alliance, 2006; Quint, Thompson, & Bald, 2008), and has been correlated with the quality of student work in mathematics (Mitchell, Shkolnik, Song, Uekawa, Murphy, Garet, & Means, 2005). The greater the quality of high school students' work in math and English language arts, the greater the association of higher achievement for these students on standardized test scores (Mitchell et al., 2005). In a five-year study in 75 high schools across 10 states, McNulty and Quaglia (2007) made a case for preparing students for modern-day work environments by addressing rigor, as well as relevance and relationships. America's economic growth and development, according to Brooks, Finnegan, Mize and Rainwater, is dependent upon its public school system to prepare students for the

demands of college, high-performance careers, and 21st century life (Rainwater & Finnigan, 2008; Rainwater, Mize, & Brooks, 2008).

The Hechinger Institute's primer for journalists (2009, June) dedicated a report that promoted rigor in education. Willen and Snider interviewed cognitive scientists, Fiez and Schunn, who stated that different brain areas are being used when attending to rigorous work, which supports a greater degree of student understanding because of the connections between prior learning experiences and current problems. However, Jacobs and Colvin (2009) also indicated that academic rigor is at the core of many educational issues on which journalists commonly report. Fennel, the past president of the National Council of Teachers of Mathematics, stated that fluency with key ideas and problem solving in numerous contexts, as well as precision in thinking, best defines rigor. Schmidt related rigor to curriculum indicating that it should be focused, coherent and provide an appropriate level of challenge. Schmidt also stated that the challenge of rigor in American education is due to a greater breadth of curriculum content compared to other nations.

The pursuit of rigor is not always fruitful, and a large percentage of high school graduates are ill-prepared for these endeavors (Savitz-Romer et al., 2009; The Pathways to College Network, n.d.). Savitz-Romer et al. have called for greater and more challenging academic demands to be placed on students through secondary school course work, because "…students who participate in certain gateway courses may significantly increase the probability of earning college degrees" (Savitz-Romer et al., 2009, p. 7). The Nation At Risk Report in the early 1980s stated that schools often lack rigor (The National Commission on Excellence in Education, 1983). These concerns were also expressed in No Child Left Behind legislation [NCLB, 2001]) designed to increase the achievement of American students compared to international test

statistics. The Nation's Report by the National Commission on Excellence in Education (1983) stated that the demands placed on students in American classrooms must increase to prepare them for the workforce in which they would one day enter. Additionally, Goals 2000 (The Goals 2000: Educate America Act of 1994) offered the same perspective in stating that students will need to be well prepared to reason, problem solve, apply knowledge and be readied for productive employment in a modern economy. Bush's revision to the Elementary and Secondary Education Act of 1965 provided the platform for new educational legislation in the form of No Child Left Behind (2001), which strongly suggested that U.S. public education required greater accountability and increased academic challenge if U.S. students were going to be capable of competing with their global counterparts.

Authors Boser and Rosenthal (2010) claimed that the public's perception of education in the U.S. is one of disfavor, especially in light of U.S. students' performance compared to other developed nations (Achieve, 2013; Armario, 2010). According to the National Center for Educational Statistics (NCES), U.S. students on average lagged in both literacy and mathematics behind 29 developed nations on the Program for International Student Assessment (PISA) in 2012. Schmidt (in Colvin & Jacobs, 2009) offered an example that highlights a reason why U.S. students' educational attainment fails to compare to that of other students in many other developed nations, and to the capacities of students in other countries. He noted that U.S. students are learning about body parts while their international counterparts are learning how the body parts work together. The result is that international students are required to use higher levels of cognition, make sense of and understand various subject content, and spend much less time memorizing and recalling factual information. This has further resulted in the public and politicians calling for an increase in rigor in the classroom (Jacobs & Colvin, 2009).

Greater academic demands are quite forcefully implied in the adoption of the Common Core State Standards (Common Core State Standards Initiative, 2016) and new forms of related assessment including the Smarter Balanced Assessment Consortium (SBAC) and Partnership for Assessment of Readiness for College and Careers (PARCC), which aim to increase the academic challenge and 21st century readiness. These are the most public of efforts that are currently focused on addressing what is perceived as a lack of rigor in schools' academic demands. However, we are more able to contend that a lack of rigor exists in classroom work (Draeger, del Prado Hill, Hunter & Mahler, 2013; Hess, Carlock, Jones, & Walkup, 2009; Manthey, 2005; Maye, 2013; Paige, Sizemore, & Neace, 2013; Wagner, 2008), but much less able to suggest ways to increase and sustain it. Jacobs and Colvin indicated that the solution to these problems is to increase the rigor in classrooms (Jacobs & Colvin, 2009), which suggests that the tasks assigned to students as classwork be made more cognitively demanding or rigorous.

The literature on academic rigor provides multiple variations on how rigor is defined. Reich, Sevim, and Turner (2013) writing for the Metropolitan Educational Research Consortium (MERC) at Virginia Commonwealth University, indicated that rigor is defined in numerous ways, and they noted a discrepancy between the way that the Virginia Department of Education defined academic rigor compared to how education scholars define it. The Virginia Department of Education defined rigor as "college and career readiness as measured by attendance in post-secondary educational institution, achievement of high standards of learning (SOL) test scores, as well as participation in Advanced Placement and International Baccalaureate programs" (p. 4). However, Reich et al. posited that educational psychologists and discipline-based scholars of teaching and learning viewed rigor as students developing a depth of understanding, and much less a breadth of coverage of "factual information and procedural steps" (p. 4). Reich et al.

(2013) lamented that accountability policies, which are often founded on the notion that high-stakes test performance is an accurate indication of a student's readiness for college and the workforce, has stifled the true operationalization of academic rigor as opposed to enhancing it. Rainwater et al. (2008) stated that many states, districts, educators, and policy professionals agree that rigor is necessary, but there is often disagreement as to what it is and how it is and should be defined. This has resulted in a lack of clarity and confusion as to how rigor should be operationally defined (K. Hess, personal communication, February 1, 2015), as well as which tasks are labeled as representing rigorous classroom work (Manthey, 2005; Maye, 2013).

Rigor Grounded in Research-Based Pedagogy

The perception that rigor is ill-defined and ambiguous is the contention of several scholars and educators (Blackburn, 2013; Daggett, 2005; Jackson, 2011; Jolly, 2008; National High School Alliance, 2006; Rainwater et al., 2008; Wraga, 2011). However, a review of the numerous definitions has revealed commonalities that relate directly to a research-based pedagogy grounded in a constructivist orientation to learning and teaching (Bransford, Brown, & Cocking, 2000; Donovan & Bransford, 2005; Brooks & Brooks, 1999; Caine & Caine, 1991; Taba, 1966). The Iowa State Department of Education (IowaCore, n.d.) issued an overview of rigor to Iowa educators clarifying what is meant by a rigorous and relevant curriculum as a characteristic of effective instruction. The issue brief they released titled, *Rigorous and Relevant Curriculum*, acknowledged that academic rigor entails students being engaged in cognitively demanding and challenging work where they apply essential concepts and skills to solve authentic, real world, complex problems by drawing on higher-order thinking processes and their prior knowledge and understanding of critical content. The document also indicated that students would need to develop an ability to express and communicate ideas and findings with peers and

5

teachers in elaborated ways when engaged in rigorous tasks. Teachers are expected to plan and (a) "…design tasks that are cognitively complex and require higher-order thinking," (b) "apply concepts and skills in real-world context" (p. 3), and (c) carefully consider the cognitive processes that students will be required to use. The Iowa State Department of Education (IowaCore, n.d.) made available to the public a literature review on rigorous and relevant curriculum indicating that there is limited research on rigor and relevancy in elementary and middle grades, but highlighted that classroom instruction must address "higher levels of [student] cognition" (p. 1, reference to Eber & Parker) if moving students up the levels of Bloom's taxonomy is to be possible. It concluded by stating that increasing and accelerating student achievement is dependent upon students being engaged in schoolwork that is authentic and relevant. Aligning with the ideas posited by King, Newmann, and Carmichael (2009), it further stated that meaningful learning requires students to organize and synthesize knowledge to create new meaning, use prior knowledge to study concepts, solve real-world problems, and communicate in elaborated ways. The Alliance for Excellent Education (2011) also stated that preparing students for a complex world requires that federal, state and local policies support deeper student learning. They characterized deeper learning as students being able to think critically, solve complex problems, work collaboratively, and communicate effectively. They called for teachers to be better trained to be able to provide such opportunities in their classrooms whereby students are required to work on tasks that demand deeper learning of essential content and higher-level skills.

Studies by Hattie (2009), Marzano, Pickering, and Pollock (2001), Marzano (2003), and Tucker and Stronge (2005) indicated that if teachers are to be the greatest positive influence on their students' capacity to engage in classroom tasks that prepare them for modern-day work,

they must have a clear and working understanding of academic rigor and how to design and implement it in their planning and instruction. School and district leaders are suggested by Hattie, Marzano, Pickering, Pollock, Stronge, and Tucker to rely on their teachers' understanding of it in order to enhance the rigor in their schools and in the work of their students.

Academic rigor or more appropriately titled instructional rigor is situated within theoretical frameworks including instructional (Merrill, 2007) and learning theory (Bransford et al., 2000), which provide a relevant platform on which to devise methods to enhance and cultivate a greater understanding of rigor. These theoretical frameworks may be one means for supporting teachers' capacity to design and implement rigorous classroom tasks as part of their instructional practices (planning, classroom tasks, and formative assessments).

Statement of the Problem

The literature indicates that teachers and practitioners evidence difficulty defining and clearly understanding the term academic or instructional rigor (Bower & Powers, 2009; Draeger et al., 2003). Their confusion may be due to the numerous broad definitions that are used to describe the concept and applicable actions (see Table 1.1). For example, Duncan et al. (2012) wrote that: "Rigor is a term used prolifically, yet there is little common conception of what it actually means" (p. 24). Various studies have associated the term complex with rigor (Cairns, 2013; Dockter, Haug, & Lewis, 2010; Joftus & Berman, 1998; Marzano & Toth, 2014), and others have used variations on higher-order thinking (Draeger et al., 2013; Manthey, 2005; Miller & Shih, 1999; Wolf, Crosson, & Resnick, 2005). This unfortunately coincides with teachers not being adequately trained to teach students to think conceptually (Erickson, 2002; Ritchhart, Church, & Morrison, 2011; Yilmaz, 2011). Additional research findings have revealed that teachers are unclear as to whether their instructional design and assessments are in fact

instructionally rigorous (Bintz & Delano Moore, 2010), and in many cases, the classroom work or tasks they present to students often lacks rigor (Hess et al., 2009; Manthey, 2005; Marzano & Toth, 2014; Maye, 2013. See also Joftus & Berman, 1993).

This literature indicates a need to formally explore teachers' perspectives of what rigor means. It also indicates that a need exists to design supports to increase practitioners' understanding and capacity to design and implement rigor in the academic tasks they assign to their students. This action research study was devised to determine the impact of an intervention (a cognitive rigor Matrix/rubric embedded within a three-step planning process) by observing teachers utilizing rigor, and garnering their self-reported perspectives on the intervention's impact on their understanding and capacity to design and implement rigor. These methods relate to the work of Doyle (1983), and align with suggestions by Bransford et al. (2000) and Merrill (2007).

Table 1.1

Definitions of academic rigor in various literature.

Author	Year	Definition of academic rigor
Joftus & Berman	1998	Includes essential concepts and skills, and requires students to demonstrate understanding and application of these concepts and skills at a complex and sophisticated, yet grade appropriate, level of challenge.
Miller & Shih	1999	High cognitive levels of achievement as defined by Bloom's to promote a deeper understanding of concepts.
Aspen and Hawkins	2000	A deep understanding of texts and material, various forms of evidence, and internal consistency
Graham & Essex	2001	Critical thinking, high standards and expectations, process more than product, and cognitive challenge.
Daggett	2005	High-rigor knowledge, as measured by Bloom's taxonomy, applied to ever-changing, relevant and real-world situations.
Manthey	2005	Higher-order thinking as measured by the upper levels of Bloom's revised taxonomy (evaluate or create procedures or metacognitive knowledge).
Wolf, Crosson, & Resnick	2005	High-level thinking and active use of knowledge as characterized by challenging tasks with content-specific knowledge, explaining ones thinking, justifying arguments, interpreting and analyzing meaning.
Wyatt, Saunders, & Zelmer	2005	Grade-point average, number of hours spent studying outside of class
Boston & Wolf	2006	Understanding (math in this study) involves mastery of major concepts, and regular exposure to opportunities to pose and solve problems, formulate hypotheses, justify reasoning, and construct explanations, which are evident in the tasks, the implementation of the tasks, the student discussions, and the teacher's expectations.
Junker, Weisberg, Matsumura, Crosson, Wolf, Levision, & Resnick	2006	Lessons are centered on an in-depth learning of important concepts, and students are engaged in active inquiry and reasoning. This was based on the National Research council's (2000) findings on learning and its implications for teaching.
Burris, Wiley, Welner, and Murphy	2008	High standards of achievement: The earning of a New York Regents Diploma and the International Baccalaureate Diploma.
Rainwater, Mize, & Smith Brooks	2008	Use ACT's (2007) definition, which comprised of academic intensity or the specific courses high school students take, and academic quality or the content of the courses.

Table 1.1

Continued

Stone, Alfeld, & Pearson	2008	Conceptual math situated within a realistic, contextual and problem-based curriculum that allows for transfer of learning to other and applied circumstances.
Wagner	2008	Thinking, which includes being able to reason, analyze, justify, problem solve, transfer knowledge to new situations, and communicate effectively.
Bower & Powers	2009	Based on Shouse's and Phillips's perspectives of academic press, which comprise of an academic climate that promotes high status courses, meaningful homework, and earned grades, as well as instruction that demands high standards and provides meaningful feedback to students, clear goals and expectations, and the completion of quality homework.
Hess, Carlock, Jones, & Walkup	2009	The upper levels of Bloom's Revised Taxonomy's thinking processes and Webb's Depth of Knowledge and understanding of content based on real-world problem investigations and research.
Dockter, Haug, & Lewis	2010	Complex intellectual work that promotes students' thinking and requires them to explore multiple perspectives, and to use knowledge creatively and critically. It also requires students to engage in meaningful conversations and produce work that is realistic and with authentic audiences in mind.
Bintz & Delano Moore	2010	Qualities of rigor include: Active engagement, curiosity, intellectual risk-taking, meaningful learning, critical thinking that emphasizes the "how" and "why", and problem solving.
Johnson	2010	Upper levels of Bloom's taxonomy and realistic work
Wraga	2011	Re-conceptualizing rigor as vigor, it fosters an active growth for active mental strength and a readiness for action, and to "use subject knowledge to understand the natural world and human experience."
Wyatt, Wiley, Camara, & Proestler	2012	A positive relationship between the college student's self-reported demands of high school course work, the course title, and the student's first-year college grade point average.
Boser & Rosenthal	2012	The reported difficulty and the expectations of the academic work that students report on the National Assessment of Educational progress background surveys.

Table 1.1

Continued

Duncan, Range, & Hvidston	2012	Deep learning, inquiry based, critical, and requiring a high level of quality and effort. It also embodies 21st century skills, such as those posited by Wagner (2008).
Blackburn	2013	Creating an environment for students to be able to learn at high levels, be supported in order to learn at high levels, and demonstrate high level learning.
Cairns	2013	"[E]ducational qualities which strive for the highest possible achievement in the acquisition and transference of skills, knowledge and understandings associated with an academic discipline and the benefit to society and culture." It also includes…"a desire to learn and impart learning at increasing levels of complexity, and high expectation for educational achievement."
Draeger, del Prado Hill, Hunter & Mahler	2013	Active learning, meaningful content, higher-order thinking, appropriate expectations
Zoo & Hill	2013	Hands-on experiences to solve real-world problems, and applying knowledge and previous experiences to a variety of real-world situations.
Maye	2013	Upper levels of Bloom's Revised Taxonomy and the application of knowledge by analyzing, synthesizing, and evaluating problems.
Paige, Sizemore, & Neace	2013	Higher-order thinking as measured by Webb's Depth of Knowledge level 4.
Cooper	2014	Tasks and work that require high levels of cognition and focus, which is operationalized through challenging work, academic press and passion for content.
Early, Rogge, & Deci	2014	All students are provided with an expectation of challenge, "to move from where they are toward higher standards…and to produce work or respond at or above grade level."
Marzano & Toth	2014	Equipping students to work collaboratively or individually to use knowledge in order solve complex, real-world problems that represent thinking at the upper levels of various cognitive taxonomies (Bloom's, Marzano's, Webb's).

Numerous definitions and descriptions of rigor exist. However, no study to date has established a simplified and encompassing definition for teachers, administrators, and policy makers by drawing on the array of definitions of academic rigor to improve teachers' capacity to understand the term rigor and design and implement classroom tasks that represent rigorous, cognitively demanding, or higher-level thinking work. No study to date has embarked upon a collaborative approach between teachers and administrators to examine and enhance rigor in classroom instructional practice, whereby its effects on teachers' perspectives of their instructional efficacy are acknowledged, analyzed and utilized to further expand educators' professional growth and learning.

The literature also revealed that most studies on rigor have been conducted in urban elementary schools (Boston & Wolf, 2006; Bower & Powers, 2009; Junker, Weisberg, Matsumura, Crosson, Wolf, Levision, & Resnick, 2006; Wolf et al., 2005), in high schools (Burris, Wiley, Welner, & Murphy, 2008; Joftus & Berman, 1998; Paige et al., 2013; Raudenbush, Rowan, & Cheong, 1993), or at the university level (Draeger et al., 2013; Graham & Essex, 2001; Wyatt, Saunders, & Zelmer, 2005). Research about rigor in suburban middle schools is simply absent.

A pilot study that explored middle school teacher's definitions of rigor was conducted in 2012 surveying 42 academic teachers. It revealed that the teachers were *Somewhat clear*, about how to define rigorous learning. However, two teachers who were interviewed indicated that they were still unclear on how to define rigor. Inconsistent findings from the pilot showed that additional teacher insight on what rigor means was warranted if these teachers were to be supported in designing and implementing rigor in their classroom tasks.

Classroom observations of teachers using the Marzano framework (Marzano, 2011) in 2014-2015 indicated that teachers engaged in instruction that either introduced students to new information or had them practice and deepen their knowledge of the new information (level one and two of three). The observations provided evidence that students were not required to engage in higher order thinking on real-world, cognitively complex tasks that involved forming and testing hypotheses (Marzano, 2007, 2014). Similar findings were evident in observations of science and math classrooms conducted by an independent consortium hired by the district to review classroom instruction and provide critical feedback on various aspects of teaching. These findings at the local level were consistent with those published by Marzano and Toth (2014), Hess et al. (2009), Manthey (2005), and Maye (2013).

According to Holian and Coghlan (2013), efforts to improve teaching effectiveness and increase cognitive rigor should be conducted by classroom practitioners and building leaders working collaboratively in their own setting. The National Research Council, based on the findings on learning and teaching in Bransford et al. (2000), suggested that methods of professional learning and teacher-practice development should be carefully considered in providing opportunities for teachers to engage in their regular practice, while providing them with on-going feedback and support.

Various studies that had focused on rigor had included observations of teachers (Dockter et al., 2010; Junker et al., 2006; Maye, 2013; Paige et al., 2013; Wolf et al., 2005), but none had included a combination of teachers, instructional coaches, and administrators working collaboratively to enhance rigor in their setting. This suggestion required that a contrasting approach to observations be utilized, and instead of employing outside evaluators as used in Paige et al. (2013), an internal team of teachers, coaches and administrators would work

collaboratively. This was aimed at minimizing the outsider and evaluator influence, and aligned more with the research on professional development that suggested that educators (teachers, administrators, coaches) observe and learn together through more authentic means, which was also expected to develop teacher's ownership of their learning, and develop their understanding and pedagogy without being subject to typical outside evaluator conditions.

Other studies examined students' work for cognitive challenge (Hess et al., 2009; Manthey, 2005; Maye, 2013), but they did not examine the reasons that teachers had assigned such low-level tasks, nor their rationale for the level of challenge they had demanded of students. Findings from the pilot study, previous classroom observations, and applicable literature support the need for an action research study to develop a process that explores teacher-level understanding of rigor, and establishes an applicable instructional intervention to help teachers more aptly design and implement rigorous classroom tasks in the teachers' own context.

Purpose of the Study

The purpose of this action research study was to determine how public middle school teachers in language arts, math, science and social studies perceive, understand, and act on the expectations of the district to comply with practices related to rigor as outlined in the Common Core State Standards and the literature on instruction. Additionally, an instructional intervention was expected to improve teachers' capacity to design and implement rigorous tasks in their natural context by seeking to increase the cognitive challenge of the tasks they assign to students in their classrooms. This action research also aimed to develop the researcher's capacity to develop instructional rigor in his school.

Nature of the Study and Conceptual Framework

An action research design (Coghlan & Brannick, 2010; Carr & Kemmis, 1986; Creswell, 2012; Mertler, 2012; Herr & Anderson, 2015) was employed to support and develop teachers' utilization of academic or instructional rigor in their classrooms in a middle school. The action research study began by defining academic or instructional rigor in the literature, determining the district's expectations, and examining the level of teachers' understanding and application of rigor in their classrooms. The intervention in this action research study included training teachers to use a cognitive rigor Matrix or rubric (Hess, 2013) along with a three-step cognitive-centered planning process to design and implement classroom tasks associated with academic rigor. The intervention also included training teachers to implement the tasks by planning how the task was to be presented before students begin working on it, monitoring students and asking probing questions, and responding to students' questions to encourage them to use higher-level thinking and taking a greater cognitively active role. This study was situated within a theoretical framework that viewed learning and teaching through a constructivist-orientated lens (Biehler & Snowman, 1997; Yilmaz, 2011). It also drew on cognitive learning theory (Bransford et al., 2000; Donovan & Bransford, 2005; Mayer, 1992, 2004, 2011), instructional design theory (Bruner, 1960, 1966; Merrill, 2001, 2007), and 21st century learning considerations (Wagner, 2008). This perspective regarded student learning as an active mental process, and the learner as an active processing agent.

This action research study (Coghlan & Brannick, 2010; Carr & Kemmis, 1986; Mertler, 2012) used a convenience sampling scheme (Collins, 2010; Creswell, 2009; Onwuegbuzie & Collins, 2007) with a single qualifying criterion (teachers of grades six, seven or eight language arts, math, social studies or science). Ten academic only participants were interviewed and observed in the first phase to better understand how teachers in this setting define and understand

rigor. From this group, five were purposefully selected and five were randomly sampled. The five purposefully sampled participants were involved in the second phase to implement the first iteration of the intervention and to determine whether the use of the cognitive rigor Matrix (Hess, 2013) as part of the three-step planning process impacts their capacity to operationally define rigor and more knowingly design and implement higher-level student thinking tasks.

Data was collected using various techniques, which involved the researcher experiencing, enquiring, and examining (Creswell, 2012). This specifically included garnering the teacher's perspectives and understanding of rigor through semi-structured interviews, open-ended questions, and focus group discussions (enquiring), observing teachers in action, writing field notes and attending and reflecting on planning meetings (experiencing), and analyzing various documents, such as weekly teacher logs and reflections, and weekly teacher planning matrices (examining).

The setting selected for this action research study was one of three middle schools in a suburban public school district. Numerous reasons supported using this site, which included a need to explore and consider teachers' perspectives of rigor in affluent, suburban middle school settings. The selected school had also informally addressed rigor in prior years, and it was the site that the pilot study was previously conducted. Previous efforts to address rigor had only included sparse site-based professional development sessions that had discussed rigor, but it had never been defined. It had also selected to focus on rigor as a school-wide goal for the year in which this action research was conducted (2015-2016), which made it a meaningful and relevant study that was conducted through a mostly second-person, insider approach (Coghlan & Shani, 2013).

Justification for an *insider* action research emphasis was found in recent writings from Fullan (2014) who stated that the principal's role as an instructional leader was too vague and narrow, and neglected critical aspects of enhancing teacher capacity. He argued that teachers should be developed by drawing on the perspective that humans are "fundamentally motivated by two factors: doing things that are intrinsically meaningful to themselves, and working with others…." (p. 7). He also drew on a body of research on school leadership to posit that principals should directly influence how teachers work and learn together with an emphasis on developing student learning through strong instructional practice, and in so doing, develop their professional capital. Combining a focus on action research with direct insider, school-leader support was a logical and appropriate angle for this research in which to positively influence and enhance the type of thinking (cognitive rigor) that students were required to utilize in 21st century-related work.

Research Questions

This action research study data considered (a) teachers' reported understanding and use of academic rigor in the selected site, (b) whether their thinking was positively impacted by them planning for instruction with specific attention to the level of thinking or cognitive rigor of the tasks they assigned to students, and (c) whether their thinking was positively impacted them planning the way they implemented (or presented) the tasks to students. This was operationalized through three main research questions:

1. What is the teachers' current understanding of academic rigor, and how do they describe the basis for their understanding?

2. Do the Hess (2013) Matrix and the three-step planning process positively impact the teachers' capacity to design rigorous classroom tasks?

3. Do the Hess (2013) Matrix and the three-step planning process positively impact the teachers' capacity to implement rigorous classroom tasks?

A fourth question considered a process aimed at developing the participants' capacity to design a concept-based unit of study that appropriately situated and fostered rigor:

4. Do teachers report that a planning framework for developing a concept-based unit of study and specific training support provide them with greater clarity and understanding on how to design a coherent unit that incorporates increasingly rigorous tasks?

There were also three main assumptions that directed this action research study, and these were as follows: (1) The participants would report that the intervention positively impacted their capacity to design rigorous classroom tasks that demanded higher-level student thinking, (2) the participants would report that the intervention positively impacted their capacity to implement rigorous classroom tasks in a way that maximized their students' thinking, (3) and design concept-based units of study that included and developed rigor.

The findings in Phase I directed the emphasis and focus in Phase II. The phase-specific questions for Phase I were:

a. How do teachers perceive and define instructional rigor?

b. How do teachers perceive and describe their pre-certification preparation's influence on instructional rigor?

c. How do teachers perceive and describe their professional development preparation's influence on instructional rigor?

The assumption was that the participant teachers would report being unclear about how to define rigor and how to design rigorous tasks and implement them in their instructional practice. It was also assumed that they would report feeling that their training did not prepare them for

18

understanding rigor, nor designing and implementing rigorous tasks. It was also assumed that

this would be the case for the purposefully selected teachers (1, 2, 3, 4, 5) and the randomly

sampled teachers (A, B, C, D, E). The information gleaned from this first phase answered

research question one.

Assumptions, Delimitations, Scope of the Study

       Assumptions. The researcher's personal belief was that teachers were unclear as to how

their definition of rigor compared to the more formal definitions in the literature, which further

complicated the issue of them being able to design and implement rigor into the classroom tasks

they assigned as student work. This was based on the pilot study and informal conversations with

various teachers in and outside of the selected research setting, as well as prior observations.

This assumption was also based on observations of teaching over the years that had revealed that

teachers often wrote lower-level-focused learning objectives, which the researcher assumed was

an indication that they were unclear as to the lesson's main aim. He further assumed that when

the learning outcome was unclear or repeatedly emphasized a lower-level cognitive emphasis

based on the use of verbs expressed in the objective, which was either verbally stated or written

on the board, the cognitive level of students' thinking was also unclear. He also assumed that this

increased the likelihood that it translated into lower levels of cognitive rigor, because the

cognitive rigor or level of thinking required by the task had not been fully considered (refer to

Ritchhart, Church, & Morrison, 2011, for support for this issue).

       Another assumption held by the researcher was related to his involvement and insider

position. He assumed that his relationship with the participants, based on its foundation of

familiarity and previous partnership in addressing aspects of instruction and school, supported a

more collaborative approach and greater levels of trust. He further assumed that each participant

independently chose to be involved in the research to provide an honest account of their understanding of rigor, and because their inclusion had the potential to improve and enhance their instructional praxis. He also assumed that his insider role provided a means for participant responses regarding their perspectives on rigor and their use of it to be accurate and honest, as well as a representation of their true feelings and beliefs, especially in the interviews and later the intervention logs, matrices and meetings.

Delimitations. This study only included the one middle school in a district of three middle schools, because the selected school had chosen to focus on increasing rigor as a school goal. It only included grade six, seven, and eight math, language arts, social studies and science teachers, as it was felt that other unified arts teachers, such as those teaching music, technology education, health, physical education may have required a different approach due to the difference in their schedules and curriculum-imposed demands.

Scope. The timeframe selected for this research was only a fraction of what was expected to be a one-to-two year emphasis. It only captured the initial stages of this emphasis, and for an approximate half year (from September to April, which was eight out of the approximate nine and half months). Therefore, it did not capture any developments to the intervention beyond the first eight months, nor how it impacted various grade levels and subjects following more professional learning over time. The timeframe also excluded the impact on students, which was to be considered as a later stage emphasis.

Relevant Vocabulary of the Study

Academic rigor. This widely used term related to a broad concept that is comprised of classroom tasks that required students to use higher-order and critical thinking, actively make sense of content, solve realistic and relevant real-world problems, and be able to transfer the

facts, knowledge and skills they may have acquired in one context to another unfamiliar and more complex context (Bower & Powers, 2009; Draeger et al., 2013; Hess et al, 2009; Joftus & Berman, 1998; Paige et al., 2013; Stone, Alfed, & Pearson, 2008).

Big Ideas. The essential understanding of core ideas associated with a subject-area topic that is transferable to other topics or subject-areas (Ainsworth, 2010). Wiggins and McTighe (2005) refer to big ideas as enduring understanding and Erickson (2002) similarly as essential understanding. Ainsworth (2010) and Erickson (2002) further describe big ideas as generalizations that involve two or more concepts stated as a relationship and expressed as a complete sentence.

Concept-based unit. A unit of study that, by its design, moves students beyond the learning of factual knowledge, skills and processes (Erickson, 2002), and requires them to eventually uncover essential and enduring understanding of a topic (Ainsworth, 2010; Erickson, 2002; Wiggins & McTighe, 2005). This is achieved by establishing the big ideas and the conceptual focus in the planning stages, and which will direct the students towards this uncovering through the unit's sequence and tasks.

Constructivism. A current theory of learning suggested that students must actively grapple with issues and ideas, build new cognitive structures from their existing ones, thereby constructing patterns and relationships in order to make knowledge meaningful and relevant (Biehler & Snowman, 1997; Caine & Caine, 1991; Yilmaz, 2011).

Insider action research. The researcher played a dual role of both researcher and organizational member. The researcher was also a full member of the organization in which he/she studied, and remained so after the investigation (Coghlan, 2007). The researcher was an interventionist and worked to enact change (Coghlan, 2007), and contended with issues related to

pre-understanding, role duality and organizational politics (Coghlan, 2001; Coghlan & Brannick, 2010; Coghlan, Shani, & Roth, 2015), as well as with issues of power (Gaventa & Cornwall, 2013; Grant, Nelson, and Mitchell, 2013; Hans & Mats, 2005; Williander & Styhre, 2006).

Instructional practice. The teacher's deliberate planning, and implemented actions that intended to influence the learners' experiences to change their knowledge (Mayer, 2011). This also included a teacher's use of formative assessments to check whether the instruction had had the desired outcome. Inevitable cognitive demands or levels of thinking were placed on the learner as a consequence of the teacher's instruction.

Student tasks. The work or assignments that students received in the classroom were the means for judging the level of thinking or cognitive challenge that were required of them. Tasks entailed a specified product that the students were required to produce, a process that included resources and materials for which they worked to produce the product, and an implied and associated level of thinking that the process required of them in order to produce the product (Doyle, 1983, 1984).

Student understanding. Cognitive learning theory emphasized that students were active processors, interpreters, and constructors of information and knowledge (Mayer, 1992), which meant that facts and knowledge became usable for solving problems, could be transferred to unfamiliar contexts, and were "connected and organized around important concepts" (Bransford et al., 2000, p. 9). Understanding therefore was the result of thinking (Ritchhart, Church, & Morrison, 2011).

Teacher perspectives. The teacher perspective included the views, beliefs and understanding that teachers held and reported regarding aspects and issues of instruction and pedagogy.

Unpacking standards. The process involved an explicit and intentional dissecting or unwrapping of the standards in order to identify the key concepts and knowledge (expressed as nouns), and the skills and processes (expressed as verbs) (Ainsworth, 2003; 2010). Once the concepts are extracted, a relationship between them can be established, which then serves as the big ideas.

Unit Planning Process to Ensure Rigor (UPPER). The UPPER was a form accompanied by a rubric that represented a unit planning process designed by the researcher. It provided explicit guidance for teachers to develop a concept-based unit that emphasized learning for understanding and to embrace the new standards (ELA CCSS, MCCSS, NGSS, C3SS). This process specifically required teachers to unwrap relevant subject matter content standards, determine the essential knowledge, procedures, and big ideas associated with the standards and the essential questions that directly linked to the big ideas, and to design an appropriate, understanding-focused final performance assessment and craft a progressively rigorous task sequence using the Hess (2013) Matrix.

CHAPTER 2: LITERATURE REVIEW

Rigor has been asserted as an essential goal in modern education (Marzano & Toth, 2014; National High School Alliance, 2006; Wyatt, Wiley, Camara, & Proestler, 2012), and many calls for educational reform have included the need for more academic rigor in schools (Washor & Mojkowski, 2007; Wraga, 2011). The definition of rigor, however, has varied depending on who is using it (Williamson & Blackburn, 2012), and this may be the result of numerous perspectives on how rigor is defined, and to what it is in reference to (Blackburn, 2013; Bower & Powers, 2009). Such variation in definition may be the reason for a lack of clarity in understanding academic rigor (Hess, 2014). Yet, academic rigor when defined within the context of instruction, and when considered as a means for addressing the pedagogical shifts now demanded by the Common Core State Standards (Common Core State Standards Initiative, 2016), is no longer an option, but a necessity (Marzano & Toth, 2014). Therefore, a clear understanding as to how academic rigor should be perceived is important for teachers and a necessary step towards them being able to increase the rigor of their instruction to meet the demands of the new standards and prepare students for a deeper level of subject understanding and the 21st century workforce (Wagner, 2008).

Variations on Rigor as a Construct

There are numerous variations in how rigor is defined (Blackburn & Williamson, 2009). One such variation comes in the form of a broad perspective on classroom and school climate. Coined as academic rigor, it has been viewed as a component of academic press, which has been an area chiefly studied by educational psychologists (Reich et al., 2013). Numerous studies have examined academic rigor within the context of the school environment that have incorporated the motivation to learn and an emphasis on high academic standards—the latter commonly identified

as academic rigor (see Berebitsky, 2010; Hoy & Hannum, 1997; Hoy & Misekel, 2001; Lee, Smith, Perry, & Smylie, 1999; Murphy, Weil, Hallinger, & Mitman, 1982; Raphael, Pressley, & Mohan, 2008; Scheerens & Bosker, 1997; Shouse, 1996).

Researchers concerned with the methods and procedures of their work, on the other hand, have viewed rigor differently. Methodological rigor in academic research has traditionally employed terms such as exact, accurate, precise and meticulous (Cooney, 2011; Finley, 2011). This has also been true for the process used when reviewing research studies (Bennett, Lubben, Hogarth, & Campbell, 2005; Edwards, Elwyn, Hood, & Rollnick, 1999). High-quality research demands that procedures and techniques are precise and meticulous, and are employed to ensure that the results and findings are accurate, valid, reliable, credible, and trustworthy, so that generalizability and inference, as well as valid conclusions can be drawn. This has constituted rigor in the methodological sense (Creswell, 2012; Kubiszyn & Borich, 2010; Maxwell, 2013; Salkind, 2011; Tuckett, 2005).

A third perspective on academic rigor has explicated it from the other components of academic press. This view on academic rigor has also been discussed in numerous empirical and non-empirical forums related more specifically to curriculum and instruction. These definitions of rigor have been varied with some relating rigor to the broad standards that underpin curriculum (Joftus & Berman, 1998), or relating it to the level of courses taken and achievement on the standardized assessments (Wyatt et al., 2012). This view is a traditional perspective on general classroom and school quality. Others, however, have viewed it as being more so related to instruction and pedagogy (Bower & Powers, 2009; Daggett, 2010; Dockter et al., 2010; Draeger et al., 2013; Hess, Jones, Carlock, & Walkup, 2009; Paige et al., 2013; Manthey, 2005; Marzano & Toth, 2014; Matsumura, Slater, & Crosson, 2008; Maye, 2013; Junker et al., 2006;

Wolf et al., 2005). The more recent perspectives on academic rigor as a pedagogical construct have been couched within the context of instruction. Thus, it has become more fitting to rename academic rigor as instructional rigor.

The studies that have emphasized academic rigor have mainly defined it as a focus on instruction and assessment that requires and promotes a high level of cognitive complexity (Senn & Marzano, 2015) and challenge whereby students are required to use and develop critical thinking and problem solving skills, engage in tasks that are meaningful and relevant, and thus draw upon their higher order thinking and cognitive capacities (Bower & Powers, 2009; Draeger et al., 2013; Hess, 2006; Hess et al., 2009; Hess & Gong, 2014; Matsumua, Slater, & Crosson, 2008; Maye, 2013; Paige et al., 2013; Raudenbush et al., 1993). The perspective of a modern-day view of classroom learning and instruction is embedded in a theoretical framework that embraces the notion that contemporary education aims to prepare students for the 21st century adult working world, and to help them make deeper sense of the world in which they live, and not just accumulate facts and knowledge for the acquisition of grades and test scores.

This view of student learning is also logically grounded in a cognitive constructivist learning theory, which contends that students move beyond procedural knowledge acquisition and related vocabulary, and develop a working insight as to the "conditions of effective application" (Glaser, 1990, p. 30) through engaging in an active sense-making process (Bransford et al., 2000; Yilmaz, 2011) that requires them to construct understanding from real problems and develop new cognitive structures (Brooks & Brooks, 1999). Teachers are also required to develop the aforementioned student capacities through their instructional and assessment design and actions, and therefore instructional design theory, which contends that students are instructed in a manner that enables them to understand why procedures exist and

how skills and knowledge are applied in context (Bruner, 1966; Mayer, 1992; Merrill, 2001, 2007), also becomes highly relevant. A combination of these two theories support both a contemporary understanding of learning and the instructional considerations that are most fitting for students being prepared for the current century's life and work demands.

Theoretical Framework

Learning is the main reason for students to attend school, and "A major goal of school is to prepare students for flexible adaptation to new problems and settings" (Bransford et al., 2000, p. 235). Many theories of learning have been posited since the early part of the 20th century where behaviorism dominated the way learning was perceived (Gredler, 1992; Yilmaz, 2011). The view that people changed their behavior through external cause and effect experiences did little to explain how their understanding and thinking was impacted. This resulted in an alternative framework being proposed called cognitivism (see Yilmaz, 2011).

Cognitive psychologists have continued to empirically observe behavior, but not as an end in itself. They instead observe it as a means to making inference as to the internal mental processes at work within an individual. Recent research on learning indicates that many people learn more naturally and deeply when specific and deliberate considerations are consciously included as part of the environment and instruction (Bransford et al., 2000; Donovan & Bransford, 2005). Learning and understanding can also be enhanced by embedding the learning of facts into organized and coherent bodies of subject knowledge (Bransford et al., 2000) rather than teaching topic-to-topic (Merrill, 2007). A framework that embraces the most current understanding of learning is essential when engaging in an effort to better understand and therefore improve teaching. A theory of instruction that best aligns with this understanding of learning should also be considered. Two frameworks, cognitive constructivist learning theory

and instructional design theory, are used in this study to support how instructional rigor is defined and associated with the modern demands of classroom teaching.

The current thinking related to instructional rigor states that the learner must be actively involved in processing information (Aspen & Hawkins, 2000; Draeger et al., 2013; Paige et al., 2013), in realistic contexts (Bower & Powers, 2009; Brooks & Brooks, 1999; Dockter et al., 2010; Draeger et al., 2013; Maye, 2013), and in a meaningful way (Draeger et al., 2013) for it to be best internalized. This requires that there is an alignment between the teacher's instructional approach and the way the learner changes what he or she knows and understands (Mayer, 2011). Instructional rigor is commonly associated with the student's cognitive system (Erickson, 2002; Graham & Essex, 2001; Hess et al., 2009), which further relates to the mental structures that enable the meaningful processing of information (Caine & Caine, 1991).

These ideas regarding the way that students learn and how to most effectively teach to support this process, however are neither novel nor innovative. They are ideas posited by theorists such as Piaget, Bruner, Ausubel, and Vygotsky, to name only a few, all of which contributed to various views on constructivism and its perspective on learning (Biehler & Snowman, 1997). Bruner mostly emphasized an instructional emphasis that required teachers to instruct in a manner that promoted meaningful learning and a discovery approach (Biehler & Snowman, 1997; Bruner, 1960). Such ideas were further derived from much of the work conducted by Piaget as to how children come to make sense of the world. The study of learning therefore provides an important starting point for considering how best to teach (Mayer, 1992).

Cognitive Learning Theory and Constructivism

The cognitive perspective views learning as an active process that involves "…the acquisition or reorganization of the cognitive structures" through which humans process and

make sense of information (Good & Brophy, 1990; Yilmaz, 2011). Cognitive learning theory therefore focuses on making knowledge meaningful to the learner, and supports them to be able to connect their existing schemas and internal mental models of the world to new information (Biehler & Snowman, 1997; Marlowe & Page, 1998; Mayer, 2004; Woolfolk, 2009; Yilmaz, 2011).

A constructivist perspective holds that: "…the contemporary view of learning is that people construct new knowledge and understanding based on what they already know and believe" (Bransford et al., 2000, p. 10). Learning is much more than simply memorizing facts and information. Rather, learning is an active process (Bransford et al., 2000; Bruner, 1966; Mayer, 2011; Woolfolk, 2009) that draws on the "…innate predisposition of the brain to search for how things make sense…" and to "…acknowledge the brain's rules for meaningful learning" (Caine & Caine, 1991, p. 4).

Constructivism is an approach often promoted by theorists, such as Piaget, Vygotsky, and Bruner, and are based on continually emerging insights into how people learn, and what we now understand about learning and learning theory (Bransford et al., 2000; Mayer, 2011). Consequently, schooling "…should be a time of curiosity, exploration, and inquiry, and…learning how to find information to solve real problems" (Brooks & Brooks, 1999, p. 9) where new understandings "…result from the emergence of new cognitive structures" (p. 15). Teachers in a constructivist classroom, therefore, design lessons that permit students to make their own meaning while focusing on concepts and big ideas (Brooks & Brooks, 1999).

Mayer, a professor of psychology at University of California, Santa Barbara, and the former president of the Division of Educational Psychology of the American Psychological Association, and current vice president for Division C (Learning and Instruction) of the

American Educational Research Association, stated that learning has been historically seen as either: (a) response acquisition, (b) knowledge acquisition, or (c) knowledge construction (Mayer, 1992). In stark contrast to the classic behaviorist emphasis, knowledge construction modified the roles of teacher and learner. Unlike previous perspectives on learning, this view held that learning required greater activity and involvement from the learner who then became an active interpreter of information, a meaning maker of sorts, and much less a passive receiver (Mayer, 1992, reference to Dewey, and Resnick). Advances in the study of cognition and cognitive learning theory have provided access to more appropriate and more fitting forms of instruction (Biehler & Snowman, 1997). This has included designing instruction to take advantage of the learner's natural inclination and need to construct knowledge and understanding, connect prior knowledge with current information, and embed problems in authentic context (Barron & Darling-Hammond, 2008; Bransford et al., 2000; Donovan & Bransford, 2005). More recent insights on the science of learning has prompted educational psychologists, such as Mayer (1992) to argue for educational decision makers to forego proposing changes to instruction, unless such changes are firmly rooted in "...how people learn, think and develop" (p. 411).

Learning theory, especially related to continually developing understanding of cognition, and what Woolfolk (2009) refers to as first wave constructivism, has aligned with the thinking of such theorists as Jerome Bruner, the Director of the Harvard Center for Cognitive Studies in the 1960s, who emphasized an instructional approach that aligns with these ideas of learning (Gredler, 1992). Bruner believed that a teacher should orchestrate conditions that support students in constructing their interpretations and understanding of content (Bruner, 1960, 1966).

Instructional Design Theory

Instructional design theory focuses on the development of the learning conditions that most effectively meet the needs of learners and respects the way that the human brain makes sense of information (Bruner, 1966; Merrill, 2001, 2007). In a modern-day theory of instruction, the emphasis is on students developing meaningful understanding and not just simply memorizing facts and knowledge (Mayer, 2011). Traditional forms of instruction have often approached learning mimetically (Brooks & Brooks, 1999) or through a telling-out-of-context (Bruner, 1966). Recent advances in understanding the learner, however, have promoted pedagogical principles (refer to Bransford et al., 2000, and Merrill, 2001, 2007) that encourage students to engage in meaningful task-related problem solving, form conjectures, challenge their pre-existing suppositions, and build new cognitive structures in the process of making sense of how and why various ideas and disciplines endure and operate (Brooks & Brooks, 1999; Caine & Caine, 1991; Wiggins & McTighe, 2005).

Bruner held similar ideas about instruction. As with Piaget's conceptions of thought development, Bruner also believed that children's thinking was under constant construction and emerged into a more refined understanding of his or her environment. Bruner, therefore, suggested that teaching should be ever striving to further the child's thinking towards the next cognitive level (Bruner, 1960). However, Bruner (1966) lamented that teachers' instruction too often took the form of "telling-out-of-the-context-of-action" (pp. 159-160), which rendered the content and school, in general, meaningless in the eyes of students.

The perspective of Bruner regarding learning was shared by Taba, a prominent figure in American curriculum design, who developed ideas about curriculum and pedagogy that were well aligned to what the modern-day learning sciences now confirm to be the way meaningful learning occurs and endures (Bransford et al., 2000; Brooks & Brooks, 1999; Caine & Caine,

1991; Given, 2002; Jensen, 2006; Mayer, 1992, 2011; Wolfe, 2001). She emphasized teaching

for cognitive development (Taba, 1966), which stressed a different role for the learner in that

they would be more active in processing information (Caine & Caine, 1991), and a different role

for the teacher whereby he or she became a guide and facilitator of learning rather than a

depositor of factual knowledge (a notion that was advocated for by Bruner, 1966). Taba (1966)

believed that an interweaving of other processes (for example, basic knowledge, attitudes, and

academic skills) were essential to learning, which is, in a more contemporary sense, an idea

advocated by Given (2002). The focus in Taba's research was on determining whether or not

teaching for cognitive development (or thinking) in upper elementary students in social studies

confirmed her hypothesis, which assumed that utilizing appropriate cognitive teaching strategies

would support students developing greater abstract understanding in less time and more

systematically than when either chance or accident was permitted (Taba, 1966). Using a pretest-

posttest control group design and classroom interaction analysis, the results generally confirmed

the hypothesis, which revealed that "[T]he experimental groups tended to produce more abstract

and complex inferences" (p. 223), and that teachers, even with only 10 days of training on how

to instruct with a cognitive development-oriented approach, can modify their teaching behavior.

  Merrill forwarded a similar emphasis on instructional design. His four design principles

of instruction were also borne out of the cognitive and constructivist perspective of learning.

Merrill (2001) emphasized that teachers should incorporate certain principles in their instruction

based on specific learning requirements. He stated that the learner, firstly, should be engaged in

solving real-world problems that progress in complexity. Secondly, the learner should be

required to recall and draw upon previous knowledge and experiences in which to advance his or

her current understanding and mental models. Thirdly, the learner should be required to practice

applying his or her knowledge and skills to realistic problems, and be required to make errors, detect and rectify them in the course of practice. Fourthly, the learner should be required to demonstrate, reflect on, and defend his or her knowledge in order to create new and more personal mental models for use in new and future issues (Merrill, 2001).

Similarly, The National Research Council's (NRC) Commission on Behavioral and Social Sciences and Education conducted a two-year study on the science of learning, which was published in 1999. An additional NRC committee, the Committee on Learning Research and Educational Practice, was then charged with linking these findings to actual classroom practice and in the attempt to explicate and expand our understanding on the science of learning and its implications for instruction (Bransford et al., 2000). The report highlighted a need for students to learn with understanding, be active participants in the learning process, and use their pre-existing knowledge. The implications for teachers, therefore, were that they must design instruction with their students' prior knowledge firmly in mind, teach for deep understanding, and teach metacognitive skills, simultaneously.

The thinking posited by Taba (1966) formed a foundation for more recent curriculum developers. Dr. Lynn Erickson, an internationally recognized expert on concept-based curriculum and instruction built on Taba's active learner-centered approach by viewing modern-day work demands to require a capacity to be independent, to identify and solve complex problems, and to collaborate rather than simply follow orders, attend to tasks that require little thought, and operate in relative isolation as in an outdated industrial model (Erickson, 2002). Furthermore, Erickson felt that brain-based research and its findings have revealed that students must be actively engaged in learning and must be able to use information in "demonstrations or complex performance" (p. 3) if that information is to be understood and retained.

Drs. Erickson and Lanning (2014) further developed this conception of curriculum, and stated that traditional models have often focused on skills and facts, which have failed to develop in students a conceptual understanding of the content they encounter in school. Instead, Erickson and Lanning (2014) proposed a concept-based curriculum model that aligns with brain research, promotes deep conceptual understanding of content and structures of a given discipline similar to that of experts in a given fields, and encourages greater transfer of factual knowledge to other varied situations in different time periods and cultures (Sousa, 2006). Similarly, Ainsworth's (2010) perspective on rigor is characterized by the application of knowledge through higher-order thinking skills, a striving for greater quality in both effort and outcome. This therefore serves as, a revised standard by which we view rigor according to 21st century criteria (Wagner, 2008).

All of these theorists and thinkers situate learning based on the insights gleaned from research in the learning sciences, which have informed a contemporary science of instruction (refer to Mayer, 2011). Mayer (2004), however, provides an instructional caution regarding a constructivist approach based on a review of constructivist pedagogy and to propose that aspects of constructivism be the focus of scientific study and not the doctrine itself. Mayer categorized constructivist approaches into three categories based on various studies conducted on this theoretical orientation to instruction: (1) Pure discovery, (2) guided discovery, and (3) expository discovery. The first approach provided the learner with "maximal freedom to explore" (p. 15), whereas the guided discovery approach required the teacher to provide systematic guidance, which included giving the learner hints, coaching, and feedback. The latter was comprised as giving the learner the problem and the answer, but no support. Mayer's contention was that guided discovery yielded the most effective approach as pure discovery relied on the learner

already possessing and then selecting the appropriate previously acquired background information, which they may not have had. Mayer's concern was that instruction based on constructivism is greatly misunderstood and is often associated behavioral activity, such as hands-on activities or discussions, which may fail to promote meaningful learning and guide students' cognitive processing without the necessary structure; a perspective shared by Brooks and Brooks (1999) and Marlowe and Page (1998).

21st Century Considerations for Rigor

Education in the post-modern era has necessitated the development of a revised view of learning and knowledge construction, which has therefore further necessitated a new view of rigor (Doll, 1993). Contemporary education is charged with the same purpose of schooling as in previous eras, which is to prepare students for the adult world and work to which they will one day enter (Blackburn, 2013; Darling-Hammond, 2008). However, the adult and working world that exists in the 21st century is vastly different today than it was years ago (Barron & Darling-Hammond, 2008), and the development of the skills and dispositions required of the current and modern workforce is the new charge of schools (Wagner, 2008). The changing nature of work and its requisite demands has been informally studied and discussed by Wagner who has written frequently that schools need to develop in students 21st century skills, which require them to be able to communicate effectively, reason, think analytically, problem solve, and develop conceptual understanding of content (Wagner, 2008). His extensive interviews with business leaders in various fields has revealed that there exists a discrepancy between the learning being promoted in classrooms, and the requirements of the adult-working world. This became evident for Wagner through a vast number of walkthroughs of classrooms in high schools and

elementary schools as part of districts' analysis of teaching quality, and discussed in his book

The Global Achievement Gap (Wagner, 2008).

Wagner's (2008) perspective on rigor is related to the skills needed for 21st century work

as determined by extensive interviews with business leaders. He stated that rigor has traditionally

been thought of as "…mastery of more and more complex academic content" (p. 110). He added

that the public has viewed it as more homework and more content, whereas educators have

typically defined it as covering more content at a faster pace. Wagner (2008) has thus defined

rigor as students being able to think critically, comprehend complex material, apply knowledge

to new and unfamiliar problems, and communicate effectively. It is through a common lens that

Wagner says that rigor should be viewed. For the purpose of honing groups to view academic

rigor consistently and reliably in classrooms, Wagner suggested that they consider asking four

key questions:

1. "How do you define rigor?

2. What are the teachers and students doing in the class that would be defined as rigorous?

3. What would be evidence that a class is more rigorous than another?" (Wagner, 2008, p. 158).

4. What in your students' work is evidence of academic rigor? (T. Wagner, personal communication, June 22, 2014).

The Connecticut State Department of Education (CTSDE) has recently adopted Wagner's

definition of rigor in its *Common Core of Teaching and Learning* (CSDE, 2010). This was

inserted when the state's guide for Connecticut teachers regarding how they should develop

student learning was revised.

Instructional Rigor in Practice

The existing research that has focused on instructional rigor has highlighted the need for a model or framework for developing teachers' capacity to employ more rigorous instruction, as well as for educational leaders to support the development of instructional rigor.

Dr. Karin Hess, President of Educational Research in Action, and former Senior Associate at the National Center for the Improvement of Educational Assessment, seemingly drew upon the brain-based science of learning from works such as those of child neurologist Judy Willis, to develop the Cognitive Rigor Matrix (Hess, 2013). Hess, who co-led the development of the content specifications for the new Smarter Balanced Assessment Consortium (SBAC) tests for Common Core in both math and English language arts, developed the Matrix by combining the revised Bloom's taxonomy (Anderson & Krathwohl, 2001) and the work of Norman Webb whose framework emphasizes the depth of knowledge required for learning application and ranges from recall (Level 1) to extended thinking (Level 4) and is used to explicate the cognitive demand of state assessments and grade level learning expectations (GLEs). This framework was used in Hess et al. (2009) to determine the level of cognitive complexity and challenge imposed by teacher assignments when considering over 20,000 student work samples across three states. The framework has been expanded to develop a Matrix for science, social studies, math and language arts and can be used in consideration of the new Common Core Standards.

A similar framework to Hess's Cognitive Rigor Matrix was developed by Daggett (2005; 2014), President of the International Center for Leadership in Education. However, Hess's Matrix provides a clear and explicit guide for studying instructional rigor, and has been widely used to evaluate the cognitive challenge of student work and tasks (see Hess et al., 2009), "assessment planning and instructional practice" (Hess, 2013, p. 1).

A constructivist, guided discovery centered approach to learning and teaching (Mayer, 2004) provides an appropriate overall lens for viewing rigor for current-day school instruction. Such a lens is supported by a view to the necessity for skills, understanding and dispositions required for the 21st century and college and career readiness. Both empirical and non-empirical literature definitions vary, but collectively viewed, they provide a conception for how it can be defined and how it might be studied beyond and in addition to what has been done, thus far.

Support and justification for the use of this selected theoretical framework is derived from the empirical studies reviewed on academic or instructional rigor. For example, in seeking to establish and validate an Instructional Quality Assessment (IQA) tool built upon the principles of learning (developed by the Institute for Learning, 2002, and Resnick & Hall, 2001), Boston, and Wolf (2006), Junker et al. (2006), Wolf et al. (2005) grounded their combined research on a constructivist approach to learning, as well as on the principles of instruction illuminated in Bransford et al. (2000). Maye (2013) based her conceptions of academic rigor on Wagner's perspective relating Bloom's revised taxonomy (Anderson & Krathwohl, 2001) to higher levels of cognition. Additionally, Paige et al. (2013) highlighted Hess's Cognitive Rigor Matrix (Hess, Jones, Carlock, & Walkup, 2009) as: "One method for assessing higher order thinking…of the cognitive complexity required of students during instruction" (Paige et al., 2013, p. 109).

Table 2.1

Theoretical Framework for the Literature

Heading	Citations
Cognitive Learning Theory & Constructivism	
This perspective views learning as an active mental process, and the learner as an active processing agent. Learning includes the acquisition of facts, but is more so defined as an understanding of big ideas and concepts, and so knowledge must be meaningful.	Biehler and Snowman (1997); Bransford, Brown, and Cocking (1999); Brooks and Brooks (1999); Donovan and Bransford (2005); Caine and Caine (1999); Good and Brophy, 1990; Mayer (1992; 2004; 2011); Yilmaz (2011)
Instructional Design Theory	
Instruction emphasizes students being engaged in meaningful task-related problem solving, and forming conjectures to understand ideas and not just know facts. This modifies the role of both the student, who becomes an active meaning-maker, and the teacher, who becomes a facilitator of learning and not a depositor of information.	Bruner (1960, 1966); Erickson (2002); Erickson and Lanning (2014); Merrill (2001, 2007); Taba (1966)
21st Century Considerations for Rigor	
Rigor in the new era requires conceptual understanding of ideas and much less knowledge of facts in isolation from context. Students are required to learn skills, such as problem solving, reasoning, critical and analytic thinking, and effective communication, all of which relate to the needs of the current work world.	Wagner (2006, 2008)
Rigor in Practice	
Situated within a learner-centered framework, rigor can be more clearly understood and assessed by educators as a view to determining the student use of higher-level thinking as a means to understanding.	Hess, Carlock, Jones, and Walkup (2009); Hess (2013)

This review indicates that the central drive behind a teacher's belief regarding the most effective instruction, and therefore the selection of the method of instructional practice to employ, is often based on his or her beliefs about how students learn. Therefore, if a teacher believes that students make greater sense of content and understand it deeply when they are presented with problems that are situated in realistic contexts (Dockter et al., 2010; Maye, 2013; Stone, Alfeld, & Pearson, 2008), require them to draw upon their higher order cognitive capacities (Bower & Powers, 2009; Draeger et al., 2013; Hess et al., 2009; Paige et al., 2013; Raudenbush et al., 1993), and are required to demosntrate a capacity to transfer their learning to new and unfamilar situations (Hess et al., 2009; Stone et al., 2008), the teacher will more likely believe that instruction should promote these elements, and therefore this will increase the liklihood that he or she will employ practices that inspire these elements to be realized in the classroom.

The following section separately presents definitions and findings from empirical research that have emphasized instructional rigor as a central part of the study.

Academic Rigor

Improving instructional effectiveness is the literature's common view on rigor. However, rigor's definition has been notably quite varied (Blackburn, 2013; Daggett, 2005; Jackson, 2011; Jacobs & Colvin, 2009; Jolly, 2008; National High School Alliance, 2006; Rainwater et al., 2008; Wraga, 2011). Jolly (2008), a researcher in the area of gifted education provides one such example, having commented that little empirical clarification and insight exists on the understanding and nature of rigor and what it means to employ rigorous tasks and curricula. Similarly, Jackson aimed at improving teaching and educational leadership by emphasizing in her book *How to Plan Rigorous Instruction* that everyone views rigor as being important, but

very few can agree on its definition (Jackson, 2011). She, nonetheless, stated, they [educators] still feel they will recognize it when they see it, despite them not having "a fully defined idea of what it is" (p. 15).

The variation on how academic or instructional rigor is defined, has created confusion within the discourse of educational improvement and reform due to the varied definitions of what constitutes rigor (Blackburn, 2013). Teacher and practitioner pedagogical efficacy has been brought into question (Boser & Rosenthal, 2012; Hess, Jones, Carlock, & Walkup, 2009; Manthey, 2005; Marzano & Toth, 2014; Maye, 2013; Raudenbush et al., 1993), and has been the subject of criticism for the lagging achievement of American students (Joftus & Berman, 1993; Quint, Thompson, & Bald, 2008; Stone et al., 2008; Wyatt et al., 2011).

The perspective that instructional rigor is unclear and ill defined is not, however, shared by educational theorists such as Ainsworth (2010), Blackburn (2013), Daggett (2005), and Hess, Jones, Carlock, and Walkup (2009). These theorists have defined it in similar ways, and all feel that they can articulate and define it within a framework that can be used to support more effective instructional practice. Their interpretations hold that student learning should be viewed within a scheme that focuses on cognition and application. Such frameworks include a continuum that begins with lower level cognitive capacities to higher levels of understanding that require students to think deeply. They also include a continuum that ranges from being able to apply learning to basic tasks, all the way to being able to transfer learning to other unique and unfamiliar situations, which is a concept and perspective posited by the Common Core State Standards (Common Core State Standards Initiative, 2016). Unfortunately, the perspectives promoted by these various theorists do not explain nor provide much guidance on how to

develop them in teacher praxis, which is the reason that many teachers are confused by rigor (Jackson, 2011).

The more recent perspective on instructional rigor (Bower & Powers, 2009; Draeger et al., 2013; Hess et al., 2009; Paige et al., 2013; Raudenbush et al., 1993) is that it is chiefly concerned with the learning tasks and assessments assigned to students by their teachers, and it embraces similar ideas as methodological rigor in that it requires students to think and operate at a high level of performance. The key shifts, for example, in the Common Core Standards that articulates rigor, and defines it as students being able to develop a conceptual understanding of course content, apply facts and knowledge to contextual situations, as oppose to only being able to recall or comprehend facts it in isolation (Common Core State Standards Initiative, 2016; Mitchell et al., 2005). It also maintains a relationship to academic press's broad emphasis on the learning environment, expectations and challenging assignments. This requirement of the Common Core State Standards Initiative (2016) is to better prepare students for the modern world of work (Porter, McMaken, Hwang, & Yang, 2011; Wagner, 2008).

Various perspectives on academic rigor through limited formal research have defined it in such a way that it plausibly emerges from a constructivist orientation towards student learning, and it aligns with what we currently understand about human learning through the learning sciences. The perspective of a modern-day view of classroom learning and instruction is embedded in a theoretical framework that embraces the notion that contemporary education aims to prepare students for the 21st century adult working world, and to help them make deeper sense of the world in which they live, and not just accumulate facts and knowledge for the acquisition of grades and test scores.

There exists a variety, albeit limited, body of empirical research on instructional rigor as a broad construct that has illuminated its encompassed constructs, which are used to define it. It is has been included as a central focus in several studies, yet there does not exist a singular, nor common definition (Bower & Powers, 2009). Various approaches to studying academic rigor have also been employed, ranging from quantitative oriented studies to qualitative interview-centered research (see Table 2.3).

The Empirical Definition of Academic Rigor

Numerous definitions exist that collectively relate to what Blackburn (2013) couches as students being expected and able to demonstrate learning at high levels within an environment that encourages and promotes such standards. This necessitates a need to draw upon the empirical and formal definitions utilized within research to explicate a definition that can be used by practitioners and other educational stakeholders in which to provide a common view of instructional rigor. The following section delineates the constructs of instructional rigor that is common to the current research.

Higher-order thinking and understanding. Some researchers have defined academic rigor in the same way that constructivists and the learning sciences have defined meaningful and conceptual learning (Bransford et al., 2000; Mayer, 2011). For example, in an analytical assessment of the rigor of state standards, Joftus and Berman (1998) broadly defined academic rigor as emphasizing the teaching of essential concepts and skills, and students being able to understand and apply the concepts and skills at an appropriate level of sophistication in accordance with grade level expectations. Similarly, but more specifically, Junker et al. (2006) and Boston and Wolf (2006) associated academic rigor with an inquiry approach to instruction, and on the student's part, an in-depth learning of important content, and an active construction of

43

knowledge. Boston and Wolf (2006) also noted that it involved making connections between concepts, and collaborating and communicating one's thinking. Both studies, which were related to the piloting of specific rubrics aimed at improving the quality of instruction and the rigor of assignments, were conducted in urban settings, and defined rigor using the National Resource Council's publication, *How People Learn* (Bransford et al., 2000). This was mirrored in Aspen and Hawkins (2000) who provided a personal description, albeit a general overview, of the components of their individual theology courses that employed active pedagogical approaches in undergraduate biblical studies at two university settings. Both settings were the site of the authors' professorship. The professors also included a limited and unsystematic report of some of their students' perceptions of the courses. The authors defined academic rigor as active learning, whereby students were able to communicate effectively, especially in writing, deeply reflect, self-evaluate, and consider ways to demonstrate that the learning had been understood. The latter also included being able to engage deeply with the content.

An examination of the instructional goals in a total of 1,205 classes taught by 303 teachers in a total of 16 high schools in California and Michigan was conducted by Raudenbush et al. (1993). The researchers implicitly defined academic rigor as higher-order thinking, as did Wolf et al. (2005) who defined rigor as giving students opportunities to think at high-levels, actively use knowledge, and deepen their conceptual understanding of content in subjects. It also included providing students with challenging tasks that required them to explain their thinking, justify their arguments, and interpret and analyze the underlying meaning of text in observations of literacy lessons as part of a multi-site study. This definition was echoed by Bower and Powers' (2009) research at a single elementary school. At this setting, academic rigor was primarily defined as the use of higher order thinking and real-world application, which was

similar to Paige et al.'s (2013) results ans defined academic rigor as the extent of time spent actively engaged in higher-order thinking and cognitively challenging tasks. Cooper's (2014) definition of academic rigor also emphasized high levels of cognition and focus, challenging work, and a passion for the content being studied. Many of these definitions were framed within an approach to instruction that was largely student-centered that required a high degree of student involvement (Dockter et al., 2010; Graham & Essex, 2001).

Draeger et al. (2013) sought to explore how academic rigor should be defined in a single university setting (the location of their professorship). This was in response to the need to create a definition that could be used to support their institution's mandate to *engage students in more rigorous learning.* Draeger et al. (2013) found that the university faculty defined academic rigor as encompassing four key constructs: (1) active learning, (2) meaningful content, (3) higher-order thinking, and (4) appropriate expectations, and thus "…argued that learning is most rigorous when students are actively learning meaningful content with higher-order thinking at the appropriate level of expectation in a given context" (p. 278). This definition aligns directly with instruction that involves students being presented with an appropriate level of complex or sophisticated challenge (Dockter et al., 2010; Draeger et al., 2013; Hess et al., 2009; Joftus & Berman, 1998). A similar study was conducted at the post-secondary level by Graham and Essex (2001) who researched the level of importance that eight selected faculty members at a single Midwestern university assigned to academic rigor when designing courses, and the types of strategies they used to ensure it. Their findings revealed that critical thinking and an emphasis on cognitive development were common definitions. Faculty participants also described academic rigor as requiring scaffolding and support for such learning.

Meaningful and contextualized learning, in addition to higher-order thinking, were the central definitions posited by Stone et al. (2008), and so academic rigor in this study, which centered on career and technical education (CTE), was represented through math tasks that were contextualized and situational, whereby learning was transferable to unlike, but realistic situations; an idea supported by Hess et al.'s (2009) description.

Traditional curriculum and classroom practices have often emphasized the use of the levels of thinking associated with Bloom's Taxonomy (Erickson & Lanning, 2014), and have at times utilized the taxonomy (Bloom, 1956) to define academic rigor based on the upper levels of cognition. For example, Hess et al. (2008) defined rigor as "…complex thinking and application of knowledge" (p. 8) that focused on conceptual understanding, relevance, and transfer of learning to new and more complex situations. These constructs were framed by the use of Bloom's taxonomical levels of cognitive complexity. In an analysis of student work, Hess et al. (2009) combined Bloom's Revised taxonomy (Anderson & Krathwohl, 2001) and Webb's (2002) Depth of Knowledge (DoK) model to devise a Cognitive Rigor Matrix that was used to support states, schools and teachers in examining tasks, assignments and tests to determine the level of challenge they mostly posed.

Daggett (2005) contended that students must be able to apply what they learn in school to a variety of ever-changing situations beyond school. The means by which students should be instructed, Daggett argued, is through rigorous and relevant tasks, which he felt is most aptly measured through a tool called the Rigor/Relevance Framework. The four quadrants related knowledge (rigor) to application (relevance) on a continuum. Relevant tasks ranged from acquiring basic knowledge in one discipline to conceptualizing knowledge and solving complex problems in authentic, real-world, unpredictable situations. The levels of Bloom's taxonomy

were used to determine the degree of academic rigor. Daggett believed that this framework would be invaluable in designing and ensuring the rigor of testing for the Common Core State Standards (Daggett & Gendron, 2010). Additionally, Daggett & Nussbaum (2008) provided justification for the framework by drawing on how brain research relates to rigor, relevance and relationships, and that fundamentally, learning should be an active process for students.

An analysis of the cognitive rigor of student work against the higher-order thinking required in CA state standards, was conducted by Manthey (2005). In this research, Manthey employed a framework that compared the work of grade seven math students in a single school to CA state standards using Bloom's taxonomy. The implication was that academic rigor was associated with the upper levels of Bloom's taxonomy. Maye (2013) also used the revised Bloom's levels (Anderson & Krathwohl, 2001) in analyzing students' work and teachers' instruction in one low-performing, high-poverty elementary school. She explicitly defined academic rigor as being the capacity to make decisions about the use of procedures, determine and critique various points of view, analyze, synthesize, and evaluate in order to solve problems. The association of the Bloom's taxonomy and the upper levels of cognition (synthesis, analysis, evaluation) as representative of higher levels of thinking, was also evident in Lynda Johnson's (2010) dissertation, which utilized an action research approach to improving academic rigor in a single K-8 setting.

The use of Bloom's taxonomy, while used to define academic rigor, has been cautioned against by some. For example, Hess et al. (2009) warned against simply using Bloom's (1956) model, which included the revised taxonomy (Anderson & Krathwohl, 2001), because some of the verbs appeared at more than one level, and was deemed unsupportive of teachers being able to adequately determine the cognitive demand required of the student to make sense of the

content. Similarly, Erickson and Lanning (2014) felt that Bloom's Taxonomy was problematic due to the limitation of teachers' understanding of how to appropriately apply verbs, especially those representing the higher levels of thinking. They indicated that rigid assignment of verbs to student learning tasks undermined synergistic thinking, which is necessary for flexible thinking (Erickson & Lanning, 2014).

Another perspective from Boser and Rosenthal (2012) stated that higher academic standards, such as the Common Core State Standards that emphasize a greater capacity for students to be challenged in class, are implicitly defined as academic rigor. The definition of challenge was not presented nor explained due to the fact that this research drew only on the perceptions of students taken from the National Assessment of Educational Progress (NAEP) student survey. Thus, it called for additional research to investigate whether classroom tasks actually lack rigor, although NAEP results, according to Boser and Rosenthal (2012), suggest this to be true.

A traditional perspective. Other researchers, such as Boser and Rosenthal (2012), Burris et al. (2008), and Wyatt et al. (2005), have defined academic rigor with less emphasis on cognition and understanding, and related it more so to college and career readiness. This is often deemed to be a traditional view of rigor whereby it is associated with grades and college entry. Wyatt et al. (2005) associated it with the time a student spends studying outside of class, and his or her grade point average (GPA), while Burris et al. (2008) associated it with a capacity to succeed on an assessment by objective means, often thought of as standardized tests. These perspectives, especially the latter, may be the view taken by many community members when emphasizing the need to increase academic rigor (Wagner, 2008).

The various constructs of academic rigor evident in the way that empirical research has conceptualized it are presented in Table 2.2. The constructs provide a view of the components that comprise cognitively challenging instruction.

Table 2.2

Common constructs of rigor found in empirical research and organized by theme

Constructs of academic rigor		
Critical thinking and cognitive challenge	Meaningful and relevant learning	Transfer of learning
Critical thinking (Graham & Essex, 2001) Higher-order thinking (Bower & Powers, 2009; Draeger, del Prado Hill, Hunter, & Mahler, 2013; Paige, Sizemore, & Neace, 2013; Raudenbush, Rowan, & Cheong, 1993) Active mental work and sense-making (Draeger, del Prado Hill, Hunter, & Mahler, 2013, 2005; Paige, Sizemore, & Neace, 2013) Appropriate level of complex or sophisticated challenge (Dockter, Haug, & Lewis, 2010; Draeger, del Prado Hill, Hunter, & Mahler, 2013; Hess, Carlock, Jones, & Walkup, 2009; Joftus & Berman, 1998) Problem solving (Maye, 2013) Synthesizing information (Maye, 2013) Multiple-perspective taking (Dockter, Haug, & Lewis, 2010) Cognitive development (Graham & Essex, 2001)	Real-world application (Bower & Powers, 2009; Dockter & Lewis, 2009; Draeger, del Prado Hill, Hunter, & Mahler, 2013; Maye, 2013; Stone, Alfeld, & Pearson, 2008) Application of concepts and skills (Hess, Carlock, Jones, & Walkup, 2009) Meaningful work (Draeger, del Prado Hill, Hunter, & Mahler, 2013) Creative and critical use of knowledge (Dockter, Haug, & Lewis, 2010) Student involvement (Dockter, Haug, & Lewis, 2010; Graham & Essex, 2001)	Transfer of learning to new and more complex situations (Hess, Carlock, Jones, & Walkup, 2009; Stone, Alfeld, & Pearson, 2008)

Numerous definitions on rigor, as indicated in this review, provide a challenge for teachers according to Blackburn, (2013) and K. Hess (personal communication, February 1, 2015) in being able to employ rigorous instruction. This is the case when considering the lack of higher-order thinking in Hess et al. (2009), Manthey (2005), and Maye (2013). Additionally, traditional curriculum and classroom practices have often emphasized the use of the levels of thinking associated with Bloom's Taxonomy (Erickson & Lanning, 2014), and have at times utilized the taxonomy (Bloom, 1956) to define academic rigor based on the upper levels of cognition.

Empirical Findings from Studies on Academic Rigor

Academic rigor has been defined in varied ways throughout the literature. Yet it embraces active sense making, meaningful learning, higher-order thinking and the transfer of learning between familiar and unfamiliar situations (Bower & Powers, 2009; Draeger et al., 2013; Hess et al., 2009; Paige et al., 2013; Raudenbush et al., 1993). Empirical studies that have involved academic rigor have gleaned results and findings that inform an understanding of this construct, as well as the next steps for studying it.

Academic rigor positively impacts student learning. Learning has been increased when certain characteristics of instruction have been applied. For example, a personal description of undergraduate theology courses in two separate university settings that utilized an active pedagogical approach, found that an active learning approach and varied approaches to assessment increased student ownership without compromising academic rigor (Aspen & Hawkins, 2000). Rigor was conceptualized as the students' capacity to communicate effectively, especially in writing, and to engage deeply with the content. These findings indicate that, even in very traditional fields of study, students prefer an active learning approach. However, it is

51

important to keep in mind that this was a description of the courses with some student perspectives regarding the active learning approach that did not indicate whether a systematic approach to gleaning the students' perspectives were employed.

Similar findings, though, were noted in Cooper (2014) who conducted a mixed methods case study focused on student engagement. The purpose was to determine how three types of engaging teaching practice, which included connective instruction, academic rigor (described as tasks that demanded high levels of cognition, focus and challenge), and lively teaching were related to student engagement. Cooper's findings indicated that connective instruction, academic rigor and lively teaching were all positively correlated with student engagement at .70, .46, and .38, respectively. Students reported being most engaged when all three constructs were present, and rigor was also more strongly linked to engagement when lively teaching was utilized (Cooper, 2014).

Students were more engaged when they were required to attend to tasks of higher order thinking, which was also a result noted by Paige et al. (2013) who conducted 676 ninth-grade core content classroom observations at a low-performing urban high school. The researchers devised their own instrument (the Student Engagement and Rigor Scale for the Classroom [SERC-C]) and sought to determine the extent to which the students were actively engaged in the lesson and secondly, the extent to which their tasks were cognitively challenging, using Webb's DoK model. Factor analysis and descriptive statistics were used to determine the relationship between classroom engagement and cognitive rigor.

Effective accountable student talk, which included teachers probing for students' thinking, and students providing justification for their thinking was found to be positively related to academic rigor (Wolf et al., 2005). Rigor was defined as high-level student thinking,

conceptual understanding, and students explaining their thinking, justifying arguments, and interpreting and analyzing content. In this study, 21 teachers drawn from three urban districts and across elementary and middle school (grades one through eight) lead the researchers to conclude that academic rigor required a high level of active mental processing, meaning making and communication, and demonstrating that content had been understood at a deep level. Similar findings were noted for active and meaningful learning, which was also found to be an outcome in a study of a documentary-film class by Dockter et al. (2010). The researchers employed a qualitative methodology that consisted of collecting and analyzing classroom observations, significant events, field notes, formal and informal interviews with the teacher, students and administrators, focus groups, and artifacts, such as student work and professional development and meeting materials. Students from a high-poverty, urban high school described their course on media as intellectually challenging and authentic. The students also stated that the course developed their sense of agency, identity and interests beyond school, and as such, was meaningful and relevant.

Studies at the university level have also revealed that learning requires students to actively participate and think at high levels and in meaningful ways. Graham and Essex (2001) qualitative approach to seek the level of importance that eight faculty at a large Midwestern university gave to academic rigor when designing courses, and the strategies they used to ensure it. Their findings provided a definition of academic rigor that was generally inclusive of critical thinking and cognitive development. All participants felt it was important, and therefore commissioned a variety of strategies to ensure it (Graham & Essex, 2001).

All of these findings support the view that academic rigor entails and promotes an active student learning emphasis, which is akin to positions noted by Bransford et al. (2000), Brooks

and Brooks (1999), Bruner (1966), Caine and Caine (1991), Mayer (1992, 2011), Taba (1966) and the constructivist perspective in general. Additionally, from a more outcomes-based perspective, students who took more perceived rigorous high school courses, which were defined as requiring higher-level thinking, making inferences, interpreting results, analyzing sometimes contradictory information, and supporting arguments with evidence, scored higher on the SAT, were more likely to attend a four-year college, and were more likely to achieve higher grades in college (Wyatt et al., 2012).

Exposing all students, regardless of their overall academic profile of achievement, to a challenging curriculum and requirements of higher-order thinking is both necessary and justifiable. Burris et al. (2008) found that by de-tracking students and providing access to a high-track curriculum for all of them, there was an increase in the probability that typically low-achieving student groups would earn an International Baccalaureate or a Regents diploma. The results of a longitudinal quasi-experimental cohort design to examine the effects on achievement of a single suburban high school's students within a de-tracked system also revealed that the typically higher-performing groups were not negatively impacted by heterogeneous classroom groupings and maintained their levels of achievement (Burris et al., 2008). This indicates that reserving a curriculum that requires higher-order student thinking (as suggested in this study) for only typical academically high-performing students is unjustified, and further suggests that instructional rigor is necessary for all levels of academic performer.

Student work often lacks cognitive challenge. An empirical body of research associated with studies involving academic rigor have found that student work often lacks the required challenge for students to be meaningfully and cognitively prepared for the demands of the 21st century. This was an idea posited by Wagner (2008), and a conclusion drawn from the work of

54

Paige et al. (2013) who stated that U.S. teachers do not fully know what makes work cognitively rigorous. This was exemplified in Manthey (2005) who found that seventh grade math students were required through teacher-assigned tasks to think at lower levels (Area 1 of 6 according to the state standards) 44% of the time, and high levels (Area 4 of 6) only 5% of the time, and only 7% of the time in Area 5 of 6. Manthey's analysis indicated that only 7% of CA state's standards required Area 1 thinking (Remember or Understand facts and/or concepts), whereas most of the thinking implied by the standards required Area 4 thinking (50%) (Apply or analyze procedures or metacognitive knowledge). The discrepancy between being asked to think at low levels 44% of the time instead of 50-63% (Area 4, and 4 and 5 combined) was indicative of low levels of academic rigor in the school's seventh grade math classes (Manthey, 2005).

Manthey's (2005) results were unfortunately repeated in other studies. For example, Hess et al. (2008), in an analysis of 200,000 student work samples from 200 public schools in Nevada and Oklahoma, found that most of the work in grade three (math and LA classes) were categorized as requiring low level thinking. The researchers used the Cognitive Rigor Matrix, which utilized the levels of Bloom's Taxonomy and Webb's DOK levels, to analyze the tasks assigned to the students. They further found that the work samples assigned to the students by their teachers required them to be overly reliant on following procedures and routine steps. This was further mirrored by Maye's (2013) small-scale study that involved 12 teachers (four from grade three, four from grade four, and four from grade five) in one low-performing, high-poverty elementary school. She used Daggett's rigor/relevance framework to analyze classroom observations, and found that most of the instruction required recall of factual information and following sequential steps. Teacher questioning was also viewed to be superficial and lacked prior planning for deeper learning (Maye, 2013).

Further evidence of a lack of cognitive challenge in teacher assigned instruction was noted in students' perspectives of their class work. According to Boser and Rosenthal (2012), who examined the National Assessment of Educational Progress (NAEP) student surveys in grades four, eight, and twelve, between 2009 and 2011, many elementary and middle school students believed that their classwork was too easy and failed to challenge them. Similar results were consistent across all subjects and grade levels. While Boser and Rosenthal (2012) defined academic rigor as an adherence to higher academic standards, such as those suggested by the Common Core so that all students can graduate high school, and be prepared for and attend college, their analysis revealed that teaching was seen to be most problematic. The authors, in response to the results, called for increased accountability for best-practice use in classroom instruction (Boser & Rosenthal, 2012).

A focus on the fundamental elements of classroom work was presented in Doyle (1983) whose review of the nature of academic work and the varying factors affecting it were guided by cognitive psychology. Doyle noted that approximately two-thirds of elementary and secondary student's classroom work tasks were directed by seatwork to complete printed worksheets. Through fieldwork in examining actual classroom tasks in high school English classes, Doyle and Carter (1984) observed that students adopted creative ways to minimize the level of challenge and complexity, or ambiguity and risk associated with understanding-level tasks. They did this by requesting additional direction from the teacher and slowing the flow of the lesson in numerous ways. As a result, the teacher eventually surrendered to the students' requests and increasingly provided more explicit direction and incentive that minimized the level of challenge, ambiguity and risk in the students' classroom tasks.

Rigor and instruction. Academic rigor has been discussed and described in numerous ways when relating to the instruction that students receive in classrooms. The level of cognitive challenge and the complexity of thinking required of students when provided tasks and assessments is at the core of a teacher's work (Doyle, 1981). The review of empirical research has revealed that it is mostly associated with constructs such as higher-order thinking, problem solving, synthesis, real-world application, and transfer of learning (Bower & Powers, 2009; Draeger et al., 2013; Hess et al., 2009; Maye, 2013; Paige et al., 2013). However, teachers are not always clear as to how academic rigor is defined (Bower & Powers, 2009; Hess, 2006; Blackburn, 2013). Bintz and Delano Moore (2010) exposed some confusion on the part of teachers in their study of instructional coaching (in math and literacy) conducted in a small western Kentucky elementary school in grades one through four. The teachers stated that they were unclear about the difference between practicing and problem solving in math. They further stated that they knew that their instruction was aligned to National Council of Teachers of Mathematics (NCTM) standards, but they did not know if their instruction was rigorous (Bintz & Delano Moore, 2010). A lack of clarity regarding how to define academic rigor was prevalent in another small-scale micro-ethnographic study in a single elementary school in a large urban district in the Southwest (Bower & Powers, 2009). The researchers stated that academic rigor was not clearly understood by the participants, which was comprised of two administrators and five teachers in grades three through five. The researchers further noted that findings from semi-structured interviews and one observation of a rigorous activity with each teacher-participant revealed that thinking skills was often superseded by the coverage of content. Bower and Powers (2009) concluded that academic rigor is a "critical element of a positive school culture that encourages academic achievement," but "…its definition and implementation remains elusive"

57

(p. 7). This result lead them to suggest further research be conducted to determine how other schools define and utilize academic rigor.

The describing and defining of academic rigor has also been a challenge at the post-secondary level. The faculty in Draeger et al.'s (2013) mixed methods study were asked to define academic rigor in their teaching. The results of their research suggested that academic rigor included analyzing various elements in course content, making judgments about the value of information, applying information to problems or new situations, and synthesizing and organizing information into more complex interpretations. However, the faculty reported feeling that they knew rigor when they saw it, but did not feel confident enough to define it (Draeger et al., 2013). The results enabled the researchers to eventually establish a definition that SUNY at Buffalo and Buffalo State University faculty could use to align their teaching with the institute's mandate to *engage students in more rigorous learning*. Likewise, an examination of how undergraduate students' attitudes towards academic preparation, effort, performance, standards and engagement differed from the faculty at a small liberal arts college in the Midwest produced interesting results. A random sample of students from the Liberal Arts and Sciences, School of Business, Teachers College and their professors held conflicting views towards the expectations for effort required for good grades (Wyatt et al., 2005). This suggested that the professors were unable to communicate and articulate the standards and expectations for high and accepted performance, because they were unclear as to how to define academic rigor, which implicitly related to the amount of time a student spent studying outside of class, and his or her grade point average. Many of the professors also reported feeling that the issue related more so to their colleagues, and not themselves, which also suggested a lack of understanding as to how rigor is defined and operationalized in classroom settings.

Varied definitions of academic rigor have been associated with teachers' lack of clarity on this construct (Bintz & Delano Moore, 2010; Bower & Powers, 2009; Draeger et al., 2013; Wyatt et al., 2005), which could be linked to the lack of cognitive and complex-thinking related challenge evident in students' tasks (Hess et al., 2009; Manthey, 2005; Maye, 2013) as evident in the research presented. It seems problematic to note that academic rigor is chiefly associated with positive student learning on tasks of higher-order and critical thinking (Cooper, 2014; Dockter et al., 2010; Paige et al., 2013; Wolf et al., 2005), as well as on more objective measures (Wyatt et al., 2012). Yet teachers seem to struggle with employing academic rigor in their instruction with students (Marzano & Toth, 2014), which is manifested through the tasks they assign. Findings from the research indicate that academic rigor as defined by the Common Core State Standards, focuses on instruction as a means for preparing students to be ready for adult life and work in the 21st century. Yet these findings indicate the implementation and operationalization of the CCSS may prove challenging (see Marzano & Toth, 2014; Raudenbush et al., 1993).

Teacher support and academic rigor. Findings from Boser and Rosenthal (2012), Hess et al. (2008), Manthey (2005), Maye (2013), and Paige et al. (2013) suggest that teacher support is required in order to promote greater levels of academic rigor in the tasks and assessments they assign to their students. This was evident in Boston and Wolf's (2006) study, whereby the students who attended a district school that had been working with the Institute for learning (IFL) received opportunities for more cognitively challenging work than students whose schools had just began working with the IFL (Boston & Wolf, 2006).

Stone et al. (2008) conducted a pre-post test to determine whether career and technical education high school students' learning was positively effected when their instructors were

supported by math teachers. The results indicated that the experimental group, whose instructors were supported by math teachers, outperformed the control group, whose instructors did not receive math-teacher support. The experimental-group students' math performance on traditional college-placement tests (similar to those used in real-world contexts) was positively influenced by infusing appropriately situated math lessons as part of contextualized, problem-based teaching (Stone et al., 2008). These and the aforementioned research findings suggest that teachers in and across various educational settings require support to enhance their understanding of, and capacity to plan for and implement academically rigorous tasks. Further justification is found in the statement that U.S. teachers do not know what makes work cognitively rigorous (Paige, Sizemore, & Neace, 2013).

The aim of teaching, according to Hattie (2009), is to ensure a cognitive change in students. Yet, DuFour and Marzano (2011) and Hattie (2009) feel that teachers lack, not the motivation to improve their practice, but a capacity to implement specific instructional interventions that positively effect student learning. Based on meta-analyses, Hattie (2009) noted that professional development may change what a teacher learns, but surprisingly, it does not necessarily impact their behavior in the classroom. Even more shockingly, he noted that professional development has a minimal effect on student learning ($d = 0.37$). Weiss and Pasley (2006), a few years earlier, had found similar outcomes. Their research indicated that math and science scores were partly the result of weak teaching, which they declared to be the product of ineffective teacher professional development. Marshall and Smart (2013) stated that teachers either harbor a positivist paradigm towards science and math, or do not understand how to establish an inquiry-oriented classroom. This has resulted in typical professional development efforts often failing to produce the intended and desired impact, and because professional

development, they noted, requires considerable time and energy to effect teachers' practice in which to move teachers away from simply providing students with activities, the current time allotted for professional development is inadequate to support teachers in providing students with meaningful, conceptual-oriented learning experiences. This may also be the result of an inadequate emphasis on conceptual understanding in professional development, which was found in the National Center for Education Statistics' 1999-2000 Schools and Staffing Survey whereby less than half of the subjects reported participating in professional development that was described by educational, research and policy groups as being of high quality (Choy, Chen, & Bugarin, 2006).

Doyle (1983) posited that teachers require training in managing the academic tasks in classrooms. He further stated that teachers need to think about the cognitive demands that their tasks require of students, and plan for tasks that emphasize understanding as opposed to only memorization and lower-level thinking tasks. Similarly, Ehrenberg (1981) hypothesized that teachers lacked clarity on the definition of concepts, which likely lead to them being unable to distinguish between teaching for higher-level conceptual understanding, versus teaching for lower-level fact acquisition. Yet, without adequate professional development and in-service training, the requirement for teachers to increase the rigor of their academic instruction will be misunderstood and likely misinterpreted. Thus, as DuFour and Marzano (2011) and Garet, Porter, Desimone, Birman, and Yoon (2001) point out, teachers may be allowed to think that their practice is rigorous when, in fact, it is not.

The existing studies on rigor also indicated that research in high achieving middle level suburban settings would add to the knowledge base. Therefore, seeking a middle school

teacher/practitioner-level perception of this construct would provide a lens that is currently unavailable.

The Focus of Previous Research on Rigor

Some researchers have examined students' work for cognitive challenge (Hess et al., 2009; Manthey, 2005; Maye, 2013), but these studies did not explore nor examine the reasons that teachers assigned such tasks, regardless of the level of challenge they posed for students. An approach to research is needed that deems it is necessary to uncover teacher's understanding of rigor and what it means to increase it in order to better understand why they make decisions as to the level of challenge they pose for students.

No study to date has drawn on the array of definitions of rigor to establish a functional and operational definition that can be used to bring a more common and practical view of high-level instructional rigor for teachers, education leaders, policy makers and parents. Such a common and practical perspective will also support efforts to improve instruction, and especially teachers' capacity to understand and use more rigorous classroom tasks and formative assessments. We also know little about how teachers actually define and use instructional rigor, especially suburban middle school teachers. No study has involved public school teachers in examining and exploring academic rigor in order to develop their understanding and use of it when planning for, instructing and assessing student learning. The research also points to the need to consider teachers' conceptions as to how they define and understand academic rigor (Bower & Powers, 2009). The absence of this understanding from teacher perspectives will limit the support they receive through professional development and through teacher professional growth and evaluation processes now prevalent as part of state and district accountability systems.

Developing a greater understanding or rigor as it relates to a teacher's subject or content area, and developing their capacity to plan with it in mind to ensure that rigor is evident in the classroom tasks (including formative assessments) they assign to students, while situating these two aspects in a teacher's natural environment is required. This recommendation was posited by Bransford et al. (2009). Further support for this view is found in Darling-Hammond and Richardson (2009), Hattie (2009), Marshall and Smart (2013), Marzano, Waters, and McNulty (2005), and Weiss and Pasley (2006).

The Methods and Methodology of Previous Research on Rigor

Various studies that have focused on the construct of academic rigor have mainly been conducted in low-performing urban settings, high school or in higher education. Very few studies have been focused on the middle grades, and none have been conducted in a suburban setting (see Table 2.3). These studies utilized various qualitative methods to examine and explore academic rigor, which included observations of teachers (Dockter et al., 2010; Junker et al., 2006; Maye, 2013; Paige et al., 2013; Wolf et al., 2005), interviews (Bower & Powers, 2009; Dockter et al., 2010; Draeger et al., 2013; Graham & Essex, 2001; Junker et al., 2006). Other studies used a variety of quantitative methods, such as correlational analyses (Boston & Wolf, 2006; Wolf et al., 2005), quasi-experimental designs (Burris et al., 2008), and surveys (Draeger et al., 2013; Wyatt et al., 2005) (also see Table 2.3).

Additionally, current research that has emphasized academic or instructional rigor has not sought to develop and increase teachers' understanding of rigor; nor has it attempted to develop teachers' capacity to align their planning, instructional and assessments with a more rigorous and cognitively challenging approach. Rather, most of the research has examined relationships between variables, such as teacher and student discussion and students' thinking (Wolf et al.,

63

2005) and rigorous instruction, curriculum and classroom climate (Matsumura et al., 2008). Other studies have investigated the extent of rigor in students' work (Hess et al., 2009; Manthey, 2005; Maye, 2013) and state standards (Joftus & Berman, 1998). Additional studies have explored perceptions of rigor at varying levels of academia (Bintz & Delano Moore, 2010 and Bower & Powers, 2009 at the elementary level; Draeger et al., 2013; Duncan et al., 2012; Graham & Essex, 2001 at the University level) (see Table 2.4).

None of these studies, however, involved actually developing teachers' capacity to understand and design instructional tasks (and assessments) and classroom work that represented high levels of cognitive rigor or student thinking within their natural context, which obviously means that measuring teachers' progress on this pedagogical component was also absent in the literature. Instead, this research employed a variety of methods, such as observations, interviews, teacher reflections, all of which are methods that can be used in a day-to-day school setting to simultaneously develop and measure a teacher's capacity to develop and design tasks that are academically or instructionally rigorous.

Furthermore, none of the studies emphasized nor encouraged a contextual approach to developing instructional quality (cognitive rigor) whereby full-time, building based instructional coaches and the building administrators, all of whom were familiar with each other, worked collaboratively and under non-evaluative conditions to support and observe teacher's practice. while this aspect was not a measurement aspect in this research, it is worth noting that only an action research approach was the only and most fitting approach to contextualize the development of teachers' capacity to better understand and increase academic rigor in their classroom instruction. This research's approach also eliminated the outsider or administrative-evaluator position, and aligned more with the research on professional development that

suggested that teachers learn together through more authentic means (Darling-Hammond & Richardson, 2009; Hattie, 2009; Marshall, & Smart, 2013; Marzano et al., 2005; Weiss & Pasley, 2006), which was necessary to develop teacher's ownership of their learning and to develop their understanding and pedagogy under less evaluative conditions. Additionally, no study to date has devised and implemented a specific teacher-learning module that has focused on increasing academic rigor, and has examined its effects on teachers' perceptions of their instructional efficacy.

Table 2.3

Methodological approaches used in studies focused on or in defining academic rigor

	Qualitative	Quantitative
Urban elementary school	Interviews (Bower & Powers, 2009; Junker, Weisberg, Matsumura, Crosson, Wolf, Levision, & Resnick, 2006) Observations (Junker, Weisberg, Matsumura, Crosson, Wolf, Levision, & Resnick, 2006; Maye, 2013; Wolf, Crosson, & Resnick, 2005)	Correlation and regression analysis (Wolf, Crosson, & Resnick, 2005) Correlational coefficients, descriptive statistics, and pairwise t-tests (Boston & Wolf, 2006)
Suburban elementary school		
Urban middle school	Observations (Wolf, Crosson, & Resnick, 2005)	
Suburban middle school		
Urban high school	Document analysis of state standards (Joftus & Berman, 1998) Classroom observations (Dockter, Haug, & Lewis, 2010; Paige, Sizemore, Neace, 2013) Interviews and focus groups (Dockter, Haug, & Lewis, 2010)	Multilevel regression modeling (Raudenbush, Rowan, & Cheong, 1993)
Suburban high school		Quasi-experimental design (Burris, Wiley, Welner, & Murphy, 2008)
University	Interviews (Draeger, del Prado Hill, Hunter, & Mahler, 2013; Graham & Essex, 2001)	Surveys (Draeger, del Prado Hill, Hunter, & Mahler, 2013; Wyatt, Saunders, & Zelmer, 2005)

Table 2.4

Investigative emphasis in studies focused on academic or instructional rigor

Academic level	Focus of study
Urban elementary school	To determine the relationship between the level of discussion (between teacher and students – questioning and classroom talk moves) and academic rigor (students' high level thinking) in reading comprehension (Wolf, Crosson, & Resnick, 2005) To determine whether the Instructional Quality Assessment (IQA) rubrics developed by the Institute for Learning (IFL) could identify the quality of reading and math instruction in two different districts affiliated with the IFL (Junker, Weisberg, Matsumura, Crosson, Wolf, Levision, & Resnick, 2006) To examine the level of accountable student talk, clear expectation and rigor (high level cognitive demands) in mathematics instruction (Boston & Wolf, 2006) To determine a single elementary school's definition and implementation of academic rigor (Bower & Powers, 2009) To examine the extent to which academically rigorous instruction was evident in a single elementary school (grades 3-5) (Maye, 2013)
Suburban elementary school	
Urban middle school	To determine the relationship between the level of discussion (between teacher and students – questioning and classroom talk moves) and academic rigor (students' high level thinking) in reading comprehension (Wolf, Crosson, & Resnick, 2005) To determine the relationship between rigorous instruction and curriculum, and classroom climate (Matsumura, Slater, & Crosson, 2008)
Suburban middle school	

Table 2.4

Continued

Urban high school	To explain the variations in teaching for higher order thinking (Raudenbush, Rowan, & Cheong, 1993)
	To evaluate the rigor of math and language arts in states' standards (Joftus & Berman, 1998)
	To examine the level of student-derived engagement in a rigorous media-based English class (Dockter, Haug, & Lewis, 2010)
	To analyze the effect of critical thinking on student engagement (Paige, Sizemore, & Neace, 2013)
Suburban high school	To examine the long-term effects on student achievement when all students were provided an accelerated high-track math curriculum and when hailing from a de-tracked middle school (Burris, Wiley, Welner, & Murphy, 2008)
University	To define the meaning of academic rigor according to members of a single university's faculty (Graham & Essex, 2001)
	To create an index of academic rigor in order to assist in providing information on the preparation of graduating high school seniors (Wyatt, Saunders, & Zelmer, 2005)
	To develop a multidimensional model to provide a single institution's faculty to increase the level of academic rigor (Draeger, del Prado Hill, Hunter, & Mahler, 2013)

The Next Steps for Studying Academic Rigor

The findings from various studies, as noted, indicate that teachers and practitioners evidence difficulty in understanding instructional rigor, and are unclear as to how they should apply the concept of rigor in their instructional practice (planning, instruction, and assessment) (Bintz & Delano Moore, 2010; Bower & Powers, 2009; Draeger et al., 2013; Wyatt et al., 2005). Many teachers relate higher levels of thinking to Bloom's Taxonomy (Ritchhart, Church, &

Morrison, 2011), but are often unclear about how to develop higher-order thinking due to the perceived vagueness in verb use within the hierarchical levels (Erickson & Lanning, 2014; Hess et al., 2009). Resulting challenges emerge when tasks and assessments assigned by teachers to their students are considered. This further reveals that they are unclear as to whether their instructional design and assessments are in fact instructionally rigorous (Bintz & Delano Moore, 2010), and in many cases, the work they present to students lacks instructional rigor (Hess et al., 2009; Manthey, 2005; Marzano & Toth, 2014; Maye, 2013. See also Joftus & Berman, 1993). This clearly indicates that an approach for supporting the development of a revised conception of learning and instructional practice for many teachers should be sought, which aligns with the suggestions in Bransford et al. (2000).

It is also evident that a plan to develop teacher's capacity to better understand and apply rigor is absent in the current literature and is therefore a necessary next step to helping them, and schools in general, adhere to the instructional requirements of the Common Core State Standards, but even more so to the need for students to deeply understand subject content and be prepared for the demands of the modern-day workforce (Wagner, 2008). This plan should be realized through strategic, site-based support similar to the studies conducted by Boston and Wolf (2006), and Stone et al. (2008).

This review of the research on rigor provides a much-needed amalgamation of perspectives on what can be qualified as instructional rigor. This can greatly benefit teachers, educational leaders, parents and policy makers by offering a clearer understanding of how rigor is and should be defined when associating it with modern educational practice and reform. The challenge, however, arises less in embracing a collective definition, although a common understanding is necessary, but more so in the capacity of teachers to understand and apply

instructional rigor in students' classroom work (Manthey, 2005; Maye, 2013; Wagner, 2006, 2008). This review uncovers an important and pertinent next level of work when considering instructional rigor.

This insight is also critical to educational leaders who seek to improve and enhance student learning in the classroom. A school's leadership must pay close attention to both the cognitive and relevant demands of the tasks assigned to students in classrooms by their teachers (see Paige et al., 2013), as well as to developing their teachers' capacity to provide cognitively challenging and meaningful instruction and assessments. A review of student work (Manthey, 2005) and teacher capacity and competency to provide challenging work to students (Hess, Jones, Carlock, & Walkup, 2009; Maye, 2013; Paige et al., 2013) indicates that specific effort should be dedicated to enhancing both of these components, simultaneously for instructional rigor to be realized and developed in accordance with the collective literature's description.

The National Research Council, based on the findings on learning and teaching in Bransford et al. (2000), has suggested that further research should be conducted that emphasizes the communication of these findings to teachers, and in a meaningful and understandable way. They further suggest that methods of professional learning and teacher-practice development should also be considered in providing opportunities for exploring and assessing as they engage in their practice, while providing them with on-going feedback and support "as they attempt to use what they have learned in the classroom environment" (p. 265). This should also include exploring teachers' preconceptions and beliefs about learning, and providing learning opportunities for teachers to challenge misconceptions and develop new models of thinking in accordance with current learning and instructional theory.

From the research presented and based on the current literature, a key question to emerge from the literature is whether supporting teachers' understanding and implementation of rigor in their instructional practice can positively impact the level of thinking or cognitive rigor that their tasks and assignments require of students. The literature on professional development and teacher learning also indicates that teachers need professional learning that is applicable and relevant to their daily work (Darling-Hammond & Richardson, 2009; Hattie, 2009; Marshall, & Smart, 2013; Marzano et al., 2005; Putnam & Borko, 2000; Weiss & Pasley, 2006), situated within professional learning communities, and within conditions that support collaborative teacher work (Darling-Hammond & Richardson, 2009), and focused on student learning (Archibald, Coggshall, Croft, & Goe, 2011; Garet et al., 2001). Therefore, by providing teachers with continuous opportunities to engage in collaborative on-the job coaching and development will support this emphasis, and therefore, provide the opportunity to seek the response to the question: Does a comprehensive and functional definition of instructional rigor positively impact a teacher's capacity to design instructional tasks (and formative assessments) and implement the tasks in a way that requires on the part of students a greater level of thinking/cognitive rigor?

A second question that we are unable to answer at this time is whether or not teachers define instructional rigor in the same way that the combined literature defines it. Other than Bower and Powers' (2009) findings that indicated teachers were unclear as to how to define rigor in a single elementary school, and Bintz and Delano Moore's (2011) small-scale findings that revealed teachers' lack of clarity on whether their instruction was rigorous, we know little as to how teachers actually define instructional rigor. Moreover, there is no currently available insight on middle teacher's definition of instructional rigor, and how they use it when planning. We also do not know what they constitute as instructional rigor regarding the tasks and assessments they

71

design for their students, and this understanding is necessary as an initial platform for developing their capacity to increase rigor.

Fundamentally, schools' and districts' capacity to increase instructional rigor is dependent upon their teachers' understanding of it, which logically influences their capacity to design and implement instruction as operationalized through student tasks and assessments they assign to students (refer to Doyle, 1983; Doyle & Carter, 1984). This suggests that teacher's understanding of cognitive learning theory is possibly underdeveloped, or that their capacity to translate their curriculum into cognitively challenging pedagogy requires much more specific and systematic support (Hess, Jones, Carlock, & Walkup, 2009; Manthey, 2005; Maye, 2013).

Justification for the Study in The Selected Setting

An initial pilot study was conducted in 2012 that explored the teacher's perspectives on rigor in the selected research setting for this dissertation. It consisted of a two-item closed-question survey administered to 42 math, language arts, social studies, and science teachers in grades six, seven and eight, which was 62% of the overall teaching staff. Semi-structured interviews were also conducted with two purposely-selected staff members in different grades and subject-areas, and their lesson plans were reviewed. The survey asked two questions of the academic teachers:

1. How clear do you feel you are regarding the meaning of the term 'rigor'?

2. How clear do you think you are regarding how to increase 'rigor' when designing lessons?

The first survey question (How clear do you think you are regarding how to increase 'rigor' when designing lessons?), despite an issue being identified with the response options (*Unclear, Vague/Fuzzy, Undecided, Somewhat clear, Very clear*), suggested that 15% of the

respondents felt they were *Vague/Fuzzy* about how clear they were regarding how to define rigor, 15% felt that they were *Very clear*, and 63% felt that they were *Somewhat clear*. No teacher felt they were *Unclear* nor did anyone feel they were *Very clear*.

The second survey question (How clear do you think you are regarding how to increase "rigor" when designing lessons?) suggested that approximately 8% of the respondents reported feeling *Vague/Fuzzy*, while 19% felt *Very clear*. Further, 73% indicated *Somewhat clear*, which likely was the result of the issue noted with these response options.

Most of the academic teacher respondents in the survey stated that they were *Somewhat clear*, about how to define 'rigorous learning,' which was the response option immediately preceding *Very clear*. This was assumed to have suggested that the teachers selected the option that seemed to fit their sense of clarity regarding how to define rigor. However, following reflection, *Somewhat clear* and *Vague/Fuzzy* could quite easily have been deemed to have been the same, and therefore, may greatly skewed these data. Nonetheless, there was a discrepancy between the responses and the interview data, which was not supported by comments and findings from the qualitative portion of the pre-pilot.

Numerous In Vivo phrases collected from the two in-depth semi-structured interviews with the purposefully selected teachers suggested that they were still unclear how to define rigor. For example, one teacher stated: "It is very frustrating because we're being told to incorporate rigor, but I don't know what it means. How can I incorporate rigor when I don't understand what it means…" (J., personal communication, June 22, 2012). Another teacher commented: "I've talked to some…colleagues…we've all expressed, I don't want to say frustration, but maybe confusion, of what we're being asked to do" (K., personal communication, June 22, 2012). Although almost eight months on, this comment is very similar to one taken from the secondary

source data, which was an informal survey created by a committee of teachers in this setting and administered to the whole faculty: "Still unclear on definition of rigor…" (unknown, personal communication, January 13, 2012).

Classroom observations of teachers in the selected setting during the 2014-2015 school year revealed that rigor (as defined as cognitively complex tasks; see Marzano, 2007, 2011) was a challenge, which also supported a need for further investigation and intervention. The observations indicated that all teachers engaged in instruction that either introduced students to new information or had them practice and deepen their knowledge of the new information (level one and two of three in terms of cognitive challenge). This was determined using the Marzano framework (Marzano, 2011), which was the evaluation model adopted by the district in the 2013-2014 school year. The evaluative observations (some announced, and others not) indicated that the teachers did not require students to grapple with cognitively complex tasks that required them to engage in higher order thinking on real-world tasks that involved forming and testing hypotheses (refer to Marzano, 2007, 2014).

The initial pilot results and prior classroom observations, collectively, indicated that rigor was considered a vague and somewhat ambiguous abstract concept amongst the pilot participants, which inevitably yielded a challenge for these teachers and their colleagues in the selected setting. The researcher determined that further teacher insight on rigor was warranted and with a larger sample. Additionally, he deemed it necessary to establish a method to support the teachers in developing a clearer and operationalized understanding of rigor, and for them to be able to design and implement rigorous instructional tasks in and as part of their classroom practice.

Rigor and Instructional Planning

The reviewed research did not directly link rigor and instructional planning. However, due to the apparent absence of rigor in classroom work (Doyle, 1981, 1983; Hess, Jones, Carlock, & Walkup, 2009; Manthey, 2005; Maye, 2013; Paige et al., 2013), coupled with teachers' lack of training to explicitly develop their students' thinking capacities (Ritchart, Church, & Morrison, 2011) and to teach for conceptual development (Erickson, 2002; Erickson & Lanning, 2014), it is reasonable to suggest that planning for rigor would be more than a challenge if one's understanding of rigor is unclear.

The research on instructional planning also disclosed similar issues with regards to a lack of clarity and focus. For example, Kerr (1981) drew on the insights gleaned from Macdonald who stated that teachers often think about what they are going to do when planning, and much less what they are trying to accomplish. He further notes that greater attention must be paid to instructional design if we want it to help teachers rather than provide only vague and general information about planning. Various other studies revealed that teachers typically do not plan using structured models, such as the Tyler or Hunter models, and instead plan with a focus on covering content, and then on selecting activities (Brown, 1988, 1993; Clark, 1983; Clark & Peterson, 1984; Doyle & Holm, 1998; Kerr, 1981; Peterson, Marx, & Clark, 1978; Shavelson & Stern, 1981; Yinger, 1979, 1980). Clark (1983) and Clark and Peterson (1984) also indicated that for all its emphasis in teacher preparation programs, lesson planning is rarely perceived as being important to experienced teachers, and according to Peterson, Marx, and Clark (1978), the focus of the lesson was given the least amount of time in planning, and was superseded by the focus on subject matter. Limited research on teacher planning has unearthed deficiencies in this realm of instructional practice, but it has not considered how teacher planning contributes to effectively sequencing instructional episodes or tasks that lead to higher-level thinking or rigor, although

Peterson, Marx, and Clark did find that teacher planning statements focused much more on Lower-Order Subject Matter than Higher-Order Subject Matter.

Justification for the Intervention

The research on academic rigor justifies a need for seeking to explore teachers' understanding of rigor, and develop them capacity to design and implement rigorous tasks. Additionally, the findings of research on instructional planning justify a need to seek an approach to develop teachers' capacity to design and implement rigorous tasks as part of a coherent unit plan. Both rigor-related interventions currently do not exist, which justifies research being conducted that investigates both aspects of a teacher's instructional practice.

Instructional. Findings in Boser and Rosenthal (2012) highlighted the unfortunate perspective held by many middle schools students that their classwork is often too easy and does not challenge them, and Bower and Powers (2009) suggested that administrators develop academic rigor in their schools by focusing on cognitive coaching to support teachers in cultivating higher order thinking for all students. Increasing the cognitive challenge in students' work by increasing teachers' capacity to design and implement such work was necessary. Therefore, a focus on the cognitive level required for successful attention to and completion of academic classroom tasks was necessary, based on insights provided by Boston and Wolf (2006), Doyle (1983), and Paige et al. (2013). Additionally, it was equally necessary to consider the way the tasks were implemented, as also indicated in Boston and Wolf (2006).

Hess et al. (2009), and Paige et al. (2013) supported the use of Webb's (1997) DoK levels when examining academic tasks. The CT state Department of Education also adopted Webb's framework for analyzing and reporting on Smarter Balanced student scores, and analyzing the percentage of students that scored in the various levels (CT State Department of Education,

2014).

A method for developing teachers' capacity to think about the cognitive level of tasks was absent from the literature, and other studies that had emphasized rigor had focused mostly on whether or not rigor was present in classrooms and student work. For example, Paige et al. (2013) focused on the degree of students who were engaged in classwork, and in certain class-parts, based on the DoK level. A different focus was evident in Boston and Wolf's (2006) study, which focused on whether the Instructional Quality Assessment (IQA) was an effective tool for evaluating math programs (see also Junker & Weisberg, 2006). Similarly, Matsumura et al. (2008) focused on predictive relationships between teachers' actions and the classroom climate, rigorous instruction and student interactions, which was similar to Early, Rogge, and Deci's (2014) study that used classroom observations in English Language Arts and math to score the level of a lesson's engagement, alignment and rigor, and to determine whether this predicted standardized test score achievement. A consideration of the lesson's level of thinking was the focus in Maye's (2013) research, which illuminated the degree that her 24 lesson observations indicated that rigor was present (or absent). Also, Manthey (2005) examined grade 7 students' math work to determine the level of rigor it exhibited. None of these studies, however, focused on building teacher capacity to increase rigor.

This research, in contrast, will seek the enactment of an intervention that will emphasize the use of a cognitive rigor Matrix (Hess, 2013) in combination with a 3-step planning process to demonstrate whether teachers become clearer about how to operationalize rigor. this will involve teachers being able to deliberately design lessons that include cognitively complex tasks in order to increase rigor and implement the tasks in a rigorous way based on Doyle (1984) and Doyle

and Carter (1984). It will also consider Shalveson's (1981) posit that teacher planning most often focuses on the activities to be used, and that the tasks should be the aspect of focus.

Planning. The current research on academic rigor has revealed that it is comprised of numerous constructs that are associated with cognitivism, constructivist learning theory, and 21st century skills. However, the lack of rigor in student work as demonstrated in the research is likely to be related to teachers' lack of understanding of rigor, which is also likely to be related to a lack of understanding of how to teach for higher-level thinking and conceptual understanding, as characterized in constructivist learning theory, which moves instruction beyond the teaching of basic facts and procedures (Ehrenberg, 1981; Erickson, 2002). Coupled with the research on instructional planning, it is reasonable to suggest that teachers require more explicit and comprehensive support and guidance on understanding rigor and how it relates to higher-order thinking. Furthermore, it is also reasonable to propose that teachers require much more explicit support on how to consciously and deliberately plan for rigor and higher-level thinking, and beyond just considering content and activities, especially since "researchers have demonstrated that teachers' plans influence the content of instruction" (Clark & Peterson, 1984, p. 40).

CHAPTER 3: METHODOLOGY

Schools' and districts' capacity to increase instructional rigor is dependent upon teachers' understanding of the construct and their capacity to design and implement high-level thinking tasks for their students. The purpose of this action research study was to define at a local level what rigor meant to purposefully selected, public middle school teachers, and to develop instructional and planning intervention strategies that improved their capacity to design and implement rigorous academic tasks in their classrooms. The designing and implementing of rigorous tasks, which was expected to increase the students' cognitive level of challenge and thinking, was refined through multiple phases to develop the researcher's process for supporting the teachers' understanding and use of rigor. This established and enhanced an approach to developing instructional rigor that was part of the daily functioning of the specific school in which the research was conducted. Additionally, this approach was developed as a model for other schools and teachers.

Methodology

Action research requires that practitioners systematically examine issues inherent in their own setting and as part of their own work (Hendricks, 2013) in which to make immediate improvements (Mertler, 2012). Action research, as described by Coghlan and Brannick (2010), Creswell (2012), and Herr and Anderson (2015) is characterized as a dynamic process involving an intervention that adheres to cycles that are comprised of identifying an issue, planning an action, and reflecting on the impact and relevance of the action or intervention (Coghlan & Brannick, 2010; Hendricks, 2013; Mertler, 2012). This study utilized Coghlan and Brannick's (2010) cycles of constructing, planning action, taking action, and evaluating action, which then cycled back into constructing or diagnosing the issues for planning the next action steps. The

process was repeated with refinements to deepen and further the teachers' and the researcher's own learning on developing instructional rigor strategies and measures.

This action research study included three phases. Phase I was considered an exploratory needs assessment that investigated 10 selected teachers' understanding and operationalization of rigor through individual semi-structured interviews, classroom observations, and focus group interviews. Phase I built on a previously conducted, small-scale pilot in 2012, and provided the foundation for developing the instructional and planning interventions for the next phases. Phase I built on the pilot to determine if the participants' understanding of rigor had changed. Research question one guided this phase along with three sub-questions:

a. How do teachers perceive and define instructional rigor?

b. How do teachers perceive and describe their pre-certification preparation's influence on instructional rigor?

c. How do teachers perceive and describe their professional development preparation's influence on instructional rigor?

The literature (Bintz & Delano Moore, 2010; Bower & Powers, 2009; Draeger et al., 2013; Blackburn, 2013; Hess, 2006; Hess et al., 2009; Manthey, 2005; Marzano & Toth, 2014; Maye, 2013; Wyatt et al., 2005) suggested that participants would report (a) being unclear about how to define rigor and how to design rigorous tasks, (b) feeling that their pre-certification training did not prepare them for understanding, designing and implementing rigorous tasks, and (c) feeling that their professional development does not prepare them for understanding, designing and implementing rigorous tasks. The combined findings from this phase and the literature reviewed on academic rigor provided the basis for the development of a relevant and appropriate intervention that was presented to the purposefully selected participants in Phase II.

Phase II (first and second iteration) introduced the instructional intervention with selected teachers, five in the first iteration, and nine in the second iteration, to design and implement cognitively rigorous tasks. It followed an iterative process towards refining the strategies, process and measures to make the intervention applicable for teachers and administrators to employ in this setting and other schools. Data used to test and refine the intervention included classroom observations, weekly teacher reflection logs, rigor-planning matrices, and meeting minutes, as well as individual, semi-structured interviews.

Phase III introduced a planning intervention with a focus on supporting five selected teachers (Teachers E, F, G science, grade 6, and Teachers 4, 5 social studies, grade 7) to develop a coherent, concept-based unit plan that meaningfully incorporated rigor. The aim was to situate the designing and implementing of rigorous tasks within a unit of study that (a) moved from the identifying and unpacking of relevant subject standards (KUDs), (b) the designing of a final assessment performance task that was cognitively challenging (as measured by the Hess (2013) Matrix), authentic and realistic, and required the students to demonstrate a capacity to use various skills and knowledge/facts (identified in the standards), and demonstrated an understanding of key concepts and principles/generalizations, and (c) the development of a sequence that lead to higher-level student thinking and for them to be successful in solving the problem presented in the final assessment (also as measured by the Hess (2013) Matrix).

The process and sequence of the exploratory, intervention and planning phases is explicated in Figure 3.1.
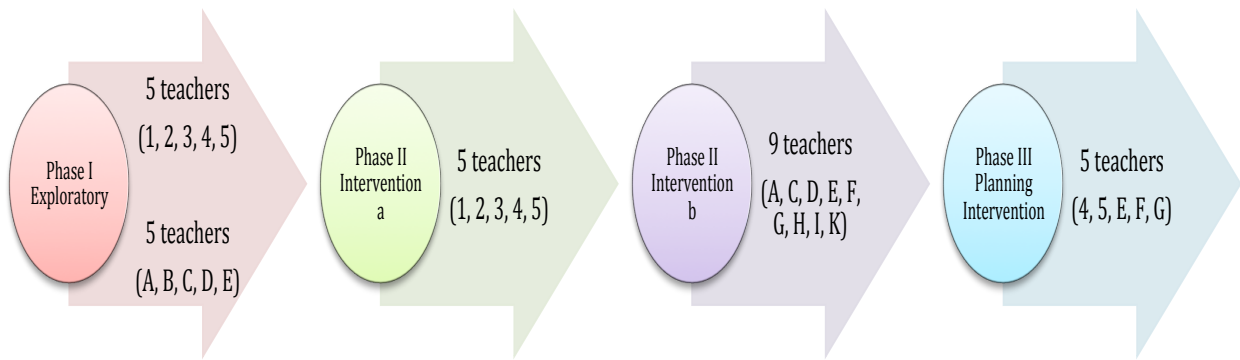
Figure 3.1. An overview of the action research study sequence and intervention phases

The intervention

The literature on academic rigor suggested that intentionally developing students' capacity to think at high levels of cognition (Blackburn, 2013) required teachers to be more focused on this aim in order to plan for rigor (Bintz and Delano Moore, 2010; Manthey, 2005; Maye, 2013). Shavelson and Stern (1981) found that teachers tend to plan by focusing on activities and tasks, which was supported by other research on teacher planning (Brown, 1988, 1993; Clark, 1983; Clark & Peterson, 1984; Doyle & Holm, 1998; Kerr, 1981; Peterson, Marx, & Clark, 1978; Yinger, 1979, 1980). Additionally, Doyle's (1981, 1983) seminal research on the nature of classroom work highlighted that the tasks assigned to students rarely required them to think at high levels.

Two interventions were devised by the researcher to address teachers' capacity to design and implement rigorous classroom tasks, and to support teachers in designing a concept-based unit of study that emphasized a sequence of increasingly rigorous tasks.

The instructional intervention. The researcher proposed that teachers first needed to plan lessons that were rigorous to address students' higher-level thinking capacity. Teachers

82

identifying the task to be assigned to the students, and then determining the cognitive level of demand the task would require achieved this. This further required teachers to focus on how the task was implemented, how it was presented to students, determining the types of questions to ask while students worked, and how to respond to the students' questions.

Hess's (2013) Cognitive Rigor Matrix (Matrix) was gleaned from the literature that provided teachers with the necessary guidance for designing rigorous tasks that involved higher-level according to Bloom's cognitive taxonomy and Webb's (2002) DoK levels. The Hess (2013) Matrix was a tool useful for teachers to identify tasks that represent low-level and high-levels of thinking. Versions of the Hess Matrix were available for multiple subject areas, including math/science, reading, writing, and social studies/humanities, which made it applicable for the core-subject teacher participants.

The instructional intervention included providing teachers with specific guidance and a three-step planning framework on how to use the Hess (2013) Matrix. The planning framework required teachers to ask: (a) *What is the task that will be used?* (b) *What is the level of cognitive rigor or thinking that this task will require of my students?* and (c) *How will I implement this task so that the students' cognitive demand is maximized?* As Doyle (1983) indicated, the aim was to maximize the students' capacity to think by not providing too much direction, to avoid breaking the tasks into easy-to-follow steps, or providing too many clues as to the answers or next steps of a complex task. Teachers encouraged the students to use their full thinking capacity to progress through tasks and complete tasks successfully.

The researcher trained the teachers during their 45-minute weekly subject-area grade level meeting, and through informal check-ins to guide designing and planning for rigor. During this time, the researcher followed a specific meeting protocol (Appendix K) to discuss how the

teachers were progressing with regards to the intervention, how it was impacting their thinking, and if they saw any impact on the students' thinking and performance. Informal check-ins and discussions during the week were included to further coach and guide the teachers to use the intervention in their daily work.

The researcher also provided selected reading materials (Superintendent's brief, 2013; Webb, 2002) to enhance the teachers' understanding and application of rigor. A brief written by the district's superintendent was used as a guide to the district's instructional emphasis. Part one of the brief focused on seven issues that undermined rigor, including incorrectly defining rigor, over-supporting students, and assuming that complex content will automatically produce rigor. Part two provided a list of obstacles to achieving rigor, which included the capacity of educators, and curricular issues. Part three listed his proposed next steps for developing rigor. This document had originally been disseminated only to the administrators, and not to teachers. However, the school principal had provided this to the faculty in the Professional Development session at the beginning of the year. Webb's (2002) DoK levels for the four content areas were also given to the participants, which provided a subject-specific overview of the characteristics of thinking in each of Webb's four levels. A table constructed by the researcher (Table 2.2) that served as a reference for the constructs associated with rigor as explicated from the literature was also provided. The intervention period in Phase II lasted for four weeks in the first iteration, and three weeks in the second iteration.

Modifications were made to Phase IIb as a result of the findings in the first iteration, which included the Implementation Rigor Rubric that focused on how much the teachers' instruction forced the students to think and use their higher-level cognition. Other modifications to the intervention included: (a) reducing the time frame for the intervention, (b) a requirement to

discuss and focus on rigor for at least part of the weekly planning meeting, (c) more flexibility on when the observations were conducted (not always inside the time frame), (d) more specific and detailed observation feedback with suggestions for increasing rigor in both task design and implementation, and (e) having the Principal, MRT and LAS conduct the weekly meetings to increase their understanding on how to foster rigor.

The planning intervention. Phase III focused on developing teachers' capacity to more deliberately and systematically plan for incorporating rigorous tasks into a unit of study. The literature noted that teachers are less able to teach conceptually (Ehrenberg, 1981; Erickson, 2002), yet conceptual learning requires students to learn content at deeper and more meaningful levels of understanding and not just know facts and procedures. The researcher then developed a concept-based unit using the Unit Planning Process to Ensure Rigor (UPPER) to support teachers in developing a unit that emphasized learning for understanding using the Hess (2013) Matrix to embrace the new standards (ELA CCSS, MCCSS, NGSS, C3SS). The UPPER provided explicit guidance for teachers on how to unwrap relevant subject matter content standards, determine the essential knowledge, procedures, and big ideas associated with the standards. Teachers then designed an appropriate, understanding-focused final performance assessment, the essential questions that directly linked to the big ideas, and a progressively rigorous task sequence using the Hess (2013) Matrix.

Intervention measures. The success of the instructional intervention was determined through the classroom observations, and the perspectives of the participants as evidenced through their weekly reflection logs, individual interviews, weekly meetings notes, and the rigor planning matrices. The combined data points were then used to conclude whether the intervention had a positive impact on the teachers' understanding of rigor, and their capacity to

design and implement rigorous classroom tasks. The measures were also used to understand the teachers' challenges to designing and implementing rigor, and for the researcher to plan improvements of the intervention and measures in future action research phases.

Participants in this study were observed twice within each iteration as they conducted lessons they deemed to be rigorous. Lessons were scored by the researcher and, at a minimum, one or more of the three independent observers: The Principal, Math Resource Teacher, and/or Language Arts Specialist using the Hess (2013) Matrix and later, the Implementation Rigor Rubric. Participants reflected twice weekly throughout each iteration period and captured their thoughts in an electronic reflection log (Appendix J). The teachers reported on how the intervention was impacting their thinking, the challenges they were facing, and their views about how the intervention was impacting their students. Participants also completed a rigor planning matrix (Appendix L) by recording and describing the main task in their lessons, the level of cognitive rigor or thinking of the tasks, and descriptions of how they implemented the task to require the students to maximize their thinking capacity.

The teachers being able to design two coherent, rigorous concept-based units of study determined the success of the planning intervention, which was realized through data gleaned from three different sources: (1) pre and post teacher reflections, (2) weekly researcher meeting minutes/reflections, and (3) rubric scores for the two unit plans. These data sources provided the researcher with the participants' perspective regarding the planning intervention's impact on their thinking and planning, and whether they were actually able to design the rigorous concept-based units.

Research Questions

Four questions were used in this action research study:

1. What is the teachers' current understanding of academic rigor, and how do they describe the basis for their understanding?

2. Do the Hess (2013) Matrix and the three-step planning process positively impact the teachers' capacity to design rigorous classroom tasks?

3. Do the Hess (2013) Matrix and the three-step planning process positively impact the teachers' capacity to implement rigorous classroom tasks?

4. Do the teachers report that a planning framework for developing a concept-based unit of study and specific training support provide them with greater clarity and understanding on how to design a coherent unit that incorporates increasingly rigorous tasks?

This study followed 7 steps: (1) Acquire consent from the district's superintendent and/or assistant superintendent, and building principal, (2) meet with the building principal, language arts specialist (LAS) and math resource teacher (MRT) to provide an overview of the research study and discuss the observation protocol using the Hess (2013) Matrix. Conduct two observations for inter-rater calibration, (3) individually and informally sample each phase's participants prior to beginning the phase through a verbal description of the research study, how they would feature in it, and how it would benefit them and likely their peers and the knowledge base on rigor, and provide the participants with letters of informed consent and the demographic data form, (4) create an overview, timeline and schedule for the phase. This included what and when data would be collected, and in Phases II and III, providing an overview of the intervention and expectations for employing it, the required measurement methods for determining its impact, (5) simultaneously analyze the data and address credibility challenges (such as having an independent interviewer conduct the individual post-iteration or phase interviews in Phase II) as the data was collected, (6) write up the findings, and disseminate interview transcripts and

analysis, and an overview of phase findings to participants for review, (7) reflect on and use the phase's findings and the literature to design an appropriate and relevant intervention (following Phase I), and make the necessary modifications to the intervention, measures and process in preparation for the next iteration (Phase II and III).

Data Collection

Individual interviews. Twenty-seven qualitative semi-structured interviews (Creswell, 2009; Seidman, 2013; Kvale & Brinkmann, 2009; Weiss, 1994) were conducted with selected teachers. Phase I consisted of five purposefully selected (Teachers 1, 2, 3, 4, 5) and five randomly sampled (Teachers A, B, C, D, E) teachers. Phase II consisted of purposefully selected teachers (first iteration will consist of Teachers 1, 2, 3, 4, 5, and the second iteration consisted of Teachers A, C, D, E, F, G, H, I, K). Each interview was digitally recorded and transcribed. The researcher listened to the digital recordings and simultaneously read the transcriptions to ensure accuracy. Each interview lasted approximately 20-30 minutes. In Phase I only, the participants were provided the questions a day in advance of the interview to ensure adequate time in which to consider possible responses, but to minimize the potential for them to research rigor.

Findings from the pilot indicated that some teachers felt that they understood and used instructional rigor, which was refuted by the interviews of the two purposefully selected staff members in that study. The researcher's reflection on those findings was used to craft the semi-structured interview questions in Phase I (see Appendix G). The questions in Phase I were also vetted by two renowned names in the education field that pertained to rigor: Tony Wagner, author of the *Global Achievement Gap* (2008), *Rigor redefined* (2008a), and Karen Hess, author of the Hess Cognitive Rigor Matrix (2013). Both of these leaders in the field of instructional rigor felt that the interview and research questions were appropriate for this study (see K. Hess,

personal communication, February 1, 2015; T. Wagner, personal communication, June 22, 2015).

At the end of Phase II (both iterations), interviews were conducted to review each participant's perspective on the intervention and whether it had impacted their thinking, their practice, and their students' thinking. This required them to reflect on their in-class observations of students, weekly reflective journal entries, and the meetings, all with a view to determining whether they felt that the Hess (2013) Matrix, the Implementation Rigor Rubric, and the three-step framework/process had positively impacted their understanding of task rigor and task implementation. The following seven questions were posed to determine this: (1) How was the intervention? What worked? What needs refinement or rethinking? (2) Were there any changes to your thinking on rigor from this work? (3) Will this intervention be something that you continue to use in the future and beyond this research? (4) What challenges did you encounter, and why? (5) Did you see any evidence of impact on your students (their performance and achievement, etc.)? What specifically did you notice? (6) How was the overall process with the intervention? (7) What recommendations do you suggest be made to the next iteration for other teachers, and why?

PD questions. In Phase I, two questions (question one and four) were drawn from a beginning-of-year professional development session for the whole faculty that required the teachers to individually disclose their definition of rigor. The session required the staff to then share their definitions with colleagues, read the district superintendent's brief on rigor (Superintendent, 2013), and consider their next steps for understanding and employing rigor based on their reading. They were also required to write questions that they still had about rigor. The first question (question one) was: *What is rigor to you? How do you define it?* One other

question (question four) was: *Are there questions you still have regarding rigor?* Responses to both questions were collected with a view to comparing the whole faculty's current understanding of rigor (how they defined it and the questions they still had) with the perspectives of the selected participants who were individually interviewed (Teachers 1, 2, 3, 4, 5, and A, B, C, D, E).

Classroom observations. Each participant was observed teaching a lesson that they deemed to be rigorous in Phase I and II. Ten classroom observations were conducted in Phase I, and each one was observed by either all of the observers, or a combination of the researcher and at least one other observer (Principal, LAS, or MRT). Phase II (both iterations) consisted of two observations per teacher (10 in the first iteration [five teachers x 2 observations], and 18 observations in the second iteration [nine teachers x 2 observations]). A total of 41 observations were conducted. Each observer adhered to an observation protocol designed by the researcher, and took notes using a lesson observation form also designed by the researcher (Appendix H). The observers took detailed notes describing the task or tasks that represented the main emphasis of the lesson, and how the teacher implemented the main learning task to students. In Phase IIa and IIb, the Hess (2013) Matrix was used to assign a score determined by the multiple observers for the lesson's level of rigor. The participant was also asked to assign a score. Both scores were then compared, and the teacher's score was considered to measure his or her understanding of the task rigor of the lesson, their current understanding and clarity of this aspect of rigor, and their capacity to accurately use the Hess (2013) Matrix.

The Implementation Rigor Rubric was also employed in Phase IIb to focus on implementation rigor. The Phase IIb participants therefore received two rigor observations scores: A task rigor score using the Hess (2013) Matrix, and an implementation rigor score using

the Implementation Rigor Rubric. The same score-assigning process was utilized for this rubric as for the Hess (2013) Matrix.

Focus group interviews. Three focus group interviews were also be conducted in Phase I, and each participant was asked to attend. The interview focused on a discussion of the individual findings from the prior individual interviews and the professional development workshop. The participants had also reviewed a narrative summary of the findings based on the collective responses in the individual interviews, and verified the accuracy or relativeness of those findings to their own perspectives on rigor. Additionally, possible next steps were discussed to prepare for Phase II and the first iteration of the intervention.

Reflection logs. The participants in Phase II were required to complete weekly reflection logs (Appendix J) that were designed by the researcher, and to make at least two entries each week throughout the iteration. The participants were asked to be as detailed as possible to support valid conclusions later being drawn. The entries were expected to consider five prompts. A protocol for completing the log was included in the word document along with a box for each week that included the five prompts: (1) The focus of this week was…, (2) changes in my thinking regarding my planning, instruction, and/or assessment have been…, (3) the impact my work within the research cycle is having on my students has been…, and the evidence of this is…, (4) challenges or questions that have and are arising for me during this work have been/are…, and (5) other thoughts (determined by the participant). Each participant was required to address numbers one and two every week, and after week two of the iteration, number three, and any other or all of these prompts. This was with a view to disclosing their feelings and observations regarding their self-reported impact of the intervention on their understanding of rigor and on their capacity to develop and implement rigorous tasks that emphasized the need for

91

students to use higher- and deeper-level thinking. The entries were also used as content and a guide for the weekly meetings/discussions.

Rigor planning matrix. The participants in Phase II were required to complete a Rigor Planning Matrix designed by the researcher that specified three central aspects of designing and implementing rigorous tasks. This planning matrix was comprised of three rows for each day. Row one required the participants to indicate for the given day a description of the main task used in the lesson and what it required the students to actually do. Row two required that the level of task rigor be indicated using Hess's (2013) Matrix, and row three required a short description of how the teacher implemented the task to further emphasize higher-order thinking, which utilized the Implementation Rigor Rubric in Phase IIb. This Rigor Planning Matrix provided a means for measuring the teacher's understanding and on-going clarity of rigor. It also provided a basis for discussion between colleagues at the weekly planning meeting regarding their developing understanding of rigor, and how to apply and consciously increase it in their lesson tasks.

Planning meetings. The participants in Phase II met once per week with their grade-level, subject-area colleagues, the researcher, and either the Principal, LAS or MRT in a scheduled 45-minute instructional planning meeting. This meeting was already part of the weekly expectations for all teachers at this research site, so it was applicable to include the discussion on rigor at this meeting. The focus of this meeting for this research study was to discuss information from the weekly teacher logs and their progress with the intervention, as well as to coach the teachers on more effectively using the Hess (2013) Matrix to design and implement rigorous tasks. The discussion points were recorded on the Weekly Meeting Form (Appendix K) designed by the researcher. An additional focus of the meeting was to observe

whether the participants discussed rigor and the intervention without direction or prompting from the researcher, or the Principal, LAS or MRT.

The researcher also met with the three observers for a 45-minute training on how to explicitly support the conversation on rigor, the participants' views and thoughts on the intervention and its impact on their instruction, and allow the conversation to flow once rigor and the intervention were being discussed more readily. The training also focused on taking applicable notes and observing the remaining portion of the meeting, and capturing the focus of the discussion and whether rigor was further discussed or initiated without observer prompting.

Reflections. In Phase III, each participant was required to complete a pre- and post-reflection (Appendix R) on their unit planning process. The pre-refection, which was completed prior to the planning intervention, asked the participants to describe their current process for planning and designing units of study, and by specifically addressing the following aspects in as much detail as possible: (a) decisions about the final assessment in the unit, (b) decisions about the activities and tasks and their sequence (from the beginning to the end of the unit), (c) decisions about how the students' progress (formative assessments) was measured throughout the unit, and (d) How unit planning included rigor. They were also asked to disclose the aspects of their planning and designing of units that they felt were particularly positive, as well as those that were challenging.

The post-reflection asked the participants to disclose how their current process for planning and designing units of study compared to the newly trained process, and by again addressing the same four aspects as in the pre-reflection. Additionally, they were asked to disclose the aspects of their planning and designing of units that they felt were particularly positive, as well as those that were challenging.

93

Planning meeting researcher reflections. The participants in Phase III met once per week over the course of the four weeks with their grade-level, subject-area colleagues, the researcher, and computer teacher/media specialist in a scheduled 45-minute instructional planning meeting. An overview of the planning intervention was first presented to both groups of teachers separately at their respective planning meeting, and the proceeding meetings were then used to coach the teachers on how to design the unit by specifically addressing the individual aspects of the Unit Planning Process to Ensure Rigor (UPPER) (Appendix P) form, which had been developed by the researcher. The researcher wrote reflection memos and notes that described what had occurred during the meeting, what he had observed with regards to what participants were learning and finding challenging, as well as his own interpretations of areas that were improving and those that were challenging for the participants. This also included using direct quotes from the participants that supported his notes.

Unit Plans. The Phase III participants were required to design two units of study using the UPPER form with the first unit being guided more explicitly by the researcher and the topic being one that the teachers had previously designed as a result of their involvement in Phase II. The second unit was one that they were just beginning or were due to begin in the comings weeks.

Self-reflecting. The researcher wrote memos throughout and reflected on the constantly developing process with regards to coaching teachers to better understand rigor, design and implement cognitively challenging tasks (see Appendix S). This also included frequently analyzing pre-existing meta-theoretic assumptions (Herr & Anderson, 2015) (epistemic reflexivity), as well as the impact on the research setting and participants (methodological reflexivity) (reference to Johnson & Duberley, as cited in Coghlan & Brannick, 2010). A meta

cycle for action research framework was used to organize the entries, which consisted of three interlinking areas: Content, process, and premise. Coghlan and Brannick (2010) defined content as the researcher's thoughts on issues within the study, and what is happening. Process was defined as on-going reflection on the strategies and procedures being used, and "how things are being done" (p. 12). Premise was defined as the awareness and critique of the underlying assumptions and perspectives, which governed and influenced thought and action (refer to Appendix S). The content, process, and premise format was repeated throughout the research study, and in all phases.

Data Analysis

  Individual interviews. Each individual's semi-structured interview transcription was hand coded, using a first-cycle eclectic coding process comprised of (a) *holistic* coding and (b) *In Vivo* coding (Saldaña, 2013) to generate initial codes. The interviews were analyzed simultaneously (Creswell, 2012; Thornberg & Charmaz, 2012). Threats to credibility, dependability, confirmability and authenticity (Mertens, 2012) were addressed simultaneously with the coding and analysis. The initial codes for each interview question were then reviewed and listed in a table as an In Vivo code or a holistic code to ensure the teacher's meaning remained intact. The In Vivo or holistic codes were then categorized to produce individual themes (theme coding) using the codes as descriptors or qualifiers (Saldaña, 2013). A narrative interpretation of the combined themes was generated for the question. This enabled the individual interviews to be analyzed by looking for similarities of themes for each question across of the interviewed teachers, as well as to explicate discrepancies and outliers. A Matrix was used for this step, and each individual teacher's themes and supporting codes and descriptors was listed in a single row on the Matrix.

Step three required that for each question similar individual themes and their descriptors/qualifiers were grouped and categorized in a matrix. Collapsing the individual themes from each interview into more refined overarching and explanatory themes developed collective themes. This further refined category was then defined, and a written explanation of the category was provided. This phase provided a clearer picture of the theory's emergence as to how the teachers perceived rigor in this research site. Step four of this process involved comparing all selected participants' raw data (In Vivo codes, initial themes and refined themes) for similarity and discrepancy.

In Phase I, question one findings from the individual semi-structured interviews were combined and blended in a matrix with the same question posed to all faculty members at this research site at the beginning PD session that focused on rigor. The responses to the PD question one were also coded using mostly an In Vivo process, as well as a holistic coding procedure as with the interviews. The findings from this data were eventually collapsed into main themes, and these themes were then compared and blended, as appropriate, with the main themes generated from the collective themes from the interviews from question one and seven. Negative cases (discrepancies) were also discussed and explored against the proposed theory.

The process employed in phase II differed slightly than the one used in Phase I. The rationale for this was that the interviews in Phase I were of primary importance to data collection. However, in Phase II, they took a secondary role amongst other data points. Therefore, the interviews in Phase II were used to distinguish between what the participants felt were positive impacts of the intervention, versus the challenges they presented. Additionally, the ideas that did not fit into either of those two categories were grouped in an *Other* column and given equal consideration as the other two categories.

Each interview was digitally recorded using the researcher's recording device, and transcribed in the same way as for the individual interviews in Phase I. Five steps were employed to analyze those interviews. Each semi-structured interview transcription were separately hand coded using an eclectic, first-cycle coding process that comprised of (a) *holistic* coding and (b) *In Vivo* coding (Saldaña, 2013) to generate initial codes (as in Phase I). This represented the first step in analyzing the interviews. The second step involved listing all of the codes in a table. In the third step, each code was refined using either an In Vivo or holistic code (phrase) that maintained the essence of the participant's stated meaning. A fourth step involved categorizing the refined codes into one of three columns: *Positive impact*, *Challenges*, or *Other*. The refined codes within each column were then reanalyzed and compared by also drawing on the initial code and actual text to group them into themes within each column. Step five involved the same procedure used in the reflection logs and the meeting minutes, and required that each participant's *Positive impact* themes were placed in a narrative along with the other participants' positive impact themes before highlighting all of the common themes by comparing the initial codes and text segments. The common ideas were then categorized and labeled by a refined theme that represented the essence of the idea, which was either an In Vivo or holistic label. The same process was employed for the *Challenges*, and *Other* section.

Classroom observations. The Hess (2013) Matrix was used to assign an individual score (a Bloom's level and a Webb's DoK level) for each lesson's level of task rigor in Phase I and both iterations of Phase II. The observers met immediately following each lesson to review their notes from the *Lesson Observation Form* (Appendix H), and score the rigor of the task. The assumption was that the participants' selection of the lesson task and its level of rigor (as measured by the Hess Matrix) revealed their understanding and clarity of rigor. Thus, the more

97

the participant's observational score reflected Webb's DoK Level four (extended thinking) and either *Analyze*, *Evaluate* or *Create* on the Bloom's cognitive process dimension (see Hess, 2013, Appendix I), the more rigorous the lesson. The lesson did not consider any additional techniques that the teacher may use to manage behavior, build relationships, or connect the content to the students. Rather, the Hess (2013) Matrix was used to determine where the lesson task and what students were required to do fell in relation to cognitive challenge and depth of thinking. Each observation in Phase IIa and IIb was expressed using a superscript. For example, Teacher 1's first observation was expressed as 1^1, and the second observation as 1^2. The same expression was used for each teacher to indicate his or her first and second observations. Overall task rigor scores for the group in Phase I and II were reported using descriptive statistics to indicate the number or percentage of participants scoring in the various levels on Bloom's and Webb's DoK levels.

Phase IIb also included a rigor implementation score using the added Rigor Implementation Rubric devised by the researcher, which specifically focused on the rigor of a teacher's implementation of the task and how the teacher presented the task, monitored it while students worked, asked cognitively demanding questions, and how the teacher responded to students' questions. Each teacher for each observation received a score (1, 2, or 3) on all three of the implementation rigor components. Descriptive statistics were used to report the overall results on implementation rigor, with a total of 54 scores being possible based on 3 components x 18 observations. Therefore, the number of participants who scored in a given level (1, 2 or 3) divided by 54 equaled the percentage for each score level.

Focus group interviews. The focus group interviews were recorded and transcribed in the same way as the individual interviews, and they were analyzed using an In Vivo and holistic

coding process (Saldaña, 2013). The initial codes were listed from the entirety of the transcription and these were then collapsed and refined to form categories or themes, which were further collapsed to generate broad themes.

Reflection logs. The participants' reflective logs were individually analyzed using In Vivo and holistic coding (Saldaña, 2013) and employed five steps. The first step involved distinguishing the statements made by each participant and organizing them into two categories: *Positive impact on teacher thinking* and *Negative impact on teacher thinking* using a matrix. The second step involved selecting and highlighting an In Vivo code (phrase) drawn from each statement that best captured the essence of the participant's comment. From this, an individual interpretation was developed that accurately communicated the participant's perspective regarding aspects of the intervention that they felt were positive versus those that they reported feeling were negative or a challenge. The third step included a comparison of the participants' interpretations also using a matrix. The fourth step involved placing each participant's positive interpretation in a narrative along with the other participants' positive interpretations, and highlighting all of the common ideas. The common ideas were then categorized and labeled by a theme that represented the essence of the idea, which was either an In Vivo or holistic label. The same process was employed for the negative interpretations.

Planning meetings. The researcher's, the Principal, LAS and MRT's weekly meeting minutes and field notes were analyzed also using a similar process to the one used for analyzing the weekly reflection logs. Four steps employed in this process, and the first one involved distinguishing the statements made by each participant and organizing them into two categories: *Positive impact on teacher thinking* and *Negative impact on teacher thinking* using a matrix. The second step required that the statements in the *Positive impact on teacher thinking* column be

coded by determining an In Vivo code, which meant highlighting a phrase within the text segment that best captured the essence of the statement. The ideas were then grouped and categorized and a theme was developed based on the In Vivo codes in the related segments. Step three involved developing an interpretation that best reflected the collective highlighted In Vivo codes for *Positive impact on teacher thinking*. These interpretations were placed in a second matrix along with the other participants' interpretations. The same procedure was followed for the *Negative impact on teacher thinking* ideas. As for the procedure used for the weekly reflection logs, the fourth step involved placing each participant's positive interpretation in a narrative along with the other participants' positive interpretations, and highlighting all of the common ideas. The common ideas were then categorized and labeled by a theme that represented the essence of the idea, which was either an In Vivo or holistic label. The same process was employed for the negative or challenge interpretations. The minutes and field notes were then used to supplement the participants' observations, logs, rigor planning matrices, and individual interviews.

   Rigor planning matrix. Each individual participant's rigor planning matrix was reviewed and analyzed separately. The task was compared to the relevant and most fitting task description in the respective subject-area cell on the Hess (2013) Matrix. The appropriate score was assigned (i.e. a Bloom's level and Webb's DoK level), and this score was compared for accuracy to the one assigned by the participant. The task rigor was matched against the Hess (2013) Matrix and scored using a score guide developed by the researcher for accurate interpretation of the task rigor (Appendix L). The accuracy of the participant's score determined his or her understanding of task rigor as defined by the Hess (2013) Matrix, and his or her competency with using it to determine task rigor. The total daily task rigor scores were

determined using the following calculation: Number of participants x number of days x number of weeks. In Phase IIa, there were a total of 50 daily task rigor scores, which was calculated as follows: 5 participants x 5 days x 2 weeks. In Phase IIb, there was a total of 135 daily task rigor scores, which was calculated a follows: 9 participants x 5 days x 3 weeks.

An Implementation Rigor Rubric (Appendix M) was developed by the researcher for use in Phase IIb to score the implementation aspect of rigor, as it was acknowledged in Phase IIa that the Hess (2013) Matrix was only able to measure task rigor. The rubric included three components with each component having a score range between one and three points. The teacher and researcher separately assigned a score using the Implementation Rigor Rubric.

Reflections. The reflections in Phase III were individually analyzed using In Vivo and holistic coding (Saldaña, 2013) and employed four steps. The first step involved selecting and highlighting an In Vivo code (phrase) drawn from statements about each component (final assessment, sequence and tasks, formative assessments, rigor, as well as aspects that were reported as positives, challenges, and other) that best captured the essence of the participant's description of that part of their unit planning process. From this, the researcher developed an individual interpretation for each component. The second step included placing each component interpretation for each participant in a matrix. The third step involved writing a narrative that included a collective interpretation of each component, as well as what participants reported as being positive and challenging. The same process was also employed for the post-reflections.

The fourth step involved comparing the narrative interpretations of the combined participants' current unit planning process to their experience using the UPPER planning method, and to determine whether a change had occurred in the participants' thinking and unit planning process in order to directly address the research question for this phase. This involved

101

using a matrix for each component of the unit planning process.

Planning meeting researcher reflections. In Phase III, the researcher's weekly meeting minutes and field notes were analyzed using a similar process to the participant reflections (In Vivo and holistic coding). These minutes and field notes were then used to supplement the information gleaned from the participants' reflections.

Unit Plans. The researcher in Phase III developed a 4-point rubric called the UPPER Rubric (Appendix Q) for scoring the unit plans. Each component of the unit plan was scored separately, and included four areas: (a) unpacking the standards, (b) developing compelling/guiding and supporting questions, (c) developing a final performance assessment (as measured by the Hess (2013) Matrix), and (d) designing a sequence of tasks (including formative assessments) that lead to higher level thinking/rigor (also measured by the Hess (2013) Matrix).

Data Triangulation and Merge.

Following an individual analysis of each of the four data points in Phase I (10 individual interviews, two whole-faculty PD questions, 10 individual observations, and three focus group interviews), the researcher merged the separate findings into a narrative, titled *Theory of Current Teacher Understanding of Rigor*, and created a visual model that signified the participants' understanding and experience with rigor. The interview and PD session findings were combined and presented to the participants for discussion in the focus group interviews and to determine whether they felt that the narrative of collective perspectives aligned with their own. Additionally, the observations were used to triangulate the interview responses. The collective findings from this phase were presented in a triangulation matrix (Mills, 2013) to support the writing of the Phase I findings.

In Phase II, the individual observations, weekly reflection logs, rigor planning matrices, weekly meetings, and individual interviews provided multiple data points, and the collective results and findings were captured in a triangulation Matrix (Mills, 2013). The results were displayed for each data point, separately, and supported the construction of a narrative that was titled *Intervention Impact (Phase II)*. A phase-specific narrative summary and conclusions were written at the end of the phase and was disseminated to the participants for their review.

The collective pre- and post-reflection narratives in Phase III were compared and an additional final narrative was written to describe and interpret changes to the participants' thinking and unit planning process. The narrative also included a comparison and interpretation of the UPPER Rubric scores derived from the first and second unit plans. Combined, these two data points directly answered the Phase III research question.

Role of Researcher and Positionality

The study was influenced by the researcher's own sensitivity (Corbin & Strauss, 2008), values, bias, and previous experiences related to instructional rigor and pedagogy. The researcher had an established background in public education having spent 10 years in the elementary classroom, five years as a middle school building administrator, and a state-level lead scorer in the state's teacher certification program. Frequent and deep reflection allowed the researcher to unearth, acknowledge and address his perspectives, as well as the reactions of the participants, throughout the study. The researcher also considered his understanding and perspective on instruction and rigor as a means for positively supporting teachers, especially those for whom rigor had become a source of ambiguity and even confusion.

The researcher acted as an instructional guide and coach to the participants and to provide them with the opportunity to support and develop their understanding of and capacity to embrace

pedagogical practices that contributed to more challenging and meaningful student learning (see Darling-Hammond, Barron, Pearson, Schoenfeld, Stage, Zimmerman, Cervetti, & Tilson, 2008; Donovan, Bransford, & Cocking, 2000; Marzano et al., 2001; Marzano et al., 2005; Marzano, 2007; Marzano, 2009). The researcher also believed that teacher training and improvement needed to include the understanding and insights gleaned from the knowledge base on teacher professional development (Archibald et al., 2011; Borko, 2004; Darling-Hammond & Richardson, 2009; Garet et al., 2001; Thompson & Goe, 2009; Weiss & Pasley, 2006), and it was from his experience working with teachers as a colleague, professor, trainer and administrator, as well as drawing on the reviewed literature that formed his assumption that not all teachers possess a clear understanding of rigor, which he believed rendered them less able to clearly define and describe rigor, and moreover, less able to consciously design and implement rigorous classroom tasks. He deemed this action research study necessary to formally understand how the participants perceive rigor, and to design a process and approach in which to support them in developing their capacity to understand, design and implement rigorous tasks. He also believed that the relevant and meaningful instructional and planning interventions increased the teachers' capacity to design and implement classroom tasks that more aptly aligned with the instructional shifts (Achieve, 2013) and cognitive demands implied in the Common Core State Standards (Porter et al., 2011).

The researcher was an insider to this study based on his employment as one of the school's administrators where the research was conducted (Creswell, 2009; Herr & Anderson, 2015; Lapan, 2012). This provided an intimate and working knowledge (or preunderstanding, see Coghlan & Brannick, 2010; Coghlan & Shani, 2013) of the critical components of this school's life (Coghlan, 2007; Coghlan & Brannick, 2010) and a deep understanding of the organization of

the school, its schedule, and instructional planning arrangements. These were critically important aspects of the functioning of the school that were of paramount importance for any researcher and change agent to possess prior to conducting change-related work in this (or any) setting. An outsider to this research would have struggled to become familiar with the current state of practice in a timely manner, and would have struggled further to impose a necessary and viable change to teacher practices without having a deep insider access and working insight into this setting (Coghlan & Brannick, 2010; Coghlan & Shani, 2013; Herr & Anderson, 2015; Lapan, 2012).

The role adopted by the researcher in this study primarily related to one that aligned with a second-person inquiry (Coghlan & Shani, 2013). Working with others obviously required the researcher to acknowledge and address the role duality that was imposed by being an insider-actor along with other insider-actors. However, given the difference in work roles, the duality between organizational member and researcher was seen as less conflicting and contentious than if he had been a teacher working with other teachers. Support for this view was found in Coghlan and Shani (2013) who posited that "Insider action researchers need to build on the closeness they have with the setting while, at the same time, create distance from it in order to see things critically and enable change to happen" (p. 646). Due to his organizational role, a degree of separation between him and the teachers was customary, which prevented him from getting too close to the participants and the data. The researcher also viewed his organizational role as an instructional leader and facilitator (similar to that of a consultant), which was less of a conflict when compared to other possible researcher roles.

First- and third-person practice was also acknowledged and addressed. Using the first-person practice view, the researcher sought to improve his own practice as a leader and insider

change agent as described by Bryk, Gomez, Grunow, and LeMahieu (2015), and Fullan (2014) whereby change was driven internally and related directly to *improvement science* that promoted learning quickly, being minimally intrusive, and using evidence to guide subsequent improvement cycles or phases (Bryk et al., 2015). The researcher also viewed this study as an opportunity to improve the manner in which change initiatives were inducted and developed with faculty, and in a way that also benefited the school and organization as a whole, which addressed the third-person stance. An additional item of importance to the third-person view was the embracing, acknowledgment and navigation of the messy and complex insider role as a building leader or power-positioned insider, which had been discussed in numerous action research studies (Gaventa & Cornwall, 2013; Hans & Mats, 2005; Holian & Coghlan, 2013; Kenneally, 2013; Williander & Styhre, 2006).

The researcher's position of power in the selected site raised questions as to his proximity to the setting and participants, and the trustworthiness of the learning gleaned from this project if viewed through a traditional research lens. This was accepted as a challenge, but not as an impediment to the credibility of the study (see Williander & Styhre, 2006 for support for this view). Hans and Mats (2005) further affirmed that: "Action research projects are constantly threatened by, but also dependent on, political processes in organizations" (p. 411). An interpretivist perspective considered this insider power-position less problematic than a positivist stance, providing that measures for openly acknowledging and constantly reflecting on this position's influence on the participants and the findings were conducted (Gaventa & Cornwall, 2013; Herr & Anderson, 2015). This required the researcher to be astutely aware of the need to make decisions that supported and strengthened the authenticity and trustworthiness of the emerging findings, and the learning that the participants experienced and revealed throughout the

106

study (Coghlan & Shani, 2013). This was addressed through the use of deep and frequent reflection and journaling, as well as discussing the researcher's role and position with a trusted outsider to gain an alternate perspective, and numerous other measures were taken to minimize the insider-power role that was inherent in this study (Herr & Anderson, 2015).

The research was presented to the participants as a way to first explore their clarity on rigor, which had previously been communicated as being problematic in the prior pilot study in 2012 and through various informal conversations. It was also communicated that it intended to explore a process of possibly developing a greater understanding and utilization of rigor in their instruction, and that this exploration and possible intervention would place their perspectives and knowledge at the center of the study and with a view to using their learning and recommendations as a platform for supporting their colleagues' understanding and utilization of rigor. It was also acknowledged that this was not the usual approach experienced when considering the initiatives that had been enacted in prior years. The fact that practitioner knowledge and understanding was being supported, and therefore democratized (Brydon-Miller, 2013) in its construction by a power-positioned actor (administrator) for the less-powerful actors (teachers), it adequately minimized the effect of a insider-power position that is often deemed so problematic to the process of and the findings in power-positioned research (Gaventa & Cornwall, 2013).

Another approach to democratizing this process was situated in the use of the focus groups, which provided an opportunity for the participants to collectively challenge the findings. Additionally, frequently reminding the participants of the study's support for their work and the level of confidentiality employed was a strategy that was utilized to challenge the power-differential and shift the power towards those who gained the most from the study's learning—

the participants (Gaventa & Cornwall, 2013). The building principal was also used as a power

counter-balance to the power position of the researcher in frequently and informally meeting

with the participants to determine if they were feeling coerced, and to support them in removing

themselves if they felt this way. The use of a power-position over the researcher provided power-

support to the participants. The ethical considerations and related decisions are identified in

Table 3.1.

Table 3.1

Insider role considerations using Coghlan's (2001) three main challenges to insider AR

	Advantages	Challenges	Measures to minimize challenges
Pre-understanding and insider knowledge	He knew the inner politics of the school; for example, which people support initiatives, and which ones try to undermine them. Also, he knew which staff wished to improve their practice, and which ones were comfortable doing what they were doing He knew how to get things done, i.e. seeking the input of willing participants, cultivating next steps in a process	He may have thought that he knew the inner landscape, but may not have done as much due to his organizational role	Journaling and constant reflection Discussions with trusted outsider
Role duality in first person research	He sought to improve his own practice so he could better help teachers improve their work (instruction, and the way that initiatives were addressed/forced on teachers)	Some staff members may have viewed him as meeting his own needs on work time	Journaling and constant reflection Discussions with trusted outsiders
Role duality in second person research	He saw his organizational role as an instructional leader and facilitator (similar to a consultant), which was less of a conflict with other researcher roles, because his main role was on improving instruction and supporting teachers in building their capacity to do so	His role as school leader and as an evaluator made it so he was not always privy to issues of the participants and how they were feeling His role as an organizational member and colleague (not as an administrator) made it difficult to avoid being too close to the participants and data	None of the research was permitted to be used for evaluation purposes Seeking disconfirming evidence (Coghlan & Brannick, 2010; Ferguson & Ferguson, 2001) and negative cases (Maxwell, 2013) was essential to remaining open and not forcing the data in a favored direction

Table 3.1

Continued

Role duality in second person research	He was able to act as a bridge between theory and practice He was able to act as a conduit of insight into the workplace He was able to act as a facilitator of deeper understanding and possible intervention/action for improvement	Role as a researcher could have conflicted with his organizational role	Principal (researcher's boss) acted as support for the participants to prevent them feeling coerced or overly taxed Journaling and constant reflection
Role duality in third person research	Learning for the organization was also learning for the field and for the knowledge base	The study's findings and conclusions could be deemed less credible based on its generation of local knowledge and conducted by a power-situated insider	Open disclosure, thoughtful reading of the literature, and careful decision-making regarding his involvement and closeness to the study. Journaling and constant reflection
Organizational politics	He was very familiar with the politics, and felt that he was politically pretty astute, given his maturity and experience He had experience in navigating the political landscape in the research setting	He may have been pressured from upper-level management to incorporate aspects of learning/knowing into the study He could have imposed on the faculty members not in the research to support the research participants	This was not the case. The district wished to see if rigor was actually being applied in classrooms Mostly ensured that the work was only conducted during the participants' own time or scheduled planning time in order to avoid imposing on non-participants Journaling and constant reflection

The researcher, throughout the study, adopted a mostly emic (insider) position, which was driven by the data collected and the analysis process in each phase, as well as the development of the intervention, and the selection of the measure of impact by the intervention. The researcher felt that the emic role permitted him greater access to the perspectives of the participants because of his understanding of how teachers had perceived the implementation of prior and current initiatives, and because he had frequently and openly acknowledged an approach to involving teacher perspectives in efforts that were related directly to their development. He also felt that an emic position allowed him to be able to demonstrate sensitivity to, and a level of safety for, their viewpoints, which included possible concerns, confusion and frustrations.

An additional reason for him conducting the Phase I interviews as opposed to having someone in less of a power position and less subjectively positioned was based on his training and experience in interviewing, as well as his relationship with the staff (Grant et al., 2013), and especially due to his competency on topics such as instruction and pedagogy. Others with less experience and insight on pedagogy may not have probed adequately enough to deepen the insights gleaned from the interviews, and those with less experience in building teachers' capacity may have been less likely to establish a genuine climate for the participants to feel that the information and research interventions were both applicable to their work and development, and overall, meaningful for them.

Another factor that influenced the researcher to be closely positioned to the research and data collection, was that the questions were about a topic that was not initiated by the researcher. By asking participants how they understood rigor and how they defined it, was not a response to whether they thought that something was or wasn't working that related to a program or

111

intervention instituted by the administration at the research site. Rather, this was an opportunity for the participants to reveal their understanding of rigor and its application in instruction that was originated outside of the school, and directed by the current demands articulated by the Common Core State Standards. Positioning himself close to the participants was a way for the researcher to communicate to the teachers that he was supporting them in their journey to developing a greater capacity to design and implement rigorous tasks as part of their instructional practice, as well as to later be able to help guide the school towards this same aim, but with a teacher-developed direction as opposed to an administrator-viewed, top-down directive. The role of the researcher, when reporting the findings was also through an emic position in asking the group to consider the findings, and to propose next steps for studying rigor in order to better support their colleagues in designing and implementing rigorous tasks. This role created a form of participatory action research (Grant et al., 2013; Herr & Anderson, 2015; James, Milenkiewicz, & Bucknam, 2008; McIntyre, 2008) to developing Phase II and III.

The researcher also assumed an etic (outsider) role in working with the participants in weekly meetings as a coach and facilitator in planning. The participants mostly worked independently with their grade-level, subject-area colleagues to develop, design and implement rigorous classroom tasks. This position provided the participants the freedom to design rigorous tasks, while being close enough to monitor the participants' progress and developing an understanding of how their clarity and use of rigor was evolving as aligned to Fullan's (2014) suggestion for building leaders in creating ideal conditions for teachers to be able to maximize their learning and improvement. The allowance for the participants to work more independently with their grade-level, subject-area colleagues on the intervention was situated on the premise that the teachers needed the freedom to explore the intervention and its use in a professional

112

environment, and in a manner that emphasized their own power and capacity to develop themselves and their praxis. This was a perspective shared by K. Hess (personal communication, February 1, 2014).

Researcher's worldview. To achieve the goal of this action research study, the researcher embraced a mostly constructivist ontology, and in so doing, drew on Creswell's (2009) view that the goal of any research situated within a constructivist paradigm is to "…rely as much as possible on the participants' views…" and to "…focus on the specific contexts in which [they] live and work" (p. 8). Similarly, Patton (2002) advanced that a researcher should "represent people in their own terms. Capture participants' views of their experiences in their own words," (p. 331). Likewise, Lincoln, Lynham, and Guba (2011) acknowledged the constructivist or interpretivist inquiry paradigm as a way of understanding participants' perceptions through their lived experiences. They further stated that, at the ontological level, or the way in which we view reality (Maxwell, 2013), the researcher must interact with the participants and the research process to ensure that what is produced as a result of the investigation is reflective of the participants' reality. Compatibly, having a deep level of understanding and insight into an organization can equip an insider researcher to promote and develop new personal, group and organizational capabilities (Coghlan & Shani, 2013).

An objectivist ontological perspective was also adopted to determine whether the impact of the interventions (the instructional and the planning) positively impacted the participants' capacity to design and implement rigorous tasks, and devise a rigorous concept-based unit of study that emphasized higher-level conceptual learning for students.

Creswell (as cited in Lincoln, Lynham, & Guba, 2011), when discussing information gleaned at the epistemological level within a constructivist view, and the relationship between

113

the researcher and what is being investigated, advised that the way in which we gain access to the information we seek and our process of thinking in such an approach to inquiry is often subjective. Therefore, it is impossible to separate the researcher from what he or she explores and therefore comes to know. It was through this view that the researcher deemed that the most appropriate way of exploring the participants' perspectives of instructional rigor was by employing an inductive methodology using methods such as semi-structured interviews, reflection logs, and pre- and post-reflections as part of an interpretivist approach (Neuman, 2006; Creswell, 2009, 2012; Maxwell, 2013). A constructivist orientation supported the sharing of teachers' voice and their perspectives regarding rigor, as the researcher felt that teacher-level insight on various practitioner matters were often less heard (refer to Cochran-Smith & Lytle, 1990), and therefore deserved much greater attention to advance improvement efforts in instructional matters such as rigor. Consequently, this paradigmatic bent provided the opportunity for teachers to express their inner thoughts and understanding of rigor (Cochran-Smith & Lytle, 1990), and also provided them with a more collaborative role in their teacher learning than was often the case (Dick & Greenwood, 2015; Gaventa & Cornwall, 2013; Grant et al., 2013).

A complementary epistemological perspective was realized through the use of a post-positivist stance that employed a deductive methodology to determine whether the use of intervention tools and framework (in Phase II and III) positively influenced the teachers to be able to more aptly design and implement rigorous tasks as measured by the Hess (2013) Matrix and Implementation Rigor Rubric, and devise two coherent, rigorous concept-based units of study as measured by the UPPER rubric.

The overall study, however, was situated within a pragmatic orientation that embraced both post-positivist and constructivist perspectives. This was seen as a fitting lens in which to situate this action research study. Christ (2013) stated that: "Pragmatism is a philosophical tradition that promotes the development of theory directly from practice (praxis), a process where theory is extracted from actions, and applied back to practice in an iterative process" (p. 111). Greene and Hall's (2010) view of pragmatism is a "stance that advances multiple sources of evidence to attain and modify knowledge, which in turn is used to inform potential solutions or varying lines of action and to consider their consequences" (p. 132). Deviating from the fixed paradigm constraint, Dewey's form of pragmatism argued for a framework that did not subscribe to the epistemological and ontological traditions within a single paradigm, but rather, saw experience as a transaction of an organism and its environment (Biesta, 2010). The argument contended that learning is the result of intelligent action; simply translated: Trial and error, but with the "intervention of thinking" (p. 107). Thus, knowledge is the result of human engagement with the world, and one's actions within it and their consequences. Knowledge is also a human construction that proffers warranted assertions. Using this view for practical purposes, Patton (2002) suggested that pragmatism requires that a person select methods based on their "situational responsiveness" (Patton, 2002, p. 72) and appropriateness for a given inquiry interest. Yet, blindly situating oneself as pragmatist does not permit abdication of philosophical and epistemological responsibility. The paradigmatic considerations in this study are noted in Table 3.2.

Table 3.2

Researcher's Worldview

Worldview	Constructivism Phase I	Pragmatism Phase II and III
Ontology *Ideas about the world and truth* (Maxwell, 2013)	From a subjectivist perspective (Lincoln, Lynham, & Guba, 2011), the possible multiple realities of how teachers could view and perceive academic rigor was explored, as well as how they described applying it in their classroom practice. From an objectivist perspective, observations of teachers in action provided a real demonstration as to whether the intervention was impacting their thinking and practice.	From a subjectivist view, the perspectives of the teacher participants were gleaned from a variety of sources such as, interviews, reflection logs, and meeting minutes, all of which contributed to a subjective view of the impact of the interventions in both phases. An objectivist stance determined whether the interventions positively impacted the teachers' capacity to physical design and implement rigorous tasks, and design two rigorous concept-based unit of study.
Epistemology *How we gain access to knowledge of the world and truth* (Maxwell, 2013)	From an interpretivist perspective, and drawing on first-order responses (Neuman, 2006), data were collected from individual and focus group interviews, and the teachers' feelings and perspectives of rigor were captured mostly in quotes in order to remain as true to their perceived reality as possible (Creswell, 2009; Lincoln, Lynham, & Guba, 2011; Patton, 2002). Knowledge accumulation was partly hermeneutical (Lincoln, Lynham, & Guba, 2011) in that participants' meanings were allowed to emerge inductively from the interviews and the reflection logs in Phase II, and in the pre- and post-reflections in Phase III, which were relative to their experiences and first-hand insights.	A post-positivist perspective framed the scoring of the observations of teachers enacting and implementing rigor in lessons they determined to be rigorous and the planning matrices, and the same perspective framed the scoring of the participants' unit plans. An interpretivist perspective was adopted to glean knowledge from multiple sources (reflection logs, planning matrices, meeting minutes, interviews, reflections). These were eventually merged to establish a practical knowing as to the teachers' self-reports of the interventions' impact on their thinking of designing rigorous task and units.

Table 3.4

Continued

Worldview	Constructivism Phase I	Pragmatism Phase II and III
Axiology *How our values direct and guide this view of the world and how we gain knowledge of it*	Careful consideration was given to the credibility of the interview and reflection log findings to remain ethical (Mertens, 2012) and true to the participants' statements in order to permit their perspectives to emerge and be considered. An ontological authenticity (Mertens, 2012) was sought through the participants developing greater awareness of their perspectives and application of rigor in their instruction. An aim in Phase I was to foster greater intellectual understanding (Lincoln, Lynham & Guba, 2011) rather than immediate change or action as in the action or intervention phases (Phase II and III).	The inquirer's inherent biases and experiences were revealed, and a *negotiated* emic view was adopted, which meant that the researcher sought to remain in an emic position as an insider to the participants' context and as an administrator. He also adopted an etic perspective in permitting the participants to explore and develop rigor, and observed their development in action. As such, a very conscious awareness of the power balance (hegemony) was closely considered and monitored throughout. In the intervention phases (II and III), understanding and action occurred simultaneously as rigor was designed, practiced, reflected upon, and practiced again.
Methodology *The way in which we study the world and knowledge*	The process in Phase I was mostly dialectical, and in part, hermeneutical (Lincoln, Lynham, & Guba, 2011) as the teachers' perspectives were acknowledged, discussed, and recorded, transcribed, interpreted and constantly compared in a systematic and inductive approach using mostly qualitative methods. The study facilitated multi-voice teacher perspectives in all phases.	A deductive approach was employed for scoring the classroom observations and the UPPERs, which were balanced by an inductive approach that investigated the participants' perspectives on the interventions' impact using qualitative methods. Thus, multiple forms of evidence were gleaned to establish catalytic authenticity (Mertens, 2012; Onwuegbuzie, Leech, & Collins, 2008).

Note. Adapted from "Paradigmatic controversies, contradictions, and emerging confluences, revisited" by Lincoln, Lynham, & Guba, 2011, *The sage handbook of qualitative research,* (4th ed., pp. 102-115). Copyright 2011 by N. K. Denzin & Y. S. Lincoln (Ed.).

Setting

The literature noted that academic rigor was often lacking in many academic settings in the U.S. (Hess et al., 2009; Joftus & Berman, 1993; Manthey, 2005; Maye, 2013; Paige et al., 2013; Raudenbush et al., 1993; Wagner, 2008a, 2008b). The setting selected for this action research study was one of three middle schools in a suburban public school district. Five reasons supported using this site. First, the selected site was justified based on the district's demand to support its teaching staff in developing an understanding of and a capacity to increase the rigor of their instruction and assessment practices. Second, the selected school had addressed rigor very informally and sporadically during the previous five years as directed by the district, and was the site where the 2012 pilot study was conducted. Third, this site was one of three middle schools in the district that, during the spring of the 2014-2015 school year, had discussed adopting a school-wide goal for the following year to increase rigor, but was the only middle school of the district's three to eventually commit to adopting rigor as a school-wide goal in the 2015-2016 school year. Fourth, the selected site was further driven by recent independent consortium reviews of math and science instruction at the secondary level (middle and high), which indicated that rigor was an area of continued focus, and especially the way that the teachers implemented rigor. Fifth, the site was selected based on convenience (Onwuegbuzie & Collins, 2007), as the researcher was employed at the school and was the one who conducted the pilot study in 2012 following the district's early emphasis on improving rigor.

An additional reason for selecting a suburban middle school was grounded in the logical assumption that more affluent, higher-performing schools and districts consist of higher performing students, and therefore require teachers who must understand, and therefore use greater levels of academic rigor in their classroom instruction than lower-performing schools.

The district in which this research setting was located was ranked ninth out of the top 100 safest cities in America, and 16th with the highest median household income (Town website). In 2011, the household median income was estimated to be $98,922 compared to the state's estimated $65,753. Additionally, almost 23% (22.8) of residents held a graduate or professional degree.

Student population. The student population for the 2015-2016 school year in the district was 10,167 (District website). The district housed 11 elementary schools, three middle schools, and two high schools, as well as an alternative high school. The enrollment data for the district is presented in Appendix F, Table F1.

Student achievement. The district's middle-level achievement data on the state's standardized test over the previous seven years (2006-2013) indicated that the three middle schools, combined, had performed considerably better than the state in grades six, seven and eight from 2006 to 2013 (Connecticut State Department of Education, 2013). This was true for tests in math, reading and writing whereby there was between a 10 and 20 mean percentage difference for every year. The selected research school had also performed comparative to the overall district middle school average for every year (2006-2013) in all three subjects.

District middle school teaching population. Appendix F, Tables F2 and F3 provide an additional and general overview of the district's middle-level demographic data and for all academic subject-areas taught (language arts, math, social studies and science). This includes the number of sampled teachers, and their respective subject areas currently taught. The demographic data from the sampled participants was also recorded for replication purposes (see Appendix F, Tables F4, F5, and F6), and explicates the additional demographic data, such as

gender, certification area, years of experience, and the total number of years teaching their current subject area and grade level.

Bounding the Case

The participants in a case should provide the most appropriate illumination of the research focus and questions (Yin, 2009). To date, much of the research that had attempted to investigate the presence of academic rigor in schools had been predominantly in settings that were socio-economically disadvantaged (see Reich et al., 2013), which therefore supported the case for research to be conducted in a suburban middle school. This physical setting and the participants' subject area further bounded the case, which was restricted to math, language arts, science or social studies, and set for the 2015-2016 school year. The research was conducted between September 2015 and April 2016 (eight months). The decision to end the dissertation research was made based on an adequate amount of time for progress to be demonstrated based on the intervention participants' understanding and application of rigor in their classroom practice and planning.

Participants

An important reason for selecting the site was also due to the relationship that had been developed between the researcher and the staff in this school over the previous five years. Traditional research sampling schemes may consider this problematic due to the researcher's familiarity with the setting and the power balance between him and the staff/participants in this study. Numerous action research and qualitative research advocates, however, feel differently about a researcher's proximity to and intimacy with a study's setting (refer to Coghlan & Brannick, 2010; Herr & Anderson, 2015; Lincoln et al., 2011; Marshall & Rossman, 2010), and explain that the power balance simply has to be made explicit and negotiated in the research

design. The sampling scheme that was used for this action research was based on convenience (Collins, 2010; Creswell, 2009; Onwuegbuzie & Collins, 2007) with a single qualifying criterion, which included the limitation of only academic (math, language arts, social studies, science) grade six, seven or eight teachers.

Of the 10 teachers involved in Phase I, five (Teachers 1, 2, 3, 4, 5) were purposefully selected, and five (Teachers A, B, C, D, E) were randomly sampled. The purposefully selected sample were used in Phase I and the first iteration of the intervention in Phase II, because they brought a high level of practitioner expertise, personal credibility, a teacher leader-level perspective, were expected to candidly share their progress and perspectives, and had demonstrated a willingness to and comfort with working with the administration to enhance teacher conditions. The selected teachers in Phase II (second iteration) were some of the randomly sampled teachers (Teachers A, C, D, E) and their grade level, subject area colleagues (Teachers F, G, H, I, K). Additionally, Phase III included a sampling of teachers from both Phase I and II (Teachers 4, 5, and E, F, G).

Participant demographics. The Phase I teacher participants were academic teachers of either grades six, seven or eight; their profiles will be noted in Appendix F, Tables F4, F5, and F6, which included their gender, certification, subject and grade level currently teaching, total years of experience, and the number of years teaching their current subject and respective grade level.

Consent. The participants were informed of the researcher's intent to use them in the study and the reason for the study in a short meeting, which was followed with an email (see Appendix C). Once all agreements were received (see Appendix D), the participants were assigned a pseudonym (Teacher number or letter) that protected their anonymity.

Techniques to Increase Credibility, Trustworthiness and Dependability

Specific measures were taken to increase the potential that the research findings in each phase of this research could be deemed credible and trustworthy, and to answer the question that Maxwell (2013) posed: "Why should we believe it?" (p. 122). These measures addressed the potential limitations, such as issues related to the researcher's involvement, the researcher-participant-relationship, the selected sample, the interview questions, the analysis of the data, and the issue of participant self-report bias. Additional considerations, as suggested by Maxwell (2013), were also considered to establish greater levels of trust in the findings and conclusions.

The researcher's involvement. The positionality of the researcher was that of an insider who held a position of power over the participants. However, Herr and Anderson (2015) proposed that the insider researcher, especially one of power, "…must be honest and reflective about the limitations of [the] multiple positionalities [one holds] and take them into account methodologically" (p. 59). Further, they strongly suggested that the insider researcher must frequently interrogate his position and its impact on the setting. Additionally, Maxwell (2013) noted that qualitative research should not seek to eliminate the researcher's obvious and unavoidable influence, but rather seek to realize it and use it constructively. This was addressed by the researcher acknowledging his involvement in the research (Altheide & Johnson, 2011) through frequent memo writing and constantly reflecting on his implicit influence.

The researcher-participant relationship. The relationship previously developed between the researcher and the participants provided the researcher with a working knowledge of the pedagogical needs of the teachers and the challenges they were facing in this area, which made the intervention relevant and the information gleaned more believable than if an outsider-researcher had conducted the investigation. The researcher's intimate knowledge of the

122

limitations of the teachers' time and availability was used to ensure that the intervention work was conducted within the confines of the teacher's regular schedule, which prevented the participants from becoming overwhelmed and discouraged.

Neither the observations nor the interviews were considered as part of the participants' teacher evaluation requirements to reduce their fear of receiving an unfavorable evaluation and feeling coerced. This was communicated explicitly and frequently to provide them with a sense of safety and to create a collaborative coaching approach to their development with rigor.

The sample. The sample size drew on an adequate number of participants that included approximately 47% of the full-time math, language arts, social studies, science teachers (see Creswell, 2012; Collins, 2010; Onwuegbuzie & Collins, 2007). Sampling bias was considered by randomly sampling five teachers (Teachers A, B, C, D, E) in Phase I to provide a form of comparison to the other five purposefully selected teachers perspectives in Phase I. They were also used in Phase II (second iteration) and Phase III to ensure that multiple views and perspectives were considered throughout the study.

The interview questions. The research and Phase I interview questions were presented to Drs. Tony Wagner and Karen Hess to establish content validity.

The analysis. The first cycle coding process was eclectic and employed both holistic and In Vivo coding (Saldaña, 2013), which was used in all phases of this research to analyze the interviews, participant reflection logs, and the meeting minutes. The consistency of codes within the data remained as reliable and as dependable as possible (Creswell, 2009), and the developed themes were constantly compared to each other (Kelle, 2007), as well as to the In Vivo codes to create an accurate interpretation of the teachers' perspectives and to seek deep levels of meaning

(Charmaz, 2011). The same consistency was employed in the rigor planning matrices and classroom observations.

Participant self-report bias. The interviews, the weekly logs, and the perspectives shared in the weekly planning meeting were subject to participant self-report bias, which Donaldson and Grant-Vallone (2002) described as research participants who "want to respond in a way that makes them look as good as possible" (p. 247). Therefore, they either under-report on less desirable behaviors or outcomes or over-report on ones that are deemed to be much more appropriate. Donaldson and Grant-Vallone suggested that at least two data sources should be used to "help rule out the validity threats of self-report and mono-method bias (p. 256). This research countered the limitations of using only participant reports, such as interviews, weekly logs and meeting conversation by also employing observations. The participants' shared perspective was therefore considered alongside what was viewed by other observers in order to draw more valid conclusions.

Maxwell (2013) listed eight conceivable strategies in which to account for and attempt to minimize potential validity threats and increase credibility of a study's findings. In this study, five of those strategies were applied. These were: (1) Engaging in an intensive, long-term involvement, (2) using rich data, (3) employing respondent validation, (4) searching for discrepant evidence and negative cases, and (5) comparison. Two other strategies were also employed to increase the credibility of the findings.

Engaging in an intensive, long-term involvement. The researcher, as an insider, and unlike field researchers who are unfamiliar with the setting and context, was not required to spend a great deal of time in which to allow the participants to accept him and the purpose of the research. While such challenges are common to any field researcher conducting face-to-face

interviews (see Maxwell, 2013; Neuman, 2006) and observations, which were present in this inquiry, the researcher already had a working knowledge of the conditions that surrounded rigor, as well as the challenges of the participants' work and life at work. Despite such familiarity, the study was conducted over an adequate period of time (eight out of the approximate nine and a half months of the school year) to ensure that the data collected and the analysis methods employed were of the highest quality, and therefore supported credible and believable findings and results.

Using rich data. The interviews were transcribed verbatim, resulting in 353 pages, before being analyzed and coded using an In Vivo process to remain as true to the participants' meaning as possible, to provide a valid portrayal of the interview conversation, and to minimize the researcher's subjectivity as to what was noted and deemed important (Maxwell, 2013). These findings were presented with sufficient detail as to provide a gateway for the reader to "feel that they were vicariously in the field (thus able to judge [the findings, the suggestive conclusions, and their credibility] for themselves)" (Corbin & Strauss, 2008, p. 300). This level of detail was pertinent not just to the physical setting, but to the way in which the participants spoke of rigor, responded to the questions, and elaborated on discussion points. Additionally, the researcher's interpretation of the participants' perspectives provided rich, thick description, and they add validity to the findings (Creswell, 2009).

The observations required that multiple observers view the lesson and take detailed notes using a consistent, predetermined lesson observation protocol and form (Appendix H). The notes were used for each observer to assign a rigor score before defending their thinking to the other observers, and before an agreed upon and final score was assigned to the lesson.

Employing respondent validation. A respondent validation procedure (Maxwell, 2013) or member check (Creswell, 2009, 2012; Mertens, 2012; Thornberg & Charmaz, 2012; Yin, 2002) was employed in all phases by providing the interviewed teachers the emergent themes and a copy of the transcriptions so that they could review and relive the experience, and check for accuracy and agreement, predominantly on the themes and overall interpretation. The participants also partook in focus group interviews to review the findings in Phase I, which were captured in a short, but precise narrative, and with the view to them being able to check the accuracy of the researcher's interpretation. This also provided them with an opportunity to use the findings to add further clarification and insight and to discuss the intervention and next action steps. Throughout the process, the participants were provided full transparency to the findings at each phase of the research.

At the end of each phase, the collective and overall findings were written in a short narrative report and provided to the participants for review. This included the information from interviews, the weekly logs, the matrices, and the observations, but did not include information that specified personal identifiers, such as statements that were made by specific participants, nor observation scores achieved by given individuals. The researcher's thoughts on the intervention iterations were also included in the narrative, along with ideas and suggestions for the next phase. The participants, after a review of the report, verbally (or through email) indicated whether they agreed with the report and the suggested next steps. They were free to individually challenge information contained in the report and to seek clarification, which the researcher provided, as well as to suggest ideas for next steps and refinements, especially in the intervention phases. Following this, the refined iteration was established and formed, and presented to the next group of participants.

Searching for discrepant evidence and negative cases. Each phase of this research required the researcher to be mindful of and open to discrepant or disconfirming evidence that did not fit the emerging patterns relating to how the teachers perceived rigor. As indicated in the individual interviews in Phase I, data that did not seemingly fall under the question headings was still captured and analyzed, as this lead to a search for more insight in this area and to consider it in the suggestive conclusions drawn.

Comparison. A comparison was made between the perspectives of the intervention participants and those of a comparison group of participants in phase I. This comparison was only used to check the perspectives of the purposefully selected group to the randomly sampled group in order to address questions relating to the sampling bias. It was assumed that the findings in this phase would indicate that both groups would perceive rigor in generally the same way, and so regardless of sampling, the credibility of these findings would support the validity of the conclusions.

Triangulation. Triangulation was a strategy used to collect, analyze and draw conclusions from a broad perspective using multiple and varied forms of data and evidence (Corbin & Strauss, 2008; Creswell, 2009 2012; Maxwell, 2013; Yin, 2009). The interviews and the sampled teachers' perspectives on rigor in phase I were compared to the whole faculty's views on rigor from a professional development session, and further compared to an observation of each of the initial 10 participants. Focus group interviews were also used for comparison, as well as to the pilot research conducted a few years prior.

Dependability. Although the researcher's intent was to create a comfortable and casual conversation-like discussion (Yin, 2009), the qualitative interviews followed a somewhat prescriptive approach by means of a specific, pre-determined protocol (see Appendix G). Also,

127

directly related, pre-determined follow-up questions had been crafted as probes to glean additional information. The transcriptions were also coded using an In Vivo coding process (Saldaña, 2013) to remain as true as possible to the interviewee's spoken words, and therefore, the meaning behind them. When using In Vivo became less applicable, holistic coding (Saldaña, 2013) was employed to again remain as true to the meaning of the interviewee's stated words.

A similar structured process as the interviews was employed for the observations. A lesson observation form (Appendix H) was created and used along with a protocol for observing the lesson as it specifically related to rigor. Multiple observers had been acquired to address the bias potential of a single observer, such as the researcher, and these included the building principal, and the math and language arts coaches (MRT and LAS, respectively). Before the phase I observations, the researcher met with the Principal, the MRT and LAS and conducted an hour-long training on the lesson observation philosophy, the focus, the note-taking process, and the protocol for the time spent in the classroom. The training also included a specific and detailed review of the Hess (2013) Matrix and the overall scoring process and procedures. This was tested with two randomly selected teachers, neither of which were initially selected for the research study. After an agreement from the teachers, the researcher and the three other observers practiced collecting information specific to the lesson observation form requirements, blind-scored the level of thinking/cognitive rigor of the tasks in the lesson using the Hess (2013) Matrix, and then discussed their score and rationale. The expectation was that the observers were consistent in their selection of the level of thinking (according to the Matrix's depth of knowledge level situated on the horizontal continuum, and were within one level of Bloom's Taxonomy on the horizontal continuum). However, the post-observation briefing and score-discussion ensured that an agreed upon and accurate score was assigned.

An additional structure was used to judge the quality of this action research using Herr and Anderson's (2105) *Goals of Research and Validity Criteria* framework. This included addressing aspects of validity such as, process, democratic, catalytic, and outcome. Process validity was established by selecting a methodology and procedures that enabled on-going and deeper learning of the issue from individuals situated within their natural context, as well as an intervention that was justified by and relevant to the participant teachers. Furthermore, numerous data sources ensured that the findings and conclusions drawn were based on multiple perspectives.

Catalytic validity was developed through an approach and intervention that required the participants to re-orient their thinking and consideration of an issue that they would likely report has having struggled with for many years. Requiring them to share their perspectives—individually and with colleagues in focus group interviews—as well as through journaling, provided a means for deepening and broadening their awareness and perspectives on rigor. This was also the case for the researcher, who maintained a reflective, on-going journal throughout the study.

Working with the participants and involving them in continued dialogue about rigor and how to define and apply it supported a democratic form of validity. The participants' learning was most relevant to them and their daily work, and it was this collaboration that enabled their voices and perspectives to be heard and considered. While the voices and perspectives of the students did not feature into this research, the teacher participants acted directly on their behalf.

The success of the study was measured by teacher participants reporting and the observations demonstrating that they were better able to define, design and implement rigorous

tasks. The level of outcome validity was dependent upon the degree to which this aim was met through the phases of the intervention.

Techniques to Increase Transferability and Applicability

The primary aim of this action research investigation was not to generalize beyond the setting in which the research was conducted (Coghlan & Brannick, 2010; Herr & Anderson, 2015). However, transferability in this inquiry was likely possible through a naturalistic slant (Chappell & Barone, 2012; Onwuegbuzie & Combs, 2010; Stake, 2010) whereby the reader or audience interpreting this study's procedures and findings is able to determine how this sample of public middle school teachers in a suburban setting represents, for them, similarities to their own setting and cases. Readers of this research are able to make such determinations based on a consideration of the procedures used, such as who was sampled, the reasons, and their demographic information (see Appendix F), as well as the inherent limitations, and the considerations taken into account to address them. The report was written in a clear and coherent manner so that this study's setting can be compared to, and replicated in, other similar or dissimilar settings (Creswell, 2009).

Ethical Considerations

Institutional Review Board (IRB) approval was sought and acquired prior to communicating with selected participants, and before conducting the interviews and observations, and collecting all other data. While IRB was awarded for the pilot study in June 2012, a resubmission that directly reflected the specifications of this dissertation research project was made in January/February 2014. A further amendment was developed and submitted in July 2015. This also applied to retaking the National Institutes of Health (NIH) Office of Extramural

Research web-based training course: Protecting Human Research Participants, and the Collaborative Institutional Training Initiative (CITI) program.

The research intent and design was fully disclosed to the superintendent and assistant superintendent in order to gain their permission to conduct the research and to do so in-house. As such, every measure was discussed at these meetings to protect the integrity and confidentiality of the participants, the school, and the district through anonymity. These measures and assurances were then communicated to the building principal and the teacher participants.

The rationale and intent for the selected research, and the methodological approach was fully disclosed to the participants, as was the way that the information was to be used, stored and kept confidential (see Appendix D). Each participant was also assigned a pseudonym (i.e. Teacher A) to protect their identify and maintain confidentiality of their involvement (Corbin & Strauss, 2008; Mertens, 2012; Neuman, 2006).

This research also aligned with the three basic principles of ethical research (Mertens, 2012). The principles of *beneficence*, *respect* and *justice* were addressed through this study's strive to maximize the benefit to teachers (the participants) through the use of a methodology and procedures that were "courteous…nonexploitative…[and] carefully considered" (Mertens, 2012). The writing of the final report was extremely sensitive to the way in which the district and the school were perceived through the findings and conclusions. The aim of the researcher was to bring greater insight to supporting the district, as a whole, in helping to provide an opportunity for its staff to share their perspectives on rigor, and to develop their understanding and capacity to more readily and consciously design and implement rigorous classroom tasks.

Participants' Rights

The participants were free at any time to discharge themselves from the study, and this was communicated to them verbally and in writing (see Appendix D).

Limitations of the Study

The relationship between the conclusions and the actual reality of teachers' understanding and use of rigor in this research may have been subject to some issues of plausibility due, not to the methods commissioned, but to the evidence garnered (Maxwell, 2013). As such, there were likely some limitations evident in this study. The sample for this study was approximately 47% of the core faculty's perspectives on and capacity to apply, rigor, which did not generalize to the entire building. The researcher was one of the main instruments in this study's data collection (interviews and observations), especially in Phase I, and at times, may have influenced the data collection and analysis process. Additionally, the employment status of the researcher as an administrator in the school may have influenced some of the participants, and they, being aware that they were involved in a research study, may have modified their behavior (similar to the Hawthorne and novelty effect, Neuman, 2006). Also, as noted by Yin (2009), "…interviewees' responses [are] subject to the common problems of bias, poor recall, and poor articulation" (Yin, 2009, pp. 108-109).

CHAPTER 4: FINDINGS

This action research study sought to determine how academic or instructional rigor was understood by core subject area teacher participants in a single middle school to determine if an instructional intervention using the Hess (2013) matrix for task rigor, an implementation rigor rubric, and a 3-step planning process as a framework for utilizing both tools positively impacted the teachers' capacity to design and implement rigorous tasks. It also sought to determine if a unit-planning framework provided the teachers with greater clarity and understanding on how to design a coherent concept-based unit that incorporated increasingly rigorous tasks. The study was guided by a pragmatic orientation within two theories relevant to developing instructional practice: Instructional design theory (Bruner, 1960, 1966; Merrill, 2001, 2007; Taba, 1966) for designing classroom tasks and sequences, and learning theory (Bransford et al., 1999; Donovan & Bransford, 2005; Mayer, 1992, 2004, 2011) for drawing on cognitive processes necessary for promoting students' capacity for higher-level and deeper thinking.

Four main research questions directed this study:

1. What is the teachers' current understanding of academic rigor, and how do they describe the basis for their understanding?

2. Do the Hess (2013) Matrix and the three-step planning process positively impact the teachers' capacity to design rigorous classroom tasks?

3. Do the Hess (2013) Matrix and the three-step planning process positively impact the teachers' capacity to implement rigorous classroom tasks?

4. Do teachers report that a planning framework for developing a concept-based unit of study and specific training support provide them with greater clarity and understanding on how to design a coherent unit that incorporates increasingly rigorous tasks?

The findings in Phase I indicated that the teacher participants' understanding of academic or instructional rigor varied and was not based on a formal definition, which had lead to frustration. Moreover, the teachers reported being able to offer a definition, but unclear as to how to operationalize it in their instruction. Following an instructional-focused intervention (Phase IIa, IIb) and a planning intervention (Phase III), all teachers reported that their understanding of rigor and how to operationalize it in their instructional practice had increased. This was supported through an observed increase in rigor scores in Phase II, and an improved understanding of and capacity to design a concept-based unit that incorporated increasingly rigorous tasks in Phase III.

Phase I: Teacher Understanding of Rigor

Phase I of this action research study was exploratory in nature and designed to understand select teachers' perspectives of academic or instructional rigor. Data included written responses by 76 staff members and 10 interviews with five purposefully selected and five randomly selected teachers in grades six through eight who teach language arts, math, social studies, and science. An observation of each of the 10 teachers was added following a combined analysis of the interviews and written responses. Three focus group interviews were also conducted. These four data points were merged in tables and later in a narrative that explicated the perspective and understanding that this setting's staff had of academic rigor.

The findings and results in Phase I answered research question one, which was guided by three phase-specific questions:

a. How do teachers perceive and define instructional rigor?

b. How do teachers perceive and describe their pre-certification preparation's influence on instructional rigor?

c. How do teachers perceive and describe their professional development preparation's influence on instructional rigor?

1. What is the teachers' current understanding of academic rigor, and how do they describe the basis for their understanding?

The teachers generally felt that they could define the attributes of rigor, and did so by describing it as *intellectually challenging work*, *deeper thinking*, *higher-level thinking*, *students engaged in purposeful struggling*, and *operating beyond their comfort zones*. Additionally, the 76 staff members across this single setting defined rigor similar to the 10 teachers individually interviewed. This was evidenced in the merging of categories from the responses to question one in both the PD and individual interviews. When the themes were combined, collapsed and refined, rigor, overall, was defined by all of this setting's teaching staff as *deeper thinking* and *forcing students to go beyond their comfort zones*. Examples of this were captured in numerous responses from the participant teachers. One response in the interviews stated that: "…academic rigor is making each child reach and go beyond their comfort zone of what their potential could be to obviously better themselves" (Teacher 1). A similar perspective defined rigor as: "…open ended for them to kind of discover on their own" (Teacher 2), and the same teacher defined it also as: "…[allowing] them to explore and experience rather than giving them everything up front…discussion can't really go anywhere and develop and flourish if you don't leave it open for children to agree, disagree, expand on ideas." Additionally, Teacher E said that rigor would require that a teacher: "ask them a higher level question…ask them to dig a little bit

135

deeper…having to think a little bit…just not give me a rote response," and yet another

participant defined rigor in such a way that students: "…are synthesizing or evaluating or

analyzing some of those higher Blooms things" (Teacher 3). Furthermore, many of the responses

to question 3 (How would I see it in your classroom, specifically?) in the semi-structured

interviews also provided a perspective that teachers felt able to define, and also, understand

rigor. All of the interviewed participants stated that an observer in their room would see more

active, student-centeredness, students synthesizing and drawing conclusions, questioning and

making their thinking explicit. One teacher exemplified this by offering that a view into his

classroom would reveal students engaged in problem solving, debating and questioning, and

working outside of their comfort zone.

The teachers' definitions of rigor and how they reported it would be viewed in their

classroom were, however, in contrast to how many of the participants were able to operationalize

these definitions in their instructional practice through classroom observations. This was also

determined from conflicting statements the participants provided in the individual and focus

group interviews, such as: "I think I'm most confused with how to make it work on a regular

basis…that's the thing, I don't even know if what I'm saying is what I think it's supposed to look

like is even right" (Teacher B). The responses from question four in the PD session, which asked

the teachers to write down questions that they still had about rigor, also revealed a conflict in

their perspectives. The responses outlined that teachers felt unclear and unsure on how to plan

and implement rigor. For example, approximately one-third of the teachers in the PD session

asked questions that indicated a lack of clarity on rigor, and two such responses were: "How to

make tasks for higher level students more rigorous without giving them more work?" and "How

to challenge my students and incorporate deeper levels of thinking into lessons?" Teachers were

also unclear and unsure on how to incorporate rigor as evidenced in the following questions: "How do you complete curriculum while still applying rigor to lessons?" "How do we maintain this level of rigor while covering all content?" and "How do I make it rigorous, but students still finish the project/task?" Additionally, the responses to two questions in the interviews (questions 7 and 8) that focused on how well the teachers felt they understood rigor and how well they felt their colleagues understood it also revealed a lack of clarity. The themes to these questions included: *Unclear*, and *Difficulty translating it into action*. For example, Teacher B noted:

> On a scale of 1 to 10, I'm probably at a 5 right now. I think I'm most confused with how to make it work on a regular basis…that's the thing, I don't even know if what I'm saying is what I think it's supposed to look like is even right. Maybe I'm already doing something that provides rigor…but maybe not. As far as…I don't know…I don't know exactly where I am in it.

Another teacher commented:

> I think I have some understanding of what I think it means for me, but I also think there's a difference between what I think it is and how to actually employ it in my own classroom. I think conceptually I have a decent understanding but how necessarily to apply it regularly is still something I struggle with. (Teacher A)

Two other comments supported the perspective that teachers were be able to verbally define rigor, but struggled to know whether or not their instruction was rigorous: "I feel like there are just some aspects of my curriculum where I struggle with developing rigorous assignments…How do I translate this?" (Teacher 5), and Teacher E shared: "I know what the concept is…don't feel like I understand how to implement it well enough." Teacher 3 posited: "I

think I understand it but I don't know if when I actually go through my lessons if I'm actually sticking to what I think my understanding is."

A similar viewpoint was found in question two of the interviews (How does academic rigor feature into your planning?). Some of the participants' responses to this question were identified as being problematic for teachers to plan for rigor, as noted in Teacher 5's statement: "It's hard to describe how it features into planning. I feel like it's more challenging for me to think about rigor." Two other perspectives supported this view: "The biggest challenge, I think, is understanding what rigor is. So I think that up until this point it's been difficult to plan for it because obviously you want to challenge students" (Teacher B), and "There's not really one direct way to always implement it into your plans" (Teacher 1).

Ten classroom observations revealed that six were categorized as level one or two thinking according to Webb's (2002) DoK levels, with five of the overall observations being categorized in the lower half of Bloom's Revised Taxonomy on the Hess (2013) Cognitive Rigor Matrix (Figure 4.1). These results were consistent with the perspectives that most teachers reported feeling that they could verbally define rigor, but felt less able to operationalize it as noted by one teacher who offered: "we were all able to define rigor but we all struggled with how you implement and what it looks like in the classroom" (Teacher E).

	Webb's Depth of Knowledge			
	1	**2**	**3**	**4**
R	1			
U	E			
A	C D	B		
A		A	2 4 5	
E			3	
C				
	40%	20%	40%	0%

Bloom's Revised Taxonomy (vertical axis label)
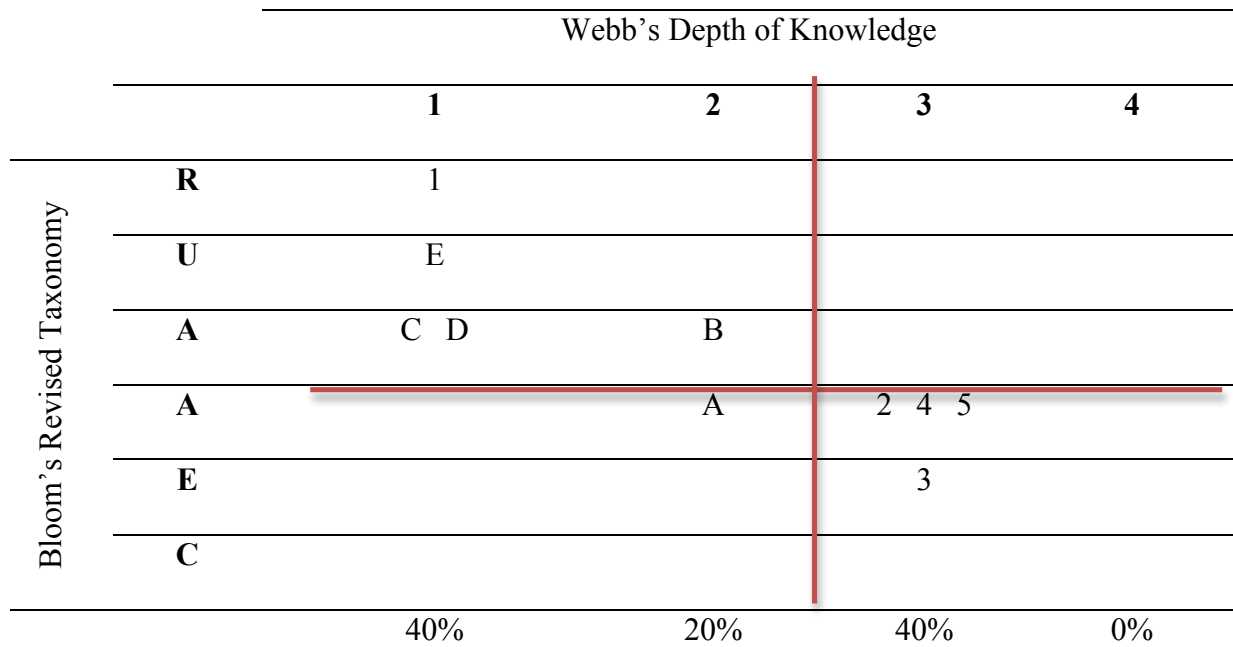
Figure 4.1. The lesson observation scores for Phase I sampled teachers.

The individual and focus group interviews revealed that teachers perceived that neither their certification and training, nor their current professional learning prepared and developed them to be able to define and develop rigor in their instructional practice. This was evident by one statement: "I can't really think of anything in particular that was done to really help us do that" (Teacher 2). Another teacher (Teacher 4) shared that: "There wasn't a lot that went into what the challenges of actual purposes I guess of the lessons as opposed to just writing the lessons," and "The term rigor was never uttered…." Teachers also felt that their professional learning had not helped them to understand and design rigorous tasks. Question five in the interviews (How has your PD training prepared you to use academic rigor?) was met with various responses, such as this:

The PD that I've seen has been more…its been kind of like, we're going to sit here and we're going to talk about this and then we're going to brainstorm information and then you're going to go and we're never going to talk about it again." (Teacher 2)

Another teacher (Teacher 3) was equally adamant in this view by stating the following: "I have to be honest that there aren't many professional developments since I started here that have been really helpful…in general…even when I out with other people I know are getting tired of hearing that word and not really knowing well, why is this being said…it's a bigger issue with like outside of just our school.

A third perspective stated that: "I don't think it's ever been defined by anybody as to what that means…It's almost been more of us on our own finding what rigor is. And so – nobody has ever said this is what rigor is" (Teacher D).

Not all teachers, however, felt that their professional learning with regards to rigor was insufficient. Due to some school-based discussions and school-level faculty meetings being dedicated to rigor over the previous four or five years, some teachers felt these experiences at the school level had helped somewhat more than the district level where they meet with their subject area colleagues from other schools. One teacher felt that: "Building level PDs have helped in that area much more than district level" (Teacher 5). Another shared: "I think at the district level, not necessarily…well, what can I say…just not as consistent as at the building level" (Teacher A). The general perspective on whether professional learning had and was contributing to increasing the teachers' understanding and capacity to design and implement rigorous tasks was that it didn't, and therefore needed to be addressed, especially at the district level.

As such, these teachers deemed rigor to be a necessary focus that required being more clearly defined, and an aspect of instruction with which they needed to be provided professional

support in order to develop their capacity to design and implement rigorous tasks. The focus group interviews also revealed that many of the teachers had not considered their work as focusing on developing their students' levels of thinking, which was expressed in one teacher's comment:

> I've never thought about how to teach – well I guess I have – I was going to say to teach students to think critically but I think it's embedded in the curriculum in a way with what I have to do but I don't know that I have strategies to get them. It's more of the task maybe but not…I don't know. I've never really thought about it that way I guess. (Teacher 3)

Phase IIa-b: Instructional Intervention

Phase IIa of this action research was the initial intervention phase, and its purpose was to determine whether the Hess (2013) Matrix and the selected 3-step planning process positively impacted the 14 purposefully selected teachers' (1, 2, 3, 4, 5 in Phase IIa, and A, C, D, E, F, G, H, I, K in Phase IIb) thinking and capacity to design and implement rigorous classroom tasks. The findings and results in Phase IIa-b answered research questions two and three. The data gleaned from five different sources, which included: (1) individual weekly teacher logs, (2) weekly researcher subject meeting minutes/notes, (3) individual classroom observations, (4) a planning matrix, and (5) individual teacher interviews, provided multiple views of the impact of the intervention on teachers' thinking, planning and instruction from their own perspective and that of the researcher. The observations, matrix plan and weekly meeting minutes/notes served to counter the possibility of self-report bias from the teachers' weekly logs and interviews (individual and focus group).

2. Do the Hess (2013) Matrix and the three-step planning process positively impact the teachers' capacity to design rigorous classroom tasks?

Teachers reported that the Hess (2013) Matrix and the 3-step framework/planning process positively impacted their thinking and their capacity to design rigorous tasks, and this was corroborated by the classroom observations. For example, two of the five teachers in Phase IIa demonstrated an observed increase in their capacity to design rigorous tasks (Teachers 2 and 3) when comparing their first and second classroom observations, while two other teachers maintained a high level of task rigor in the classroom work they assigned to their students (Teachers 1 and 4). There was also an increase in the percentage of teachers scoring in DoK level 3 (60% to 80%), and a decrease in the percentage of teachers scoring in DoK level 2 (40% to 20%) between the first and second observations (see Figure 4.2). A comparison of Teachers 1, 2, 3, 4, 5's scores from Phase I to Phase IIa also revealed that two of the teachers demonstrated great improvement and maintenance of rigor. Teacher 1 made the most improvement (DoK level 1/Bloom's *Remember* to DoK level 3/Bloom's *Evaluate*), and was able to maintain high rigor scores in both observations in Phase IIa. Also, Teacher 4 was able to maintain a high rigor score (level 3) between Phase I and IIa, and even increased the Bloom's taxonomical score from *Analyze* to *Evaluate*, and maintained this in both Phase IIa observations.

Webb's Depth of Knowledge

Bloom's Revised Taxonomy	1	2	3	4
R				
U				
A		2[1] 5[2]	3[2]	
A		3[1]	2[2]	
E			1[1,2] 4[1,2] 5[1]	
C				
	0%	30%	70%	0%
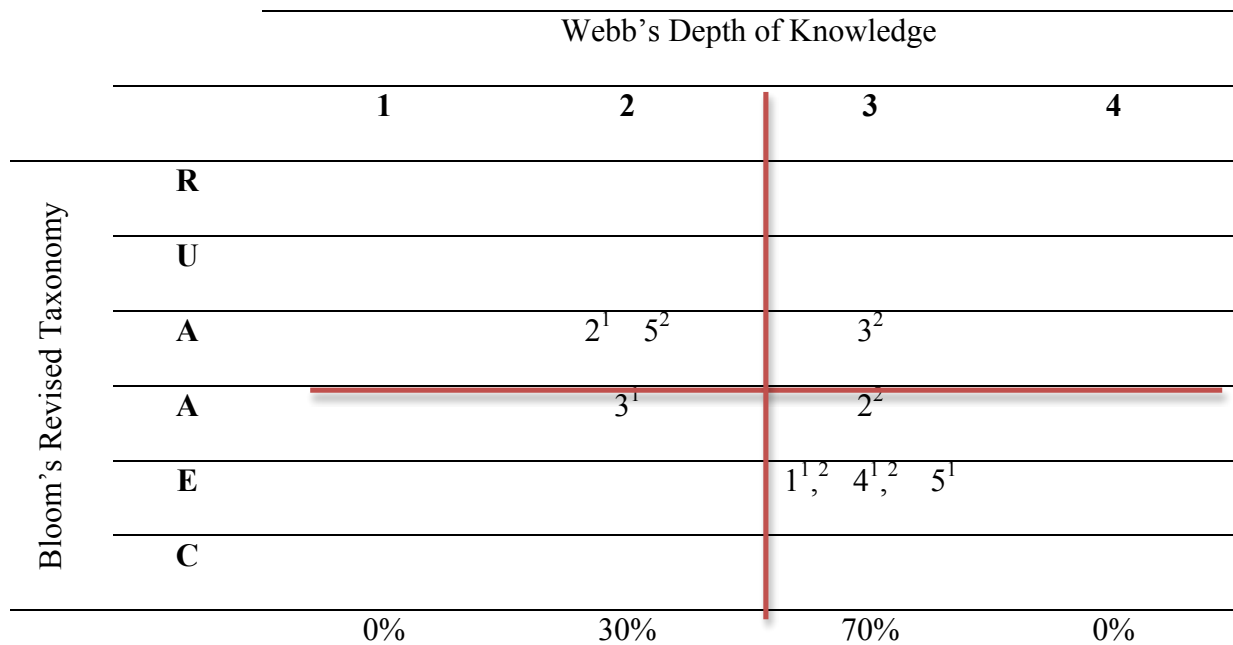
Figure 4.2. Phase IIa Lesson Observation Scores using Hess (2013) Matrix.

Similar improvements in the classroom observations were noted in Phase IIb where eight of the nine teachers (89%) demonstrated an observed increase in the capacity to design more rigorous tasks when comparing observations one and two. Additionally, six teachers (67%) increased their task's DoK level of complexity. Also, when comparing Teachers A, C, D, E's scores from Phase I to IIb, all improved. For example, Teachers C, D, and E all scored in DoK level 1 in Phase I. However, Teachers C and D all scored in DoK level 2 in at least one Phase IIb observation, and Teacher E demonstrated much greater improvement scoring in DoK levels 2 and 3, respectively in Phase IIb. Teacher A also scored in DoK level 2 in Phase I, and increased to DoK level 3 in both observations in Phase IIb, and even increased the Bloom's score from *Analyze* (Phase I) to *Evaluate* (Phase II observation two). Teachers G, H, I, and K also demonstrated improvement between the first and second observations. Teachers H, I, and K all moved up one DoK level in their second observation and designed a more rigorous task. Teacher

G did not increase the DoK rigor level of the task, but it did increase based on the Bloom's Taxonomy level, which improved from *Understanding* to *Analyze* (see Figure 4.3).

The combined Phase IIa and IIb classroom observations results indicated that the number of teachers scoring in the DoK level 3 on the Hess (2013) Matrix increased between the first and second observations from five to eight teachers (36% to 57%). Additionally, the number of teachers scoring in DoK level 1 or 2 decreased from nine to six teachers (64% to 43%).

		Webb's Depth of Knowledge			
		1	2	3	4
	R				
	U		D^1 G^1	A^1	
Bloom's Revised Taxonomy	A	C^1 I^1	C^2 D^2 I^2 H^1 K^1	H^2	
	A	F^2	E^1 G^2	E^2 F^1 K^2	
	E			A^2	
	C				
		17%	50%	33%	0%

Figure 4.3. Phase IIb Lesson Observation Scores using Hess (2013) Matrix.

An additional aspect of helping the teachers to better understand and design rigorous tasks was through the use of the Rigor Planning Matrix. The Phase IIa analysis included a total of 50 daily task rigor scores (5 participants x 5 days x 2 weeks), which revealed that 45 (90%) of the teachers' assigned scores were deemed accurate (Appendix T, Table T1) according to the Hess (2013) Matrix, and only five were slightly inflated. For instance, Teacher 1 assigned a score

144

of *Understand*, DoK level 2 to a task that was described as a "Review day for assessment on Friday. Create study sheet, by understanding vocabulary and content associated to vocabulary." However, a review of the Hess (2013) Matrix for this assigned score indicated that students would likely have been explaining relationships, summarizing results, and making basic inferences, to which the teacher's description of the task did not match. A more fitting score was *Understand*, DoK level 1, which included selecting appropriate terms, defining facts, and describing or explaining who, what, where, when, or how.

The Phase IIb analysis included a total of 135 daily task rigor scores (9 participants x 5 days x 3 weeks), which revealed that 90 (70%) of the assigned scores were deemed accurate (Appendix T, Table T2). Not all of the classroom observations took place during the three-week period assigned to this intervention, but 12 out of the 18 did, and only two out of the 12 (17%) were deemed an accurate match when comparing the observers' score for the observed lesson to the score assigned by the teacher on their Rigor Planning Matrix.

Despite this level of inaccuracy, this analysis did reveal that the teachers made a valid attempt each day to accurately match the task description to the level of task rigor, which was evident by the language that some used to justify the rigor score. For example, Teacher G on week 3 assigned a score of DoK level 4 to a task that was described as students being required to draw conclusions about a weather map and compare and contrast the results of a partner's map. While the Hess (2013) Matrix for this assigned score indicated that students would likely have been drawing conclusions if provided a DoK level 4 task, the observation of that lesson actually revealed that the task did not call for drawing conclusions, and was in fact scored as *Understand*/DoK level 2. This suggested that while the teacher (G in this case) were making an attempt to use the Hess (2013) Matrix to match the level of rigor to their lesson task, they were

145

still in need of support with being able to accurately define and describe their own lesson task, as well as interpret the task noted on the Hess (2013) Matrix.

All teachers in both phases (IIa and IIb) reported through the weekly logs, meeting minutes, and individual interviews that the intervention positively impacted their thinking and instruction, which was noted in the three main themes from the weekly teacher reflection logs in Phase IIa and IIb: *Thinking more about rigor in planning, Changes to instruction,* and *Perceived positive impact on students.* In Phase IIa, the Hess (2013) Matrix was reported by the teachers as being used to plan tasks and with a pre-determined and intentioned level of thinking according to Bloom's Taxonomy and Webb's DoK levels (*Analyze*, *Create*, levels 3 and 4), which lead to various tasks being reviewed and changed to reflect greater rigor. Teacher 4 commented that the: "rigor matrix was helpful," and Teacher 3 stated similarly: "…we've spent a lot of time really kinda trying to work on the Hess [Matrix] in particular so I think that one worked best for me…what was most helpful on that [Hess (2013) Matrix] was really just having a reminder of the Blooms in order and the Depth of Knowledge and not even necessarily all the little stuff in all the boxes in between."

The use of the Hess (2013) Matrix and the 3-step planning process included frequent planning with colleagues to review and adapt lessons and assessments to emphasize a greater level of rigor (Teacher 4 & 5). This also inspired more explicit thought about rigor in the planning process (Teacher 1), and thinking more consciously about the tasks provided to students (Teacher 2), which included more of a focus on the students' process rather than just the task (Teacher 3). This therefore lead to the teachers being more aware of what the tasks were asking students to do (Teacher 4), which further lead to a better understanding of rigor. Teacher 5 echoed this view, and stated that, "the definition of rigor I feel like it's been clarified. I feel like I

146

have more confidence now that what I do would be rigorous." Teacher 4 conveyed that it helped define it as the degree and depth of thinking required of a task, which forced the teacher to think more about what was being taught and how it should be taught. The intervention and the Hess (2013) Matrix had helped the teachers feel rigor was less daunting and provided them with a guide to knowing how to increase rigor through the tasks they assigned (Teacher 5), and one teacher even stated that rigor had come to be seen as less about difficulty and much more about students' thinking (Teacher 4).

The teachers in Phase IIb reported that the intervention changed their thinking (Teacher E, F, G, H, I, K), and forced them to plan by being more mindful of whether the tasks were cognitively challenging as indicated on the Hess (2013) Matrix (Teacher C, E, F, H, I). It also forced a greater awareness of the level of thinking that daily tasks required of the students (Teacher A, K). Two teachers stated that they frequently referred to the Hess (2013) Matrix when planning, which was observed during the meetings when designing lessons (Teacher C, D). Teachers generally reported that the Hess (2013) Matrix helped them to increase their awareness of the language associated with rigor and higher-level thinking (Teacher E, F, G, H, I), and provided them with language to design lessons. The use of the Hess (2013) Matrix had revealed to them that their old lessons were not rigorous, because they felt that the old lessons lacked rigor and did not require the students to think as deeply as they had come to realize was necessary when thinking about rigor (Teacher E, F, G, H). Teacher K, who stated that planning had undergone the biggest change, echoed this. As a result, lessons also were reported as becoming more meaningful to students by using the Hess (2013) Matrix, and a focus was placed on what students were to get out of a lesson (Teacher F, G). The teachers also developed a fuller grasp on how to define rigor (Teacher C), and, overall, it became more understandable (Teacher G).

147

3. **Do the Hess (2013) Matrix and the three-step planning process positively impact the teachers' capacity to implement rigorous classroom tasks?**

The Hess (2013) Matrix did not permit the observers to witness the implementation of rigor as originally thought, and it was not until late in Phase IIa that it was realized that an additional and more specific tool for implementation of rigor was needed. This was made clear when Teacher 5 conducted the same lesson as Teacher 4 in the second observation in Phase IIa, but the observers did not feel that the lesson for Teacher 5 demonstrated the same level of rigor, even though the task aligned with DoK level 4/*Evaluate* on the Hess (2013) Matrix. This dilemma and the ensuing discussion lead the observers to determine that it was the way in which the teacher implemented task based on the presentation, and through the questioning of the students that justified a different-leveled score of rigor being assigned. This indicated that the Hess (2013) Matrix was unable to detect and determine how the teacher had implemented the task to foster students' thinking capacity through the directions, questions and responses to students' questions.

This insight lead to the researcher engaging in a more thoughtful analysis and deeper understanding of implementation rigor, which resulted in further reading (Connecticut State Department of Education, 2014; Doyle, 1983) and the development of the Implementation Rigor Rubric, and this was then used in Phase IIb to focus on teachers' capacity to implement rigorous classroom tasks. The findings confirmed that it, and not the Hess (2013) Matrix, along with the three-step planning process, positively impacted the teachers' capacity to implement rigorous classroom tasks.

The implementation rigor rubric more fittingly supported the implementation aspect of rigor in Phase IIb for the classroom observations. Most of the scores in both Phase IIb observations were assigned to the middle level (2) of the rubric, and the percentage of scores in the highest level (3) increased in all of the three categories between observation one and two (see Table 4.1). In observation one, 26% of the scores were at level 1, 63% of the scores were at level 2, and only 11% of the scores were at level 3. Following additional discussion, planning with the newly implemented rubric as a supplement to the Hess (2013) Matrix, and having been provided specific feedback from the researcher after the first observation, the teachers' scores improved. In observation two, 11% of the implementation scores were at level 1, 63% of the scores were at level 2, which remained consistent with the first observation, and 33% of the scores were at level 3. Therefore, more scores were at level 3, and fewer scores were at level 1. This improvement to level 3 represented a three-fold increase between observations one and two.

Overall, the majority of scores fell in level 2 (63%), and when considering the increase of level 3 implementation scores in the second observation, the overall level of implementation rigor was much improved (Table 4.1).

Table 4.1

Phase IIb Observation Implementation Rigor Rubric Scores

	1	2	3
Presenting	K^1	$A^1 C^1 E^1 G^1 H^1 I^1 K^1$	$D^1 F^1$
		$C^2 F^2 G^2 H^2 I^2$	$A^2 D^2 E^2 H^2 K^2$
Monitoring & questioning	$C^1 E^1 G^1$	$A^1 D^1 G^1 H^1 I^1 K^1$	F^1
	$G^2 I^2$	$A^2 C^2 D^2 E^2 F^2 G^2 K^2$	$H^2 K^2$
Responding to questions	$C^1 G^1 I^1$	$D^1 G^1 H^1 I^1$	
	G^2	$C^2 D^2 F^2 G^2 I^2$	$E^2 G^2 H^2$
	19%	63%	24%

Note. Scores for *Responding to questions* were not applicable (N/A) (15%) for A, E, F, K

Some scores were represented in two levels (i.e. K appeared in both level 1 and 2).

The Hess (2013) Matrix was the only tool used in Phase IIa for both the task and implementation sections on the Rigor Planning Matrix. However, it was determined that 13 (26%) out of the 50 total days (across the five participant teachers' matrices) from what teachers wrote only somewhat addressed how the teacher implemented the task to encourage and stimulate rigor. Two out of the five teachers wrote statements that related more so to tasks than how they were implemented. For example, Teacher 2 wrote on one day that the students had to "…fill out sheet regarding both mechanics and content their partner needs to fix within work." This notation did little to describe how the teacher implemented the task, but rather, focused on what the students did. Similarly, Teachers 4 and 5 wrote that: "We developed a question sheet to increase thought," which did little to indicate how the task was implemented in a way that required students to think more deeply, and instead only acknowledged that a sheet was made. In other cases, teachers wrote statements that described the task and not how they had implemented

it. However, Teacher 1 provided a notation that was akin to implementation by stating that [the teacher] "…did not provide all questions for them. They had to design 2 evidence collecting questions as they read."

The Implementation Rigor Rubric in Phase IIb indicated that Teachers C, D, H and I only listed the rubric component and their assigned score (either 1, 2, or 3), but did not describe how they implemented the task, which gave no information about what they actually did to increase implementation rigor. However, it was noted that six of the nine teachers (C, D, F, H, I, K) were referring to the rubric. Additionally, using what the teacher had written on the matrix on the day that the lesson was observed, and comparing it to the assigned implementation rigor score by the observers, indicated that only one of the nine teachers were aligned to the observers' scores. On these days, five of the teachers (A, E, F, G, K) described more about the task, and two teachers (C, D) provided only the rubric component scores, which differed from the observers' scores, and two (F, G) provided statements that were too general. This made it impossible to align their perspective on their implementation to that of the observers' perspective. Only Teachers H and I wrote numbers that were aligned with the observers' scores, although they only noted some of the components and not all. These results did nonetheless suggest that the participants were using and becoming clearer with both the Hess (2013) Matrix and the Implementation Rigor Rubric as evidenced by the alignment and detail of each rigor-type score.

The teachers in Phase IIb commented through the weekly logs, meeting minutes, and individual interviews that their implementation rigor had undergone the biggest change. The teachers' questioning forced students to demonstrate their thinking more, and two teachers reported that the students scored better on recent assessments, especially on the higher-level thinking questions, were engaged more in discussions, and asked questions that demonstrated

higher-level thinking (Teacher C, D). The intervention also was reported to have changed the teachers' instruction, and developed in them a greater understanding of how to increase rigor (Teacher C) by how they implemented the lesson through asking questions (Teacher C, E, H), and by forcing the students to think at higher levels (Teacher D). Teacher C stated: "I think my biggest change in thinking about rigor was the implementation of rigor," which was new learning, and was something that this teacher had not considered before the intervention. This teacher also noted: "To just up the rigor that way as opposed to the task rigor…So that was something I definitely hadn't considered. I mean I'd always thought about questioning strategies but not questioning strategies in terms of rigor." Teacher D also reported a similar view in stating:

> We found that it was easier to incorporate rigor, especially in the implementation part with the questioning techniques…. How you're asking the questions. How you're responding to their questions…It's the easiest way to increase rigor on a daily basis without it being developmental inappropriate.

Teacher F also stated that considering the rigor of a lesson as viewed though the way the teacher implements the task was eye-opening: "really putting it back on them if they had a question and then actually answering it themselves. And hearing them explain their thinking to me – it was…it really was mind blowing." Teacher A and K came to view rigor more about implementation and students' thinking, and not just the task given to students. According to Teacher K, the Implementation Rigor Rubric was most helpful. This teacher reported:

> I think what helped me think about rigor differently was that it really is about what we're asking the students to do…I think what I realized about myself as a teacher is that it doesn't necessarily matter how complex the task is as much as how much it is that I'm

152

putting on the kids. You know, how much I'm asking them to do the thinking… in LA where we can tend to scaffold over and over…you know give them so much of a framework that they don't necessarily try to think it through themselves.

Similarly, Teacher H and I came to realize that rigor also included the questions that they asked, as evident in Teacher I's statement: "It's not just level of difficulty of the problems or that – it was more of how you presented it, what questioning you were asking and how open ended the questions you were asking were."

The implementation Rigor Rubric provided the teachers with a new and, in some cases, a more functional means to increasing the rigor of their lessons, and in addition to designing a rigorous task. After each observation, the teacher was asked to provide an Implementation Rigor Rubric score, and while most of the teachers' scores (20 out of 27 or 74%) for all three categories (presenting, monitoring and questioning, and responding to questions) in Phase IIb did not align with the observers' scores, they reported that it was certainly positively impacting this aspect of their instruction, which was supported by the following quote:

> That implementation rubric and the one thing that has been very liberating is not feeling the need to answer….directly answer their question…to be able to answer their question with a question… it's forcing me to think a little bit differently so then I'm thinking about a little more in depth questions to ask them." (Teacher E).

Similarly, Teacher K commented on the impact of the implementation aspect of the intervention by stating the following:

> I'm sure in all classes, but in LA where we can tend to scaffold over and over…you know give them so much of a framework that they don't necessarily try to think it through

153

themselves… I think it was certainly beneficial to me and my understanding of what rigor looks like.

The participants communicated that there were five aspects of the intervention that they felt were positive and helpful to their teaching and thinking about their own instructional practice. First, every participant in both Phase II iterations (a, b) indicated that the intervention in general was a positive experience, which was exemplified in the following two statements: "I enjoyed kind of looking at my teaching through a different lens. I think it opened my eyes to some things which I'll take forward with me" (Teacher 2), and "The intervention was good. It actually was helpful… It helped tremendously" (Teacher E). The intervention also helped make rigor become clearer and more operational (Teacher 1, 3, 5, D, G, H, I), and as Teacher 4 said: "We definitely got a better handle on what rigor looks like in the classroom." Teacher A also offered: "it was helpful just to think about it I think. There was more thought going into the planning and then more reflection afterward which I think is always helpful." However, two teachers (Teacher 2, F) questioned whether they really could define rigor and felt that they still needed a model or example of rigor.

Second, the participants expressed how much they felt that collaboration with their colleagues helped with planning and thinking about rigor (Teacher 2, 3, 4, 5, C, E, F, G), which was noted in the following quote:

> I think if I'd been doing this alone, I think if all of us had been doing this alone, it would have been much harder. The fact that we had a colleague in our subject area definitely made it easier because we were able to sit down together, bounce ideas off each other, come up with things that would work in both of our classes. And just the collaboration

made it a lot better than if I was sitting there staring at the matrix alone, I'm not entirely

sure what I would have accomplished. (Teacher C)

Third, the Hess (2013) Matrix and Implementation Rigor Rubric helped planning and

defining rigor (Teacher 1, 3, A, I, K), which was exemplified in one quote:

…to have some language for it according to Hess's rubric and how it applies to students

but also really to the teacher intervention aspects of it and what it looks like for us… I

think that in some ways the teacher intervention rubric was maybe more useful…not

useful but it simplified things…I think that that rubric that [the researcher] devised was

really a good one with the intervention. (Teacher K)

Teacher D provided a global view when asked whether rigor had been more clearly defined; the

teacher said:

Yes. Definitely…at the beginning, we thought we knew what rigor was and in some

ways we were correct…but now because of the implementation rubric and Hess's matrix,

we have a better idea of where within the level of rigor we actually are.

Implementation rigor was also noted as being the biggest change for some teachers (Teacher C,

D, H, I). Teacher C provided one perspective on this, stating: "I think my biggest change in

thinking about rigor was the implementation of rigor," and an additional quote offered: "I think

the questioning for me. And the wait time and waiting for the kids. For me, it was my delivery

that changed the most" (Teacher I).

Fourth, rigor came to be seen as an important component of instructional practice, but

that it was not necessary for it to be evident in every lesson and everyday (Teacher 1, A, C, E, I).

For example, Teacher 1 suggested: "Understanding that not every lesson or every single part of

the lesson needs to be rigorous," and Teacher I furthered this view by offering: "what we discovered, is you're not always going to be in that three or that two range."

Fifth, nine of the 14 teachers (64%) in Phase II (a and b) stated that they felt that there was a positive impact on students (Teacher 1, 2, 4, 5, A, C, D, F, G). For example, Teacher I noted: "They're not just coming up and saying, I don't know how to do this. Now they'll come up and say, I understand this part and this part but then what do I do next? So it's good." Teacher 2 provided additional support by indicating that students "were really thinking through the process. Which is great. Which is wonderful. It's what you always want. So, yes, I did see an impact of those lessons on the kids." However, not all of the teachers felt that it was so easy to tease out how much the intervention positively impacted students (Teacher A, E, K) as exemplified in the quote: "I can't say for sure that because of the intervention the kids responded this particular way" (Teacher K).

The participants also expressed that they faced five challenges in both iterations of the instructional intervention in Phase II (a and b). Having a new curriculum was a challenge for two teachers (Teachers 2, 3) as expressed through the following quote:

> if every year we're wrapping our minds around something new, we're never going to be able to bring the learning to the level it needs to be at for these kids to be you know, partaking in regular, rigorous lessons." (Teacher 2)

Time for the teacher participants was a challenge (Teacher 1, 2, 4, 5) as highlighted by Teacher 4: "So it's still a challenge to implement. It requires a lot of time and thought which is unfortunately sparse when you look at a teacher's schedule, and how many meetings that there are." Teacher 5 supported this quoting: "finding time to journal was challenging because…other

aspects of life are busy and you're planning for your next week… You have to grade and you have to enter all that information into the grading systems."

Engaging in journaling and reflection logs was a challenge also (Teacher 1, 2, 4, 5), as Teacher 4 captured by stating:

the logging of journals was a pain… Every week writing journals, like we don't have a lot of planning time as it is… There's always value in reflecting but it's not something I would obviously choose to do on a regular basis.

This was supported by Teacher A's perspective who understood the rationale for the reflection logs, but stated that it was a challenge:

it was cumbersome at times to sort of track everything that I was doing and to reflect and complete the logs. So that part of it just seemed somewhat excessive… but I understand why it was happening.

An additional challenge was evident in the use of the Hess (2013) Matrix, which many participants felt was challenging to interpret (Teacher 2, 4, 5, A, C, D, G, K). Teacher K mentioned that "Hess's rubric has a lot of boxes and a lot of language in it." A supporting viewpoint was that "The rigor matrix was both helpful and difficult to use at the same time. Because it's so complex and so many…it's very wordy" (Teacher 2), and Teacher A noted that: "Sometimes we found it difficult to figure out exactly where it fit." However, Teacher D challenged this view by stating that: "I think the bigger piece to work on would be the task rigor using Hess's rubric."

Accommodating differences and increasing some students' thinking was a challenge (Teacher 5, D, E, F). For example, Teacher F shared: "I just felt like trying to meet the needs of each student is really different. So I found that really challenging." A related perspective was

157

concerned about the developmentally appropriateness of rigor and certain students, as expressed through the following quote: "Hess's Cognitive Rigor Matrix – the evaluate and the create…we're just not…we're just trying to be careful as to what is developmentally appropriate" (Teacher D). Taking both viewpoints into account, meeting the needs of varying levels of student capacities remained a challenge for Teacher 5 who offered: "to differentiate the rigor that's still something that I'm thinking about… so what do we do then for those students for whom their left not grasping what it is that we're shooting for?"

The instructional intervention was reported to have been a positive experience for all 14 participant teachers, and it helped them develop a clearer and more operational understanding of rigor, which was expressed through their reflection logs, in the weekly planning meetings and the individual interviews, and observed in their use of the planning matrix and through their lesson observations using the Hess (2013) Matrix and the Implementation Rigor Rubric. Challenges noted by the participants related mostly to time for planning collaboratively, planning with a new curriculum, translating the Hess (2013) Matrix, and planning for student differences and rigor, simultaneously. Therefore, situating rigor within a longer-range planning framework was deemed a necessary next step in developing rigor, which lead to the development of the Unit Planning Process to Ensure Rigor (UPPER).

Phase III: Planning Intervention

Phase III of this action research study included five purposefully selected teachers who used a Unit Planning Process to Ensure Rigor (UPPER) developed by the researcher to emphasize learning for understanding, and used the Hess (2013) Matrix to develop a sequence of increasingly rigorous tasks. The following findings represent five teachers (Teachers 4, 5, E, F,

G) from grades six and seven who teach science and social studies, and will be required to embrace new curriculums in the next two years based on updated and more challenging standards. The data from three different sources: (1) pre and post teacher reflections, (2) weekly researcher meeting minutes/reflections, and (3) UPPER rubric scores for two unit plans per subject area, provided a view regarding the impact of the intervention on the teachers' thinking and planning from their own perspective, and that of the researcher. The completed UPPER unit plans and their corresponding rubric scores were used to counter the possibility of self-report bias from the teachers' reflections, and the following research question guided Phase III.

4. **Do the teachers report that a planning framework for developing a concept-based unit of study and specific training support provide them with greater clarity and understanding on how to design a coherent unit that incorporates increasingly rigorous tasks?**

The three grade six science teachers and the two grade seven social studies teachers reported that the UPPER and the researcher's weekly training and discussions helped them to develop two concept-based units of study (Erickson, 2002) that involved unpacking standards and determining the essential knowledge, skills, processes, big ideas and corresponding essential or compelling questions (Ainsworth, 2003; 2010). It also included helping them develop final performance assessments that lead to the big ideas and essential understandings, and a sequence of tasks along with formative assessments that became increasingly more rigorous throughout the unit (Hess, 2013). The teachers stated in their reflections that the UPPER and training had positively impacted their understanding of and their capacity to develop concept-based units that systematically included a progressively rigorous sequence of tasks. Additional researcher meeting notes supported both the rubric scores and the teacher reflections.

Both subject area (Teachers 4 and 5 in grade seven geography/social studies, and Teachers E, F, G in grade six science) produced two units using the UPPER document. Four of the teachers' unit plans achieved a minimum score of 3 out of a possible 4 for each of the four components (unpacking the standards, developing compelling/guiding or essential questions, developing a final performance assessment, and designing a sequence of tasks [including formative assessments] that lead to higher level thinking/rigor) (see Table 4.2).

Although the teachers' capacity to develop a unit was not formally measured against the UPPER Rubric at the outset of Phase III, discussions in the first meeting with the participants revealed that none of the five teachers knew how to use and unpack standards to extract the essential knowledge, understanding/big ideas and skills in their units, and nor did they clearly know how to systematically situate rigor in their unit planning. Teacher 4 expressed that a streamlined process was not used, and stated: "…truthfully we don't have a single streamlined process that we follow.... The question assumes a methodical approach to unit planning, but we don't really work in that manner." Teacher F made a similar statement: "our units of study haven't changed much over the last few years, our activities and tasks have stayed close to the same…we used the same science experiments over the past 5+ years." Teacher F followed this by stating that:

> [O]nly been this year that rigor has become a big part of my lesson design & planning…
> In the past, I really didn't put much rigor into my daily lessons, labs or activities. I pretty
> much gave students the answers so they all had the right material. There wasn't much
> higher level thinking going on or figuring things out themselves.

In realizing the need to systematically develop rigor within the context of a larger plan, Teacher 4 offered: "if we had a more streamlined, methodical, unit plan procedure in place, we

could work more efficiently and have more focus. However, I sometimes worry that this could lead to standardization and monotony." The participants' understanding and capacity to design a coherent concept-based unit that included rigor greatly improved in the three weeks, and with only a single planning meeting each week.

Table 4.2

Phase III UPPER Unit Scores by Component

	Science 6		Geography/Social Studies 7	
Component	Weather	Earthquakes	Zombie Project	Env. & Hu Imp.
Unpacking the standards	3/4	3	4	3
Developing compelling/guiding or essential questions	3	3	3	3
Developing a final performance assessment	3	3	4	4
Designing a sequence of tasks (including formative assessments) that lead to higher level thinking/rigor	3	3	4	3

The individual teachers' post-reflections indicated that a positive change had occurred in their understanding of and capacity to design a concept-based unit of study that incorporated rigor when compared to their pre-reflections. The comparison was divided into eight sections that included five critical components for unit planning: Standards/Process, final assessment,

sequence and tasks, formative assessments, and rigor. Positive aspects and challenges, along with other statements that did not fit into any of the aforementioned categories, were also included.

Process and standards. The pre-reflections indicated that the process of developing units of study provided little detail across all five teachers. However, two of the five teachers (Teacher 4 and 5) stated that planning a unit is time consuming. Teacher 4 stated that units are constantly reviewed, and teacher 5 noted that planning units includes selecting a direction for learning, while Teacher E offered that unit planning has evolved over time. Teacher 4 also indicated a consistent approach was not used when planning, which can make units disjointed at times. The lack of detail and response from two of the five teachers suggested that this was likely the case for all the participants.

However, in the post-reflections, the UPPER was viewed as new learning for all teachers, and provided greater detail for planning all aspects of a unit plan. The new process made a clearer connection between all key unit-planning components, provided greater clarity and focus, and will be used with new curriculum going forward, according to Teacher 4. Teacher 5 stated that the UPPER aligned to past practice and made translating standards into practice possible. However, Teacher 5 felt that time was needed to determine its effectiveness. The UPPER required the standards to be unpacked, which was new learning (Teacher E and F), and it helped with determining the big idea and developing clearer outcomes (Teacher E), and backward planning to develop students' understanding of earthquakes (Teacher F).

Final assessment. Statements regarding the development of a final assessment also provided little detail and consistency in the pre-reflections. For example, Teacher G, when only referring to the most recent unit and not unit planning in general, stated that the final assessment was a collaborative effort and well thought out. Teacher 4 offered that final assessments are

sometimes research projects and other times quizzes and tests depending on the unit, and Teacher 5 simply noted that all activities link to final assessment. The final assessment, according to Teacher E, depends on what was done in the unit, and is simply the research project if the unit was research-oriented. Teacher F did share that tests were the most common form of final assessment, but others have been considered and developed recently.

The teachers did indicate in their post-reflections that the final assessment was enhanced by the use of the UPPER. For example, the final unit assessment was reported as being mostly tests in prior units, but most teachers had developed more inquiry-based final assessments using the UPPER. Teacher 5 felt that the UPPER can enhance the final assessment, and Teacher 4 stated that the final assessment now incorporated the unpacked key nouns and verbs and included an expectation for students to use the knowledge and skills to solve realistic geographic problems. According to Teacher E, the UPPER helped develop a more complex, rigorous and realistic final assessment and not just a test, which, as echoed by Teacher F and G, is what was typically used in most cases as a final assessment.

Sequence and tasks. The pre-reflections indicated that there wasn't a consistent and clear process apparent in the way that tasks and the sequence was developed when planning units, which was exemplified in the comments made by Teacher 4 who shared that there's no streamlined process that is used. Teacher 4 further noted that the unit usually starts with a teacher-centered emphasis and moves towards a more student-centered emphasis, which was an approach echoed by Teacher G who offered that units progressed from basic to more complicated tasks. For Teacher E, the task sequence includes a variety of methods, including direct instruction, labs, group and independent work, hands-on activities, and videos, and yet,

tasks and sequence have mostly remained the same for 5 years, according to Teacher F. Yet, recently higher-level thinking had been considered.

The post-reflections acknowledged that the sequence of tasks was reported as being more connected to other aspects of a unit through the use of the UPPER. For example, Teacher G noted that the sequence of tasks was developed to lead to the final assessment and required students to problem solve, think at high levels, and develop an understanding of earthquakes using the UPPER. The sequence and tasks was more student centered, according to Teacher E, and the UPPER, according to Teacher 5, more clearly articulated the sequence of tasks and trajectory of rigor.

Formative assessment. Only general details provided a lens into how and where formative assessments were used based on the pre-reflections. Teacher 4 shared that on-going learning is measured by various methods, and Teacher E stated that they could be presented in various forms. Teacher 5 stated that student progress is measured along the way through pre-planned check-ins and deadlines. Formative assessments had only recently become a focus for Teacher F, but had been helpful to know students. Teacher G noted they increased in complexity as the unit progressed, and they were determined with other colleagues.

The teachers did not say much about how the UPPER supported or improved their capacity to design and incorporate formative assessments in the post-reflections. However, minimal information was gleaned from some of the post-reflections. For example, formative assessments now incorporated the key knowledge and skills, according to Teacher 4, and the UPPER allowed formative assessments, their level of rigor, and their timeframe to be identified (Teacher 5). Teacher F noted that exit slips as formative assessments had been used in the past, which was helpful for planning.

164

Rigor. It was not apparent, in the pre-reflections, that rigor had been a conscious emphasis in prior unit planning, which Teacher F noted by stating that rigor had been mostly absent in past units, but had recently become a focus. Teacher G felt that rigor had increased in recent units as it was developed, but didn't indicate how it had been addressed in past units. It had been mostly based on Bloom's taxonomy, according to Teacher 4, who also stated that it had really been addressed more informally in past planning efforts. Teacher 5 and E also provided only more recent perspectives on rigor in offering that it required addressing an essential question, using multiple sources, synthesizing and taking a stand (Teacher 5), while requiring time, collaboration, technology, and having students find information independently (Teacher E). The limited comments specific to how rigor was addressed in prior unit planning suggested that rigor was not consciously addressed or was only loosely considered.

The teachers' post-reflections mostly referred to the Hess (2013) Matrix and not the UPPER for supporting the development of rigor. However, the portion of the UPPER that related to the development of rigor in the sequence required the use of the Hess (2013) Matrix. Therefore, as part of the UPPER, rigor was developed by continuing to use the Hess (2013) Matrix, which allowed for the DoK level to vary throughout the unit (Teacher 4), and the UPPER and the Hess (2013) Matrix provided clarity on how rigor was infused into a unit (Teacher 5). Teacher E stated that the UPPER was more effective in helping to scaffold rigor. Collaborative planning and the Hess (2013) Matrix were helpful for incorporating rigor, according to Teacher F. Additionally, Teacher G indicated that units had never included planning with rigor in mind, but now planned using the Hess (2013) Matrix to require students to use higher levels of thinking.

Positives. Positive aspects of prior planning efforts, as noted in the pre-reflections, included the process being seen as exciting, creative and fun, according to Teacher 5, and it allowed for flexibility, innovation and collaboration (Teacher 4). Teacher E and G also felt that collaboration was important in the way that they viewed planning, which lead to units of study being co-developed. Rigor was also seen as a recent improvement in their work and consciousness (Teacher F), which emphasized trying to make lessons more rigorous (Teacher G).

A few comments in the post-reflections suggested that the UPPER represented positive new learning and process, which included Teacher 4 stating that a unit will be more cohesive and will ensure rigor leading to the big idea with the use of the UPPER. Additionally, Teacher 5 offered that unpacking standards and infusing rigor made for a sound unit planning process. One other comment by Teacher G related to the best part of the process being co-planning.

Challenges. There were numerous challenges shared by the participants in their pre-reflections who stated that unit planning included a lot of work and was difficult to try to find time to collaborate with colleagues (Teacher 4, 5, G). Teacher 5 also felt that changing teaching assignments from year-to-year negatively impacted a grade-level subject area team's capacity to collaborate and plan effectively. Time, in general, was seen as a challenge for Teacher E, as was computer availability and developing rigor, which was a noted challenge for Teacher F, who also stated that accommodating all learners had been time consuming.

Inevitable challenges were noted by some of the teachers in the post-reflections, and especially because the UPPER was a new and unfamiliar process (Teacher 4), and it was time consuming (Teacher 5, F). Teacher 5 also stated that teachers who were unfamiliar with using standards might struggle, but felt that it is important to use the UPPER. Unpacking standards and developing a rigorous sequence was time consuming, according to Teacher E.

166

Other. An additional statement that did not fit into the aforementioned categories and made by Teacher 4 in the pre-reflection provided a view to how improvements to the planning process could be considered, which included the adoption of a more methodological procedure.

Teacher 4's post-reflection stated that planning in the past had often been hindered by futile tasks, and that administrators needed to support purposeful teacher planning. Teacher 4 also suggested that prior work with the Hess (2013) Matrix and collegial planning had both been helpful components for using the UPPER. Teacher G offered that encouraging students to answer why questions had helped them become better thinkers and problem solvers, which related more to the work conducted in Phase II than the UPPER in Phase III.

The researcher's meeting notes indicated that neither of the two grade-seven social studies/geography teachers (Teacher 4 and 5) was familiar with how to unpack a standard and they reported that they had never done it before. Additionally, neither had ever been trained to strategically connect unpacking a standard to explicating the essential knowledge/concepts, skills, and big ideas, and nor did they know how the big idea connected to essential or compelling questions. Even though both participants were very competent in listing the facts and skills they felt they needed for the unit, as well being able to craft a big idea statement that was relevant and meaningful, this unifying, systematic process was new learning to them. The link between these components and the standards appeared to be unknown and absent in their current planning process, which therefore, represented justifiable next steps in learning to plan a concept-based unit that systematically incorporated rigor.

The same level of understanding was noted in comments made by the three grade six science teachers (Teachers E, F, G). They initially stated that they didn't really know much about the standards, and Teacher G affirmed that they were confusing, and that the science department

had been discussing them recently in preparation for the adoption and implementation of the new science curriculum that will be emphasizing an inquiry approach.

During the three weeks, the five teachers were able to unpack the standards and extract the essential knowledge, skills and processes, and determine the implied big idea/essential understanding. They were then able to develop essential or compelling questions and a final performance assessment before developing a progressively rigorous sequence of tasks and formative assessments using the Hess (2013) Matrix. The information gleaned from the meetings and the UPPER Rubric scores for the four unit plans served as evidence of the teachers' improved understanding with the process of planning a concept-based and rigorous unit.

Summary

Participants initially were confused and unclear about rigor, and although they were able to define it using various attributes, most were less able to operationalize it and openly expressed this. Yet, simultaneously, some participants offered descriptions as to how rigor would be viewed in the classroom, although it was much less evident in actual lesson observations. Through an instructional intervention in Phase II that involved two iterations and refinements, 14 participants reported being much clearer and were observed being more capable in understanding and operationalizing rigor in their instructional practice. As such, they came to view rigor as designing and implementing tasks that fostered students' higher level thinking capacities, and this was verified through classroom observations, weekly planning meetings, the Rigor Planning Matrix, and individual post-phase interviews.

Teachers involved in the planning intervention in Phase III were able to systematically incorporate and develop rigor by designing two concept-based units of study that originated from unpacking content standards, such as the Next Generation Science Standards, and the C3

168

Standards for Social Studies. This supported the notion that relevant training in unpacking

standards, and following a logical design process, the use of a specific framework, such as the

UPPER, and a scoring scale, such as the UPPER Rubric, provided the teachers with greater

clarity and understanding on how to design a coherent unit that incorporated increasingly

rigorous tasks.

CHAPTER 5: DISCUSSION and CONCLUSIONS

The findings and results from this action research study highlighted an initial lack of teacher clarity and variation on how they defined rigor, and it further revealed that teachers had initial difficulty operationalizing it in the classroom tasks they designed and implemented. Fifteen participants in Phase I also emphasized that their teacher training and their professional learning experiences had not prepared them to design and implement rigorous tasks, and nor had it clarified rigor. However, an instructional intervention in Phase II assisted 14 teachers in being able to consciously design rigorous tasks and implement them in rigorous ways, which lead to rigor becoming more clearly understood, and more competently and deliberately operationalized in the teachers' classroom practice. It later became necessary for rigor to be more systematically fostered through longer-range planning efforts, which lead to a planning intervention in Phase III. The findings in this phase revealed that a specific planning framework (UPPER) helped the five teachers systematically and deliberately develop rigor as part of and within a concept-based unit design process.

These findings further provide a platform for four important conclusions for teachers and practitioners that should be considered when seeking to address rigor and improving teachers' instructional practice with a view to increasing the cognitive challenge of the work they provide to their students.

Discussion

The researcher felt that it was essential to better understand what teachers knew about rigor, and how they defined it, as well as how they operationalized it, as this was mostly absent from the literature. The researcher felt that this information provided an important and necessary

170

view to how they planned for and employed rigor as part of their instructional practice. The findings in the first phase of this research study suggested that teachers could verbalize terms that were associated with rigor and even higher-level thinking, but they were less confident and able to deliberately design and implement rigorous or higher-level thinking tasks in student work, which was a finding documented in Bower and Powers (2009). Similarly, Bintz and Delano Moore (2011) wrote that the math teachers they worked with, when asked about evidence of rigor, were able to state that their curriculum was aligned with the NCTM and state standards, and that their instruction was based on best practice, but reported feeling unsure about what rigor entailed.

Teacher statements from this study's interviews also revealed that they felt their training to become a teacher and their current professional development did not prepare them well enough to understand, design and implement rigorous tasks. Research literature related to rigor and professional development acknowledged that teacher training and learning did not prepare teachers adequately enough for the cognitive demands of classroom instruction (Choy, Chen, & Bugarin, 2006; Paige et al., 2013; Weiss & Pasley, 2006). This was also consistent with Erickson (2002) and Erickson and Lanning's (2014) claim that traditional models of planning and instruction had focused on skills and facts, and as a result, had failed to help teachers develop students' capacity to develop a conceptual understanding of the content.

Much of what the teachers in this action research study used to initially define and describe rigor did not fully coincide with how they operationalized it in their instructional practice, which was realized through the classroom observations in Phase I. Six of the ten (60%) of the classroom observations were scored at the lowest and second lowest levels of Webb's DoK, and five (50%) of them were scored on the lower half of Bloom's Taxonomy on the Hess

(2013) Matrix. These findings aligned with those found in Manthey (2005), Maye (2013), Hess et al. (2009), and Paige et al. (2013), which revealed a lack of rigor in the work assigned to students in classrooms. While four teachers (Teacher 2, 3, 4, 5) designed and enacted tasks in their lesson observation that were categorized as achieving DoK level 3 and the upper level's of Bloom's Taxonomy as measured by the Hess (2013) Matrix, their comments in the interviews suggested they were unsure how to consciously and consistently demonstrate an operationalization of rigor in their instructional practice.

Teachers' understanding of rigor was also found to be a major roadblock to them being able to design and implement rigorous tasks, which was highlighted in this study, and again aligned with the findings in other research that indicated the lack of cognitive challenge present in student tasks. Little direction on how to enhance rigor through teachers' instructional practice was offered, while the literature provided ample support for a lack of rigor in students' classroom work (Draeger et al., 2013; Hess et al., 2009; Manthey, 2005; Maye, 2013; Paige et al., 2013; Wagner, 2008). Previous research on rigor had not examined whether and to what degree an intervention could positively impact a teacher's understanding and operationalization of rigor, and so the use of specific tools to support teachers designing rigorous tasks and increasing their understanding of rigor was absent in the reviewed literature. Yet both the Hess (2013) Matrix for task rigor, the Implementation Rigor Rubric for implementation rigor, and the 3-step framework/planning process, demonstrated in Phase II of this study that they provided the potential for teachers, practitioners, and school leaders to more clearly define and understand rigor, and to positively influence teachers' capacity to design and implement rigorous tasks. This was an essential addition to the knowledge base in order to move the theoretical conception of academic rigor into actual teacher practice, and it opposed the notion that simply providing

172

teachers with a definition of rigor and expecting them to enact it through the tasks and methods used to design student classroom work would enhance their understanding and increase the rigor in their instructional practice.

Previous research on planning had noted that teachers plan mainly by focusing on the activities, and as an unintended focus, the entertainment value of the work and not on the coherence of how the activities fit with the intended outcomes and evaluation means of the unit (Shavelson & Stern, 1981). Erickson (2002) similarly claimed that teachers typically design units that emphasize topics and not big ideas and conceptual learning (as expected through the Common Core State Standards, the Next Generation Science Standards, and the C3 Social Studies Standards). Researched cited by Clarke (1983) also indicated that experienced teachers dedicated little value and time to planning. These issues considered in conjunction with the fact that teachers had difficulty clearly understanding rigor indicated that an important need existed for teachers to develop their understanding of how to explicitly design concept-based units as a vehicle for appropriately infusing rigor. Such units would require students to wrestle with and uncover big ideas (Wiggins & McTighe, 2005), and would require deep and meaningful, higher-level thinking, which is characterized as rigorous thinking (Draeger et al., 2013; Manthey, 2005; Miller & Shih, 1999; Wolf et al., 2005).

The UPPER and the UPPER Rubric, along with training on how to unpack the standards using direction taken from Ainsworth (2003; 2010) and ideas presented by Erickson (2002), provided a means for supporting teachers to understand how to develop a concept-based unit that emphasized inquiry and students learning for understanding. Both the UPPER and the UPPER Rubric also afforded a means for teachers to actually design a more detailed, coherent unit of study that systematically incorporated task rigor. For example, Teacher 5 felt that the UPPER

173

clearly articulated the sequence of tasks and trajectory of rigor, and stated that: "Sequencing of activities and tasks are clearly articulated in the form, and this allows for time to consider rigor. The "trajectory" of the unit's rigor can be observed." This teacher also offered that: "I also feel that the ability to combine the concept of unpacking the standards in conjunction with infusing rigor when appropriate makes for sound unit and lesson development." Teacher G and E also felt that the UPPER gave them a clearer means for designing a unit with a greater understanding of how to infuse rigor. Teacher G said: "We have never before planned with rigor in mind and now have a much clearer understanding of what the expectations should be for students and how to challenge them on all levels." Similarly, Teacher E stated that: "The new process was more effective in making me be mindful of scaffolding a rigorous lesson."

Teacher 4 provided support for the UPPER in his future planning approach: "…by unpacking the standard, and knowing the knowledge and skills students should have, this will make lesson planning and sequence easier…this new planning process has allowed us to unpack the standards with greater focus and clarity." The teacher extended this support in remarking that: "I believe the new procedure allows us to see a greater connection between the standard, to the Big Idea, to the compelling and supporting questions, to the tasks and how they all are related."

The teachers reported that the Hess (2013) Matrix and the UPPER allowed them to systematically and relevantly incorporate rigor into their unit plans. Designing a concept-based unit aimed at more globally supporting rigor was the need to establish the big ideas as a central component and focus. Rigor, as defined in the literature as higher level and deeper thinking (Draeger et al., 2013; Manthey, 2005; Miller & Shih, 1999; Wolf et al., 2005), requires students to synthesize, problem solve, draw conclusions, and develop an understanding of core ideas

174

(Erickson, 2002; Wiggins & McTighe, 2005). As such, rigor is tantamount to students being instructed in such a way that they come to understand big ideas. Conversely, Erickson (2002) highlighted that teachers often instruct on topics and facts about content, and never reach the level of concept, principal, or generalization, which inevitably prevents the students from interacting with and understanding the core ideas, and therefore also limits their capacity to employ higher level or deeper thinking. Shavelson and Stern (1981) affirmed this perspective in stating that teachers often plan focused only on activities and tasks. However, the new and revised standards (Common Core ELA, Math, Next Generation Science Standards, and the C3 Social Studies standards) emphasize that teachers need to develop their students' conceptual understanding and progress beyond instruction that merely helps them accumulate facts, knowledge or processes. The researcher's weekly meeting notes and reflections indicated that none of the five teachers had developed their unit plans to intentionally focus on leading their students to develop an understanding of the core or big ideas. Rather, using Teacher 4's claim that planning didn't really employ a methodological approach to unit planning in terms of systematically developing a learning path borne out of the unpacking of standards, establishing the big idea and key understanding in a unit topic, was also absent and at best, only a loose focus. Additionally, none of the teachers addressed or discussed big ideas in their pre-reflections.

The post-reflections, however, indicated that the teachers had become more aware of it and were able to establish the big ideas in a unit. In referring to the use of the UPPER, Teacher 4 further stated that: "…it seems as though the unit will be more cohesive and it will be easier to ensure that there are rigorous tasks for students that are always shooting to understand the Big Idea."

Conclusions

Four important conclusions were drawn from three phases of this action research. Firstly, the teachers' first-hand perspectives gleaned from multiple methods (individual and focus group interviews, reflections logs, and weekly grade-level, subject-area planning meetings) provided critical insight into how teachers defined and described rigor, and how they reported understanding it, planning for it, and whether and to what degree they felt their training and professional learning had prepared and helped them understand and employ rigor in their instructional practice. The classroom observations of lessons that the teachers selected as being rigorous provided additional data that was used to determine whether they actually understood rigor, or whether they were only able to describe it. This comparison was also provided insight into whether they were aware of the match between their descriptions of rigor and how they operationalized it. Teachers' explicit insights into their world also revealed numerous roadblocks to rigor, which emerged throughout this study, and they were accepted as being obstacles to teachers' capacity to understand, design and implement rigorous tasks. As such, these roadblocks needed to be unearthed, acknowledged, and addressed for rigor to be developed in practice. Teacher 2 and 3 dealt with the unfamiliarity of a new curriculum, which required them to dedicate a great deal of their time to just trying to figure out the next day's lesson and focus. They openly remarked on this challenge and felt that they could have done much more with rigor had they been able to plan with a greater view as to what each new unit required as an end result. Teacher 2's comment captured this difficulty: "The whole unit that we were doing for the theme based literary essay was brand new to us so we were trying to understand it as we were teaching it to the kids." The teacher further stated with frustration:

…if every year we're wrapping our minds around something new, we're never going to

be able to bring the learning to the level it needs to be at for these kids to be you know,

partaking in regular, rigorous lessons.

Secondly, the Hess (2013) Matrix and the Implementation Rigor Rubric offered the teachers and observers a common, workable lens in which to view rigor, and taken together, both tools were reported by the 14 teacher participants to be very helpful in supporting their designing of rigorous tasks, and their implementing the tasks through rigorous methods. The findings revealed that explicit attention and focus needed to be placed on supporting teachers to better interpret both rubrics during weekly planning meetings, as well as on being more accurate when describing the actual selected lesson tasks. Although the Hess (2013) Matrix was found to be helpful in supporting teachers to design more rigorous tasks, it was also perceived as a challenge as reported by eight of the 14 participants. They noted that it was confusing, wordy and difficult to always match the task with the language in the cells, which was expressed by Teacher 2 who best captured this sentiment by stating:

I like that the matrices were for individual content areas – it made it easier but some

things that were on the matrix…was for…like high school kids would be doing it. So,

it's hard to kind of put that into some kind of middle school frame of reference.

However, continuous and frequent teacher training on the use of this tool in planning was acknowledged as necessary, if not essential for this, and the Implementation Rigor Rubric, to be utilized effectively and efficiently to infuse and enhance rigor in instructional practice.

Thirdly, providing the teachers with planning methods enabled them to design rigorous tasks and simultaneously better understand rigor. This was evident in the use of the weekly Rigor Planning Matrix, which the participants reported and demonstrated improved their understanding

177

of consciously planning for rigor, which they had never done before. A claim made by Teacher 3 that the Rigor Planning Matrix was helpful to see a weekly overview and what the tasks were asking of students, and the teachers' comments on how they felt that this aspect of rigor was the biggest change in their thinking (Teacher C, D, E, H, I), was evidence that it can support teachers in considering how rigor should increase over time. This study also demonstrated that explicit teacher training and support in defining, designing and implementing rigor was necessary, which also was absent from the literature focused on rigor. Only one study was found that provided evidence for this claim, and that was found in Stone et al. (2008) who had compared Career and Technical Education (CTE) instructors who received explicit math training and support with those who didn't as measured by their students' achievement scores on two standardized math tests. The students whose instructors received explicit math support achieved better results than the those students who instructors didn't receive the same training, which highlighted the need for explicit teacher training and professional learning for instructional practice improvement to be experienced. The current study offered a similar view: Teachers require explicit support and training in order to understand and operationalize rigor in their instructional practice.

Fourth, a more comprehensive planning approach that focused on the entire unit plan (UPPER) was also reported by the teachers as providing them with a means to connect unfamiliar aspects of unit planning, such as unpacking standards, establishing big ideas related to essential or compelling questions, to designing a sequence of tasks that progressively increased in rigor using the Hess (2013) Matrix. The unit plan in Phase III provided the teachers with a clear and coherent method of designing learning experiences for their students that emphasized deep and meaningful understanding outcomes and rigor, which they reported was also very much new learning for them.

Summary

Four conclusions were drawn from the findings from the three phases of this action research study. In Phase I, the researcher asserted that it was essential for teacher perspectives and their understanding of rigor to be explored and made explicit if meaningful progress towards rigor was to be made. In Phase II, the researcher concluded that the Hess (2013) Matrix and the Implementation Rigor Rubric had the potential to develop rigor, and that teacher collaboration was an important aspect in developing rigor, and to do so it required multiple means. Additionally, the researcher asserted that the roadblocks to rigor should be openly and precisely acknowledged. Furthermore, two additional conclusions were drawn from Phase III, which declared that unit planning requires a systematic approach for rigor to be intentionally incorporated, and that the big (or core) ideas should be established as a central component of a unit plan.

CHAPTER 6: LEADERSHIP and RESEARCHER LEARNING

This chapter addresses the research questions that directed the researcher's learning as a leader within the context of his administrator position, and with regards to how rigor is defined within instructional practice, his leadership towards developing and fostering teachers' capacity to design, implement and plan for rigor (first-person perspective), and developing a building-wide emphasis on rigor that may be transportable to other settings (second- and third-person perspective). It also discloses the researcher's learning as a researcher. In its disclosure, this learning provides important implications for other teachers, leaders, and insider researchers that can support them in developing rigor in their own setting.

Researcher Questions

Two questions framed the researcher's capacity to effect change through his instructional leadership and research:

1. Was the researcher successful at improving his *instructional leadership capacity* as a result of deep reflection and analysis of the three phases of research associated with this action research study?

2. Was the researcher successful at improving his *researcher capacity* as a result of deep reflection and analysis of the three phases of research associated with this action research study?

1. **Was the researcher successful at improving his instructional leadership capacity as a result of deep reflection and analysis of the three phases of research associated with this action research study?**

The researcher learned much about rigor as an instructional emphasis, which included knowing how to define it, and more importantly, how it should be operationalized, through this study. Moreover, he learned a great deal about how to support his staff who had been frustrated upon hearing the term rigor for a number of years prior to this study because they were unclear as to what it meant and how they were supposed to incorporate it into their instructional practice. Understanding rigor as a practitioner and leader, and determining how to increase his teachers' capacity to design, implement, and plan for rigor fostered in him a greater capacity to lead for improved instructional practice in his setting.

Learning as a Leader

All fourteen participants reported that their involvement was a positive experience, and it had made them think differently about rigor. All reported that the intervention had positively influenced their planning and had made them more conscious about and capable of developing their students' higher-level thinking capacities. Using the Rigor Planning Matrix to correctly match their task description to the appropriate score on the Hess (2013) Matrix also suggested that they had developed a better understanding of rigor, especially task rigor. The classroom observations further revealed that over the two iterations of Phase II, the number of teachers whose task rigor was scored at the DoK 3 level had increased from five to eight (36% to 57%), and the number of scores in level 3 for implementation rigor had also increased from 11% to 33%. This indicated that even in a short period of time, teachers had increased their understanding rigor, how to better define it, and increased their capacity to operationalize it. The instructional intervention was therefore deemed by the researcher to have had a positive impact on the teachers' capacity to more aptly understand and design rigorous tasks.

Participants in Phase IIb also reported that the intervention had positively impacted their thinking about, and their capacity to, design and implement rigorous tasks. Many teachers in this second iteration reported that the newly devised Implementation Rigor Rubric had been the biggest change to their thinking (Teacher C, D, H, I) and other teachers (Teacher E, F, G, H, I) also reported that the implementation aspect of rigor had been a very new and positive improvement in their instructional practice. While the researcher felt that the development of the Implementation Rigor Rubric was a very positive modification to the intervention, he still felt that task rigor was the most critical aspect of rigor, and was concerned that by teachers so heavily embracing the Implementation Rigor Rubric, it might have overshadowed the focus needing to be placed on task rigor and the use of the Hess (2013) Matrix. This he deliberated on in a personal memo:

> Currently, some teachers are not seeing the value to using the Hess (2013) Matrix everyday, and therefore are unable to know the student thinking level of the next day's task. How can one know the student thinking level without doing this? And if it is not being done, why isn't the student thinking level considered to be important, and what then is more important? One can ask rigorous questions of students, but as Doyle (1988) notes, the task assigned to students is the representation of how the curriculum is manifested, and how the students will come to understand and make sense of it.

Additional evidence for deeming the intervention modifications successful was found in the feedback provided to staff following their observations. Providing context-specific feedback was a suggestion found in the research reviewed on teacher professional learning (Bransford et al., 2000; Darling-Hammond & Richardson, 2009; Hattie, 2009; Marshall, & Smart, 2013; Marzano et al., 2005; Putnam & Borko, 2000; Weiss & Pasley, 2006). The fact that no study

reviewed in the literature on rigor was found to have focused on developing teachers' capacity to better understand and operationalize it, the researcher noted that providing specific feedback to teachers on the level of task and implementation rigor observed during a lesson, as measured by the Hess (2013) Matrix and the Implementation Rigor Rubric, was an essential component for leaders to develop rigor in their own setting.

Providing more flexibility to the participants to schedule their observation lessons was also a positive modification as it prevented the teachers from needing to squeeze such lessons, especially the second observation, into a very short timeframe. This was noted as being problematic by some of the participants in Phase IIa (Teacher 2, 3, 4), and to highlight this, Teacher G in Phase IIb scheduled the second observation almost three weeks after the end of the three-week iteration, and was able to increase the degree of rigor on the Hess (2013) Matrix according to the Bloom's level, as well as demonstrating an improvement in one component of the teacher's implementation rigor score. The researcher felt that requiring the teachers to schedule two very rigorous lessons into a three- or four-week time frame without accounting for where they were in their current unit, would have undermined the relevance and authenticity of rigor in practice, which may have therefore lead to some of the participants adopting a view that rigor was a theoretical nicety as opposed to an instructional reality.

The researcher's perspective was that the modifications made in the second iteration were successful in increasing the participants' capacity to design *and* implement rigorous tasks, which was a view based on the observations of the teachers and their Rigor Planning Matrices, as well as their insights gleaned from the weekly meetings, the reflection logs, and interviews.

Both iterations also lead to a teacher-release day PD being partly dedicated to the participants in both Phase I and II sharing their learning, their challenges, and proposed next

183

steps in further developing their capacity to design and implement rigorous tasks as part of their instructional practice. One teacher stated in regard to the teacher-driven rigor PD that it was the best PD he had attended in all his years as a teacher, and because it included his colleagues sharing how rigor was defined and how the tools helped them better understand and operationalize it. However, he was most appreciative of hearing about them sharing the challenges they had and were facing with rigor, and that they had come to realize that not every lesson should be rigorous, as this made it more practical and realistic.

Understanding Rigor

The researcher first came to understand that teachers were vague on their understanding of rigor, and some teachers had explicitly reported this in addition to feeling unclear about how the upper levels of the Bloom's Taxonomy was operationalized in classroom tasks. An important lesson learned by this researcher was that school leaders must develop greater clarity as to how rigor is defined and in accordance with the literature, especially if meaningful progress is to be made towards developing and increasing teachers' capacity to design and implement rigorous tasks. Additionally, and through a great deal of reading on the topic, he came to appreciate that simply accepting one perspective of rigor limited his own capacity to define and operationalize it, and therefore his understanding of how to contemplate helping his staff begin to understand and operationalize it. He further acknowledged that the many definitions, although seemingly varied at first, were actually characterizing rigor as developing students' higher-order cognition. Yet without further and deeper analysis, he would have been unable to move the idea of academic or instructional rigor from theory into practice for teachers to accept and embrace it as they came to do through this work.

A more extensive and deeper review of the literature allowed this researcher to acknowledge the work of Karin Hess and the Hess (2013) Matrix, which he felt, through his review of the various models of rigor, such as the one developed by Daggett (2005), provided the clearest model of how to move rigor into practice, both for himself and his teachers. Due to the participants' reports regarding the perceived complexity of the Hess (2013) Matrix, he realized that it could not be simply given to teachers with the expectation to use it without extensive and frequent discussion, but it provided a common language for which a school or district leader and teacher could use with the aim of developing rigorous tasks. This model, which was available for numerous subject areas, provided for teachers and administrators at various levels, examples of tasks and their corresponding level of cognitive demand and rigor associated with it. In using it, the researcher developed a greater awareness of how it minimized the subjectivity of how rigor can be perceived, especially during observations if no such model was used, or rigor was defined only by such terms as higher-level thinking or critical thinking. The researcher also felt that the Implementation Rigor Rubric, like the Hess (2013) Matrix, provided a similar level of objectivity and clarity for observing, discussing and evaluating the implementation aspect of rigor. Both these tools therefore provided a specific means by which to define and evaluate rigor.

Developing Teachers' Capacity to Improve Rigor

The link between teacher perspectives of rigor and their capacity to operationalize it can now be drawn as a result of this action research, even if only from this single setting. Thus, seeking teacher perspectives and their understanding was a key lesson for this researcher, and an essential component to first knowing whether and to what degree teachers actually understood rigor before considering the next action steps.

The understanding that each participant involved in Phase II of this research study reported as a consequence of the intervention was, from the researcher's perspective, the result of an initial, in-depth exploration of their perspectives on rigor, which included exploring how they defined it, how they stated an observer would see it if visiting their classroom, how well they felt they and their colleagues understood it, and how their pre-service and current in-service PD training had and was helping them understand it. Without this, and then verifying the collective perspective on rigor with the teachers, the researcher felt that he would have been likely unable to design a relevant instructional intervention to address and increase his teachers' understanding of rigor. He also felt that it would have been very difficult to have involved his staff in the process, which was a suggestion made by Bransford et al. (2000) with regards to instructional improvement efforts.

This researcher also came to realize that rigor needed to be discussed often, and regardless of the stage of understanding teachers were in. He further found that when the participants openly and honestly shared their experiences with their colleagues, noting the positives, the challenges and roadblocks, and the ways that they had and were addressing them, their peers better received the information. The participants at the researcher's school provided workshop discussions for their colleagues by sharing their experiences in the intervention on a teacher-release day following Phase II. They were asked by the school leadership to honestly disclose their positive experiences, as well as their challenges, and to describe how and through what methods they were addressing them to ensure that their colleagues realized that a roadblock was not an endpoint, but simply a challenge to be overcome in the name of providing a greater level of cognitive challenge for the students.

The Hess (2013) Matrix provided an objective, specific, and common lens through which to view rigor for both the teachers and the four observers (researcher, Principal, language Arts Specialist, and Math Resource Teacher), which was immensely helpful with the observations. It also provided a means for writing specific feedback to teachers on the observers' reason for their task rigor score, as well as to provide specific suggestions for consideration on how to increase the level of task rigor. However, the researcher realized through both iterations of Phase II (a and b) that the Hess (2013) Matrix needed to be discussed often, as many participants reported that it was confusing because the language in the cells that provided an example of tasks did not always directly match the teachers' selected task. He realized that teachers required his or another support member (such as the Principal, LAS or MRT), who was familiar with the Hess (2013) Matrix, to attend the weekly planning meetings to direct the conversation towards helping the teachers be more able to match the cell descriptor to their task. He learned that teachers sometimes needed to be less concrete about the matching of the cell description to their selected task, and instead, be comfortable finding the closest match. He frequently had to remind the teachers, especially in Phase IIb through the Principal, LAS and MRT, that the cell descriptors on the Hess (2013) Matrix did not contain every possible task, but only some. He acknowledged that this was met with varied levels of teacher comfort, which prompted him to make note that for the Hess (2013) Matrix to be accepted and embraced by teachers, he needed to support them through this perceived ambiguity and initial discomfort. This was also the reason for him having the Principal, LAS and MRT attend the weekly planning meetings in Phase IIb, as it required them to verbalize and describe matches between teacher tasks and Matrix cell descriptions, and therefore afforded them greater familiarity with the Hess (2013) Matrix, even beyond the classroom observations and post-observation discussions.

The researcher gleaned an essential insight in Phase IIa, which unearthed the suitability of the Hess (2013) Matrix to detect how well the teachers implemented the tasks. After reviewing the state's rubric: *The Connecticut Common Core of Teaching (CCT) Rubric for Effective Teaching 2014* (Connecticut State Department of Education, 2014), and considering the work of Doyle (1983), he developed the Implementation Rigor Rubric, which was well received by the participants in Phase IIb, and as stated by Teacher D, it was a means for infusing and increasing rigor into every lesson, which the teacher felt was less the case for task rigor and the use of the Hess (2013) Matrix. While this rubric also provided more common language for the implementation component of rigor, the researcher felt that it overshadowed the importance of designing rigorous tasks and the use of the Hess (2013) Matrix. He felt that an essential consideration for him to develop rigor in general, would be to focus first and foremost on developing task rigor, which would simultaneously address the issues noted with the Hess (2013) Matrix, and would increase teachers' familiarity and comfort with its use. He felt that introducing implementation rigor as an additional, and important component to support task rigor, would be the next step and once greater comfort with task rigor had been developed.

The researcher's decision to use both of these tools to explicate and clarify rigor in practice was a necessity, and an important recommendation for leaders and teachers working to deepen their understanding and capacity to design, implement and evaluate rigorous tasks. Using general phrases and models would do little to support the development of rigor in the classroom, because it would lead to varied perspectives and disagreement. This would ultimately lead to teacher frustration and undermine rigor's value in their instructional practice.

The researcher became clearer as the study progressed that teachers required explicit training on how to design and implement rigorous tasks, and in their own day-to-day context.

The literature reviewed that provided suggestions on developing teachers' instructional capacity (Bransford et al., 2000; Darling-Hammond & Richardson, 2009) made this clear, and implied that one-time presentations or discussions have little power in sustainable change in instructional practice. This information was utilized in the researcher's decision to attend, or to have one of the other observers (Principal, LAS or MRT) attend, the weekly planning meetings as this was an important opportunity for rigor to be made more clear and operationalized. He decided early in the study's design that simply understanding rigor was insufficient and that valuable time would be wasted in only discussing it without putting it into action. Discussing it in the weekly planning meetings while actually designing rigorous tasks to employ the following day or coming days was, as the researcher felt, the most efficient and effective way to bring rigor out of theory and into practice. Given the positive findings and results in Phase II, this decision was deemed to be effective.

The importance and value of the weekly planning meetings, which had already been instituted a year prior to this study, was realized by the researcher, as they provided a weekly opportunity for teachers to collaboratively plan and develop their instructional practice. However, the researcher, despite noting the need for these specific planning meetings to be made part of the regular week for teachers, also came to recognize that rigor (and therefore, instruction/pedagogy) was not a focus, nor an item of discussion. One teacher offered a perspective on this when asked by the researcher, saying that instruction is personal and maybe teachers feel uncomfortable discussing that. The researcher felt this was an issue that needed to be addressed, and so employed a requirement in the meetings for teachers to dedicate a minimum of a third of the meeting to discussing and addressing rigor and pedagogy. While this was met with some resistance from some participants, they stated that they understood why this was

necessary, but were just so used to discussing other aspects of teaching, which they acknowledged to be actually less important than the core of their job, and because of their perceived lack of time together with subject-area, grade-level colleagues. However, it was embraced by Teacher E, F, G in Phase IIb who developed and designed a completely new unit on weather and began to discuss more openly as to what they were doing to increase the challenge for students, and how the students were reacting. Additionally, these meetings also provided the researcher with a greater understanding of the roadblocks to rigor, which was communicated by Teacher 2 and 3, who were experiencing a new curriculum. He came to realize that meaningful progress in developing teachers' capacity to design and implement rigorous tasks would be thwarted if such roadblocks weren't acknowledged, and with a view to then devising a realistic solution.

The researcher, providing explicit feedback on the observed lesson and including specific considerations for improving the level of task and implementation rigor, was another method for enhancing teachers' understanding of rigor and their capacity to redesign and implement rigorous tasks in their classrooms. Teacher H stated in an individual feedback meeting following his first observation that he had wanted a model and example of rigor prior to the intervention, but since receiving feedback and experiencing the other aspects of the intervention, he had come to realize that an example would have limited him to only one model. Instead, he came to realize that specific feedback and discussion on rigor relative to his daily work and context was much more effective, forced him to really think about rigor and his instructional practice, and develop a greater capacity to understand rigor in order to design and implement rigorous tasks in increasingly more rigorous ways. This view also aligned with the suggestions in Bransford et al. (2000).

Essential to providing a reality and context to rigor's development was that teachers came to see it as an emerging progression towards greater levels of cognitive demand and higher-order thinking. Prior to this action research study, many teachers were of the mind that rigor was to be observed everyday in every lesson, which they reportedly felt was unrealistic and too theoretical. The Hess (2013) Matrix clarified for all of the participants that the tasks that they designed for their students at the beginning of a unit were likely to demand lower-levels of cognitive challenge, and the instruction may even involve a more teacher-directed emphasis, which made sense to them. The Matrix and ensuing discussions on its use further clarified that the tasks should become progressively demanding from a cognitive perspective and increase the emphasis on student-centeredness. The language on the Hess (2013) Matrix provided specific examples of tasks that would demand such high levels of thinking and cognition, and teachers were expected and able to visually note and manipulate the journey towards rigor as the unit progressed. However, the key takeaway and clarification for both teachers and leaders was based on where rigor is more authentically and practically situated within a unit (although this was not formally addressed in Phase II), and that it should not be expected to occur everyday in every lesson. An additional aspect was that implementation rigor, as noted by Teacher D, could and should be included into a teacher's daily instructional practice, and that this could be varied to challenge individual students based on their learning needs.

The researcher gradually realized in Phase II that developing a complete unit would be a necessary next step for teachers in order to help them plan for rigor in a longer-range plan beyond the weekly expectation of the Rigor Planning Matrix. Providing teachers with a planning tool, such as the Rigor Planning Matrix (Appendix L), was also found to provide the participants with an authentic lens in which to plan with rigor in mind, and to situate rigor in a weekly plan,

as opposed to one isolated lesson. It also required them to use the Hess (2013) Matrix in an authentic way, which, by its very use, increased their familiarity with the tool. The researcher came to realize that teachers needed to follow a structured process, such as the UPPER, when planning a unit for rigor to be understood and deliberately situated within it. Phase I of this study revealed that teachers were unclear on how to operationalize rigor, which logically impeded them from intentionally planning with rigor clearly in mind. Rigor became more operationalized through the use and understanding of the Hess (2013) Matrix and the Implementation Rigor Rubric, but these tools alone did not provide the teachers with a systematic method and approach for designing units of study that lead their students to develop a deep understanding of core content or big ideas, which was indicated by Teacher 4. The UPPER was deemed to be effective by Teacher 5 who also stated that:

> Sequencing of activities and tasks are clearly articulated in the form, and this allows for time to consider rigor. The "trajectory" of the unit's rigor can be observed…. I also feel that the ability to combine the concept of unpacking the standards in conjunction with infusing rigor when appropriate makes for sound unit and lesson development.

It was possible for rigor to be included in a lesson and therefore observed in isolation, which could have been possible at times during Phase II of this study. However, for it to be intentional, relevant and meaningful, it needed to be developed and incorporated as part of the whole unit system along with standards, essential knowledge, skills, and processes, big ideas, essential questions, differentiation, assessment, and the learning or task sequence. Rigor developed in this way became coherent and linked directly to the final performance assessment and the tasks that immediately preceded it, which lead the students to grapple with and uncover the big ideas and essential understanding (Wiggins & McTighe, 2005).

The researcher further realized that teacher teams needed to conduct long-range planning, and it needed to be a collaboration between teachers, Library Media Specialists, and other relevant support staff for rigor to be situated and developed within a concept-based unit. Phase II responses from teachers, especially Teacher G, acknowledged the positive impact that collaborative planning for rigor had had on their capacity to understand, design and implement rigorous tasks. Teacher G also reinforced this perspective in Phase III, noting that: "planning with colleagues was the best part." All five participants in this phase worked closely with their grade-level, subject-area teachers to design and develop the concept-based unit plans, which they reported, enhanced their understanding and final plan. Additionally, both groups worked closely with the computer teacher and the Library Media Specialist to review and implement some of the units in their curriculum throughout the year in order to infuse research skills and integrate technology, which therefore provided another perspective in which to consider all of the components of the UPPER and rigor.

The researcher's effort to emphasize developing students' higher-level thinking capacity was helped by having rigor as the school's focus for the year. The school-wide focus made the work in both Phase I and II more relevant and meaningful for the staff, which was supported by the literature on teacher learning needs (Darling-Hammond & Richardson, 2009; Hattie, 2009; Marshall, & Smart, 2013; Marzano et al., 2005; Putnam & Borko, 2000; Weiss & Pasley, 2006). This focus also provided greater accountability for teachers to focus on rigor as a required component for instructional practice, although this was still an area that this researcher felt required continued thought and address beyond this study.

The researcher was also left pondering over how to make rigor an on-going requirement and an obligatory component to the district's current teacher evaluation plan. Many discussions

with the school's administrative team were dedicated to this issue, and he judged this to be an area for which further thinking is certainly needed for rigor to remain an accepted and highly related focus and emphasis for teachers and administrators in the coming years, and aside from the demands of standardized testing and other mandates that are perceived by teachers to be fads.

2. **Was the researcher successful at improving his** *researcher capacity* **as a result of deep reflection and analysis of the three phases of research associated with this action research study?**

The results and findings gleaned through this action research study firmly supported the notion that the researcher's investigative capacity was successful in utilizing participant perspectives to develop two practitioner interventions that lead the teachers to disclose their understanding of rigor, improve their capacity to design and implement rigorous tasks, as well as their capacity to design concept-based units of study that coherently incorporated increasingly rigorous tasks aimed at having students demonstrate an understanding of the big ideas in the topic. The researcher's *learning as a researcher* was powered through deep and continuous reflection on his involvement in the project, and his influence on the participants and the results and findings. His insider, power-position made it extremely necessary for him to be astutely aware of his relationship with, and effect on, others. However, as a school leader, he was compelled to experience, examine, and enquire (Creswell, 2012) on instructional issues that were central to the core work (instruction) conducted in his school, and therefore, driven to seek ways to unearth essential and truthful information in which to make necessary and on-going improvements in his setting. He also felt that his learning as a researcher provided critical leader-researcher considerations for others in a similar position, seeking to conduct similar work in their

setting. As such, his learning as a researcher was realized through two broad areas: Working with the participant teachers as a power-positioned insider, and working with the data to compile accurate findings and results, organize it, relate it to the literature, and draw valid and meaningful conclusions and implications.

An important aspect learned by the researcher was in regards to his position and influence on all teachers, especially those involved in the research study. He began to understand this aspect much more by reading various works on the insider-researcher (see Coghlan, 2001; Coghlan & Brannick, 2010), which lead him to create a table for exploring action research insider role duality issues within the first-, second-, and third-person stance (see Table 3.1). This table allowed him to consider the advantages and disadvantages of his varied insider roles, and devise appropriate methods for combatting them. For example, in considering the second-person role duality, he wrote that his role as school leader and as an evaluator made it challenging to know the issues with which the participants were grappling, and how they were feeling. Additionally, he realized that his role as an organizational member and colleague (not as an administrator) made it difficult to avoid being too close to the participants and data. This directed him to ensure that no part of the research was used for his evaluation purposes. He also sought disconfirming evidence (Coghlan & Brannick, 2010; Ferguson & Ferguson, 2001) and negative cases (Maxwell, 2013) to remain open to what was said and demonstrated by the participants, and to avoid forcing the data in a favored direction.

The researcher worked diligently to ensure that the participants were very comfortable with their involvement in the study (Herr & Anderson, 2015). To achieve this, he employed the use of a respondent validation procedure (Maxwell, 2013) or member check (Creswell, 2009, 2012; Mertens, 2012; Thornberg & Charmaz, 2012; Yin, 2002) in Phases I and II, and felt that it

was important to be seen as developing credible and transparent findings in which to develop fitting and justifiable intervention steps.

The researcher learned that it was exceptionally important to engage in deep and constant reflection on his power-positioned, insider role in order to become astutely aware of his influence on the participants, and therefore, the research findings (Altheide & Johnson, 2011). The importance of this was due to the findings and results being largely dependent on the reports and reflections of the participants, and not just on their performance in the classroom. He found that engaging in frequent memo writing, discussion with a trusted colleague, and constantly reflecting on his influence supported this, which Coghlan and Shani (2013) had advanced in stating that: "Insider action researchers need to build on the closeness they have with the setting while, at the same time, create distance from it in order to see things critically and enable change to happen" (p. 646). The researcher began to realize as the study progressed that he had underestimated the need to more deeply consider his influence on participants, which was largely due to the positive relationship he had developed with the staff over the previous five years. He felt justified in conducting the individual and focus group semi-structured interviews in Phase I, because of his background and expertise with regards to instructional practice, and the findings and wealth of information gleaned from them supported this decision. However, in both iterations of Phase II, he felt that his position in relation to the study and as an administrator could have gleaned less credible data from the individual interviews, which is why he recruited less influential interviewers to conduct them. He made the same decision and for the same reason in Phase IIb by having the Principal, LAS or MRT guide and take notes in the weekly planning meetings. Although some of the participants expressed that they would have been equally as open with the researcher had he conducted the interviews in Phase II, he felt much more

confident that having someone else conduct them removed the potential for power influence, which was the result of his deep and frequent reflections on his positionality.

The researcher realized that his role as an insider action researcher was central to working with teachers to improve their work. His role within the study, and as an instructional leader, became clearer as he recognized that the researcher or investigator role was to find out something, which forced him to shift his role to coach and intervene with an appropriate actionable response to what was found. He therefore found that his role as an investigator on teacher perspectives, and his role as an instructional coach of teacher capacity to design and implement rigorous tasks, and design concept-based, rigorous units of study, were complimentary. For example, in Phase IIa, he realized, that by taking a more passive role in the weekly planning meetings, that the teachers were not discussing rigor unless he guided it. His investigator role enabled him to uncover important information that he immediately put to use by implementing the requirement for the teachers to spend a minimum of 15-20 minutes in each weekly meeting, discussing rigor (or pedagogy). He also realized that this complimentary researcher-coach role was one that he naturally gravitated towards in his leadership position, which he acknowledged, through this study, was one that he needed to utilize to a greater degree in the future to more adequately effect instructional change in his setting. He also felt that the researcher-coach role aligned with Bryk et al. (2015) idea of *improvement science* that promoted learning quickly with minimal intrusion, and using the evidence to immediately direct actionable next steps.

The researcher also learned the importance of gathering data and developing a system for storing it so it could be accessible and functional, which he achieved by creating numerous electronic folders, and using tables or matrices to capture the results in one location. Moreover,

197

he learned the most about analyzing the qualitative data and its purpose, which became especially evident in the analysis of the interviews. While he opted for an eclectic first cycle coding process involving holistic and In Vivo coding (Saldaña, 2013), which was used in all of the interviews in Phases I and II, he found that the importance of the interviews in relation to the other data points changed the method he employed to establish the themes. For example, in Phase I, the individual interviews were the central data point used to explore the teachers' perspectives and verbalized understanding of rigor. For each of the eight interview questions, the responses were individually coded, the codes categorized, a theme was established using the codes as support, and a short interpretation was written that related to each question. Later, the individual themes were compared across the 10 participants, collapsed, and refined themes were established for each question.

However, for the interviews in Phase II, a different process was used as the interview data took a less prominent, and a more supplementary role to the observations. Its aim was also different, as the interviews in Phase I sought to understand how the teachers described rigor, and in Phase II, it sought to determine whether aspects of the intervention were either positive or a challenge. Each transcript was again coded, but more holistically than in Phase I. The codes were refined, and then grouped according to whether they represented a positive impact, a challenge, or represented an idea that did not fit into either the positive or challenge category. In some regards, the analytic process used for these interviews emerged just prior to the analysis of the transcriptions, and it was through deep consideration for the purpose that an appropriate analytic theme-development process was selected and employed.

Combining numerous varied data points did not seem challenging to the researcher at the outset of this study, but as it progressed, and many data points were collected and analyzed, the

challenge of seeing all of the data points together became very difficult. Consequently, one of the main aspects of the researcher's learning as a researcher was in the realm of triangulation. He used Mills's (2013) matrix to organize all of the findings in all three phases, which he found made seeing the overall results and findings more comprehensible, which also made it much easier to draw accurate and relevant conclusions.

Implications

Seven important implications were garnered from the results and findings in this action research study, as well as from the researcher's learning as a leader and as a researcher, that provide considerations for school and district leaders when developing rigor. The focus of the implications relates to understanding teachers' and practitioners' perspectives on rigor, and employing methods to support teachers from various approaches that were found to be successful in this study.

1. Teacher perspectives are important. This study's Phase I findings and results suggested that both teachers' perspectives and their praxis must be explored and should be considered essential knowledge before improvement efforts are employed, which would add an important element to the understanding of academic or instructional rigor that is currently absent from the knowledge base. This is an element of insight necessary before designing a relevant and meaningful instructional or planning intervention that is focused on designing and implementing rigor in student work.

2. Roadblocks to rigor must be known. The roadblocks to teachers understanding, designing and implementing rigorous tasks in rigorous ways should also be acknowledged and explicitly addressed. This study's Phase II findings indicated that implementing new curriculum forced teachers to spend time interpreting it and trying to devise and select activities to engage

students, which impeded their efforts to concentrate on rigor. A lack of adequate training and

professional development was also noted as a roadblock, which was why many of the

participants reported feeling confident in defining rigor, but much less able to operationalize it in

practice. The same lack of training and knowledge was recognized as a barrier to teachers being

able to design a concept-based unit that could incorporate rigor, which unsurprisingly lead them

to develop more topic-focused units (Erickson, 2002) that failed to provide a clear sense of how

to appropriately situate rigor within it.

      3. Explicit and direct support for teachers is needed. Continuous and explicit support

for teachers to design and implement rigorous tasks is necessary. While various studies had

employed classroom observations (Junker et al., 2006; Maye, 2013; Paige et al., 2013; Wolf et

al., 2005), none had done so with a view to explicitly coaching and providing continuous support

to teachers to effect a change in their pedagogical thinking and rigor-related actions. For

example, increasing teachers' understanding of rigor, as well as their capacity to design and

implement rigorous tasks, requires that they be observed employing rigor by supportive faculty

members, such as the Principal, Assistant Principal, Language Arts Specialist, Math Resource

Teacher, and other building coaches, and that both practitioner and observer have a consistent,

unified view and measure of academic rigor, which can be achieved through the use of the Hess

(2013) Matrix and the Implementation Rigor Rubric. Additionally, it requires that specific

feedback and suggestions for increasing the level of task and implementation rigor be provided

to teachers to enable them to compare their initial view of operationalized rigor to that of familiar

observers, and to then make the necessary adjustments in preparation for a next observation and

with a refined perspective of rigor. For example, following initial observation feedback, Teacher

H developed a new perspective on what he constituted as rigor in classroom work. Teacher H

later commented on how effective the feedback was, which likely resulted in the increase in this teacher's observed level of rigor (DoK level 2 to 3) when comparing the first and second Phase IIb observations.

4. Focus on rigor and instruction in planning meetings. Rigor and (pedagogy) should be made a focus in weekly planning meetings, because as noted in this study, teachers were drawn to discuss procedural and peripheral items of teaching during such meetings, which included discussing and selecting activities as part of a new curriculum (as with Teacher 2 and 3). Teacher 2 in this study remarked that: "thinking about what the students are doing and why they're doing it is a big piece and sometimes the procedures of what you're doing in the classroom get in the way." Most of the participants felt that their planning was at least adequate prior to the intervention. However, following the intervention, all of them reported that their planning had been positively impacted and included much more thoughtful and deliberate consideration for rigor.

5. Unit planning must emphasize big ideas and rigor. The apparent lack of clarity as to how big ideas are established, where they originate from in terms of planning a concept-based and rigorous-focused unit, and how they link to the essential questions clearly suggests that this is an area in which contemporary units should be focused if essential understanding and not just facts and knowledge is to be derived (Erickson, 2002). Focused support and coaching is necessary to guide teachers to plan and design units of study that emphasize the big ideas through a predetermined and performance-based outcome, and realized through a sequence of increasingly rigorous tasks that lead students to uncover and explain the big ideas. Focused support and coaching is also essential to redirect teachers from planning isolated and entertaining activities and tasks, as noted by Shavelson and Stern (1981), and to prevent teachers from

overlooking such instructional-oriented planning altogether, as noted in Clarke (1983).

6. Consider researcher role duality thoughtfully. Coghlan's (2001) insider action research role duality in the first, second and third person stance must be considered, and is essential for recognizing and acknowledging the advantages, the challenges, and means for combatting the challenges. This researcher found that Table 3.1 was a simple and organized method for examining these considerations for power-positioned, insider action researchers, because without a clear and simple method, important considerations could be overlooked that could eventually compromise relationships with colleagues, as well as the accuracy and credibility of the data. An additional consideration that is explicated in much of Coghlan's work, but is worth mentioning again here, relates to the need for deep and frequent reflection on the researcher's influence on participants, the methods, and the data throughout all parts of an action research study.

7. Collect and organize multiple data points. Multiple perspectives and insight is required for studying rigor, which could include numerous perspectives from various stakeholders and not just teachers, as well as observations and other points by which it can be examined, which was a suggestion noted in Donaldson and Grant-Vallone (2002) to address self-report bias. This researcher also found it immensely helpful to use a variation of Mills's (2013) matrix that allowed him to organize all of the findings and results in one place. This further allowed him to draw accurate and relevant conclusions from all of the combined data points.

Recommendations for Future Research

The following recommendations build on the work of this action research study and propose areas that were not explored nor examined. They also relate to a local setting empirically exploring its own work and development towards rigor, which could also be adapted to larger

scale studies in order to seek the same information for considering the current state of rigor, and the necessary steps towards enhancing it.

Student achievement. Rigor's impact on student achievement and performance was not measured in this research study, and was only considered as a point of consideration through teachers' observations. The researcher did not want to create confusion by trying to enhance teachers' understanding and capacity to design and implement rigorous tasks and simultaneously measure whether students performed better. This would have required either the selection or development of specific and valid measures to determine this. Many studies reviewed on rigor had included classroom observations (Dockter et al., 2010; Junker et al., 2006; Maye, 2013; Wolf et al., 2005; Paige et al., 2013), but directly linking improvements in teachers' instructional practice to student learning outcomes is still an area needing to be studied, as noted in the research on teacher professional development (Archibald et al., 2011; Garet et al., 2001). Therefore, whether and to what extent teachers' designing and implementing of rigorous tasks (as in this research) actually result in higher achievement on specified and relevant measures is recommended for future emphasis.

Teachers' understanding of learning theory. A formal exploration of teachers' understanding of contemporary learning theory is an area that should be examined, and especially in light of the new and more cognitively demanding nature of the standards (Common Core State Standards for ELA and Math, the Next Generation Standards in Science, and the C3 Standards in Social Studies). This study's Phase I findings implied that teachers were somewhat unclear about how learners make sense of and effectively process information based on how they described rigor, and it became more evident that teachers were struggling with this in the observations. Some of the questions from the PD session at the beginning of the year also made

note of this issue. An additional component to this exploration would be to simultaneously unearth teachers' perceived link between how they view learning and their understanding of learning theory and their theory of instructional design. This would provide important insights into the planning decisions teachers make and how their plans are manifested in the classroom lessons and units. As noted by teacher participants in this study, professional learning was not viewed as focusing on instruction, which would imply that little time is dedicated to discussing and improving the practitioner's understanding of learning and their capacity to design experiences that naturally align with this knowledge.

Actual teacher work. A more in-depth look at teacher work, based on the work of Doyle (1983, 1988, 1996), is required for classrooms that have focused on developing and implementing more rigorous tasks. A phenomenological study of teachers' instructional practice is needed, and to explore their planning process for an entire unit, and how the unit unfolds and develops rigor. It also needs to consider, as in Doyle (1983), how much of the teachers' actual instructional practice is rigorous. Furthermore, and as importantly, the study should explore in much more detail than this action research project the reasons for classroom work not being rigorous, and thereby utilize teachers' insights when considering how to overcome this challenge.

Collaborative teacher planning. This study's findings also suggest that teachers felt that the best approach to designing rigorous tasks was by working collaboratively with their subject-area/grade-level colleagues as opposed to working in isolation. Collaborative planning to develop rigor was an idea suggested by K. Hess (personal communication, February 1, 2015) who felt that it was the key to supporting teachers' working in this area. Bower and Powers (2009) explicitly expressed the same sentiment: "Collaborative planning time would need to be

reallocated to discussion of the "what" along with the "how" to make inquiry activities possible" (Bower & Powers, 2009, par. 78). Paige et al. (2013) also suggested that teacher collaboration (through Professional Learning Communities) was at the heart of instructional change from lower levels of instruction to developing cognitive rigor. While the collaborative nature of teachers' planning to design and implement rigorous tasks was not formally measured, it was noted by participants as being most helpful in suporting them to be more clearly able to define it, and less frustrated with its ambiguity, which was a point raised by some of the participants in the Phase I interviews. Therefore, exploring this more formally would be a recommendation for future research in the area of rigor.

Local professional learning. A great deal of research has been dedicated to examining professional development and teacher learning, and it warrants mentioning that a specific analysis of teacher learning be explored in each local setting to determine how its teachers perceive it and how they feel it contributes to them designing and implementing rigorous tasks. It also warrants investigating just how much instructional practice and pedagogy really is a focus in school- and district-level professional development. This would include looking closely at the amount of time and effort that is dedicated to a focus on developing rigor.

Leadership perspectives and understanding. This research has focused primarily on the teachers' perspectives of and their capacity to develop rigor, but the same is required for administrative, school- and district-level leadership perspectives on rigor. This would coincide with examining a school or district's professional development for its teachers, and investigating whether there is a difference between the perspectives of teachers and school and district leaders regarding their understanding of rigor. This would be of great importance to the development of rigor, as it is assumed by this researcher that just as the cognitive complexity of students'

classroom work is dependent on the understanding and capacity of the teacher to design and implement rigorous tasks, teacher's capacity in the area of rigor would be as dependent on the school and district leadership's capacity to explicitly train its teachers to understand and employ rigor.

Community perspectives and understanding. An additional important consideration would be that of the community perspectives on rigor. Asking the questions: How do parents and students define and understand rigor? Do they define and understand it differently than teachers and school and district leaders? This would be important to helping provide a common perspective for all education stakeholders with regards to rigor, and especially since community perspectives on school performance, which many may associate with the level of rigor in schools, is currently looked upon with disapproval (Boser & Rosenthal, 2010).

The researcher concluded that his decisions and continuous deep reflections on his leadership and researcher capacity and influence positively contributed to helping the teachers in his setting become more clear about how to define and describe rigor, but moreover, on how to operationalize it in their instructional practice. This was the result of analyzing the data and his influence as the study progressed, and making appropriate modifications during the work, which the researcher felt increased the authenticity of his dual leadership-researcher role, and aligned with Bryk et al.'s (2015) perspective on effecting organizational change. As a result, important implications and recommendations for future research were advanced, which build on the learning experienced in this insider action research study.

REFERENCES

Ainsworth, L. (2003). *Unwrapping the standards: A simple process to make standards manageable*. Englewood, CO: Lead + Learn Press.

Ainsworth, L. (2010). *Rigorous curriculum design.* Englewood, CO: Lead + Learn Press.

Achieve, Inc. (April 2013). Appendix A – Conceptual shifts in the Next Generation Science Standards. Retrieved from

http://www.nextgenscience.org/sites/default/files/Appendix%20A%20-%204.11.13%20Conceptual%20Shifts%20in%20the%20Next%20Generation%20Science%20Standards.pdf

Alliance for Excellent Education (2011, May). *A time for deeper learning: Preparing students for a changing world.* Policy Brief. Retrieved from

http://www.all4ed.org/files/DeeperLearning.pdf

Altheide, D. L., & Johnson, J. M. (2011). Reflections on interpretive adequacy in qualitative research. In Denzin, N. K., & Lincoln, Y. S (Ed.), *The sage handbook of qualitative research* (4th ed., pp. 581-594). London: Sage.

Anderson, L. W. & Krathwhol, D. R. (2001). *A taxonomy for learning, teaching, and assessing: A revision of Bloom's taxonomy of educational objectives.* New York, NY: Addison Wesley Longman, Inc.

Archibald, S., Coggshall, J. G., Croft, A., & Goe, L. (2011). *High quality professional development for all teachers: Effectively allocating resources* (NCCTQ Policy Brief No. S283B050051). National Comprehensive Center for Teacher Quality. Retrieved from

http://www.tqsource.org/publications/HighQualityProfessionalDevelopment.pdf

Armario, C. (2010). Wake-up call: U.S. students trail global leaders. Retrieved from

http://www.msnbc.msn.com/id/40544897/ns/us_news-life/t/wake-up-call-us-students-trail-global-leaders/#.T5I_Hu3R3dk

Aspen, P. F., & Hawkins, F. K. (2000). After the facts: Alternative student evaluation for active learning pedagogies I the undergraduate biblical studies classroom. *Teaching and Theory, 3*(3), 133-151.Retrieved from http://eds.b.ebscohost.com.libproxy.bridgeport.edu/ehost/pdfviewer/pdfviewer?sid=b84d55fc-0b0a-449d-9a0d-0f6bc146a127%40sessionmgr115&vid=9&hid=109

Bennett, J., Lubben, F., Hogarth, S., & Campbell, B. (2005). Systematic reviews of research in science education: Rigour or rigidity? *International Journal of Science Education, 27*(4), 387-406. doi: 1 0.1080/0950069042000323719

Berebitsky, D. P. (2010). *Teacher's academic press and student achievement in reading comprehension* (Doctoral dissertation, University of Michigan). Retrieved from http://deepblue.lib.umich.edu/bitstream/2027.42/77686/1/dberebit_1.pdf

Blackburn, B. R. & Williamson, R. (2009, November). The characteristics of a rigorous classroom. *Instructional Leader, 22*(6). Retrieved from http://static.pdesas.org/content/documents/M4-Slide_11_Characteristics_of_a_Rigorous_Classroom.pdf

Blackburn, B. (2012). *The seven myths of instructional rigor.* Retrieved from http://suite101.com/article/the-seven-myths-of-instructional-rigor-a407235

Blackburn, B. (2013). *Rigor is not a four-letter word* (2nd ed.). [Nook version]. Retrieved from http://www.barnesandnoble.com/w/rigor-is-not-a-four-letter-word-barbara-blackburn/1116874593?ean=9781317922063

Biehler, R. F., & Snowman, J. (1997). *Psychology applied to teaching*, 8th edition, Boston, MA:

Houghton Mifflin

Biesta, G. (2010). Pragmatism and the philosophical foundations of mixed methods research. In

Tashakkori, A., & Teddlie, C. (Eds.). *Handbook of mixed methods in social and*

behavioral research (2nd ed.). (pp. 95-117). Thousand Oaks, CA: Sage.

Bintz, W. P., & Delano Moore, S. (2010). What children taught us about rigor. *Teaching*

Children Mathematics, 17(5), 288-297. Retrieved from

http://www.jstor.org.libproxy.bridgeport.edu/stable/41199660?seq=1

Borko, H. (2004). Professional development and teacher learning: Mapping the terrain.

Educational Researcher 33(3) 3-15. Retrieved from

http://media.leidenuniv.nl/legacy/educ-researcher-33-(2004)-3-15---borko---professional-

development-and-teacher-learning.pdf

Boser, U., & Rosenthal, L. (2012). Do schools challenge our students? What student surveys

tell us about the state of education in the United States. *Center for American Progress*.

Retrieved from http://www.americanprogress.org/issues/2012/07/state_of_education.html

Boston, M., & Wolf, M. K. (2006). *Assessing academic rigor in mathematics instruction: The*

development of the instructional quality assessment toolkit. CSE technical report 672.

Retrieved from http://www.eric.ed.gov/PDFS/ED492868.pdf

Bower, H. & Powers, J. (2009). What is rigor?: A qualitative analysis of one school's

definition. (Vol. 7, No. 4). *Academic leadership: The online journal.* Retrieved from

http://www.academicleadership.org/388/what_is_rigor_a_qualitative_analysis_of_one_sc

hool_s_definition/

Bransford, J. D., Brown, A. L., & Cocking, R. R. (Eds.). (2000). *How people learn: Bridging*

research and practice. Washington, DC: National Academy Press.

Brooks, J. G. & Brooks, M. G. (1999). In search of understanding: The case for constructivist classrooms. Alexandria, VA: ASCD.

Brown, D. S. (1988). Twelve middle-school teachers' planning. *The Elementary School Journal, 89*(1), 69-87. Retrieved from

http://www.jstor.org.libproxy.bridgeport.edu/stable/pdf/1001913.pdf

Brown, D. S. (1993). *Descriptions of two novice secondary teachers' planning. Curriculum Inquiry, 23*(1), 63-84. Retrieved from

http://www.jstor.org.libproxy.bridgeport.edu/stable/pdf/1180218.pdf

Bruner, J. (1960). *The process of education: A landmark in educational theory*. Cambridge, MA: Harvard University Press.

Bruner, J. (1966). *Toward a theory of instruction.* Cambridge, MA: Harvard University Press.

Brydon-Miller, M. (2013). Ethics and action research: Deepening our commitment of principles of social justice and redefining systems of democratic practice. In P. Reason, & H. Bradbury (Eds.), *The sage handbook of action research: Participative inquiry and practice* (pp. 199-210). Thousand Oaks, CA: Sage Publications.

Bryk, A. S., Gomez, L. M., Grunow, A., & LeMahieu, P. G. (2015). *Learning to improve: How America's schools can get better at getting better.* Cambridge, MA: Harvard Education Press.

Burris, C. C., Wiley, E., Welner, K. & Murphy, J. (2008). Accountability, rigor, and detracking: Achievement effects of embracing a challenging curriculum as a universal good for all students. *Teachers College Record, 110*(3). 571-607. Retrieved from

http://www.colorado.edu/education/sites/default/files/attached-files/Burris,Wiley,Welner_Accountability_Rigor_and_Detracking.pdf

Buss, R. R., Zambo, D., Painter, S. R., & Moore, D. W. (2012). Examining faculty member

 changes in an innovative educational doctorate program. *Innovative Higher Education,*

 38, 59-74. doi: 10.1007/s10755-012-9222-3

Caine, R. N. & Caine, G. (1991). *Making connections: Teaching and the human brain.*

 Virginia: ASCD.

Cairns, M. (2013). *Academic rigor task force report.* Muncie, IN: Ball State University Task

 Force on Academic Rigor. Retrieved from http://cms.bsu.edu/-

 /media/WWW/DepartmentalContent/Senate/Task%20Force%20on%20Academic%20Rig

 or/ARigor2013Final.pdf

Carr, W., & Kemmis, S. (1986). *Becoming critical: Education, knowledge and action research*.

 New York, NY: RoutledgeFalmer.

Chappell, S. V., & Barone, T. (2012). Arts-based research. In Lapan, S. D.,

 Quartaroli, M. T., & Riemer, F. J. (Eds.). *Qualitative research: An introduction to*

 methods and designs (pp. 271-289). San Francisco, CA: Jossey-Bass.

Charmaz, K. (2011). Grounded theory methods in social justice research. In Denzin, N. K., &

 Lincoln, Y. S (Ed.), *The sage handbook of qualitative research* (4th ed., pp. 341-358).

 London: Sage.

Choy, S. P., Chen, X., & Bugarin, R. (2006). *Teacher professional development in 1999-2000:*

 What teachers, principals and district staff report (NCES 2006-305). U.S. Department of

 Education. Washington, DC: National Center for Education Statistics. Retrieved from

 Retrieved from http://nces.ed.gov/pubs2006/2006305.pdf

Christ, T. W. (2010). *Paradigm considerations and mixed methods in social science research*.

 (Handout in EDLD 811). University of Bridgeport, Bridgeport, CT.

Christ, T. W. (2013). The worldview Matrix as a strategy when designing mixed methods

    research. *International Journal of Multiple Research Approaches, 7*(1), 86-94. (Handout

    in EDLD 815). University of Bridgeport, Bridgeport, CT.

City, E. A., Elmore, R. F., Fiarman, S. E., & Teitel, L. (2010). *Instructional rounds in education:*

    A network approach to improving teaching and learning. Cambridge, MA: Harvard

    Education Press.

Clark, C. M. (1983). *Research on teacher planning: An inventory of the knowledge base*

    (Occasional Paper No. 66). East Lansing, MI: Institute for Research on Teaching,

    Michigan State University. Retrieved from

    http://education.msu.edu/irt/PDFs/OccasionalPapers/op066.pdf

Clark, C. M., & Peterson, P. L. (1984). *Teachers' thought process* (Occasional Paper No. 72).

    East Lansing, MI: Institute for Research on Teaching, Michigan State University.

    Retrieved from https://education.msu.edu/irt/PDFs/OccasionalPapers/op072.pdf

Cochran-Smith, M, & Lytle, S. L. (1990). Research on teaching and teacher research: The

    issues that divide. *Educational Researcher, 19*(2), 2-11. Retrieved from

    http://edr.sagepub.com/content/19/2/2.full.pdf+html

Coghlan, D. A. (2001). Insider action research projects: Implications for practicing managers.

    Management Learning, 32(1), 49-60. Thousand Oaks, CA: Sage.

Coghlan, D. A. (2007). Insider action research doctorates: Generating actionable knowledge.

    Higher Education, 54, 293-306. Retrieved from

    http://content.ebscohost.com/ContentServer.asp?T=P&P=AN&K=25462635&S=R&D=a

    ph&EbscoContent=dGJyMNHX8kSeprI4yOvsOLCmr06ep7JSsam4SbOWxWXS&Cont

    entCustomer=dGJyMPPk4Irn2u6MuePfgeyx44Dt6fIA

Coghlan, D. A. & Casey, M. (2001). Action research from the inside: issues and challenges in

    doing action research in your own hospital. *Journal of Advanced Nursing, 35*(5), 674-

    682. Retrieved from

    http://content.ebscohost.com/ContentServer.asp?T=P&P=AN&K=5042545&S=R&D=ap

    h&EbscoContent=dGJyMNHX8kSeprI4yOvsOLCmr06ep7JSsay4TbCWxWXS&Conten

    tCustomer=dGJyMPPk4Irn2u6MuePfgeyx44Dt6fIA

Coghlan, D. A., & Brannick, T. (2010). *Doing action research in your own organization.* (3rd

    Ed.). Thousand Oaks, CA: Sage.

Coghlan, D. A., & Shani, A. (2013). Action and collaboration between scholarship and practice:

    Core values of OD research. *OD Practitioner, 46*(4), 35-38. Retrieved from

    http://content.ebscohost.com/ContentServer.asp?T=P&P=AN&K=98653770&S=R&D=

    mfi&EbscoContent=dGJyMNHX8kSeprI4yOvsOLCmr06ep7JSsK64S7aWxWXS&Cont

    entCustomer=dGJyMPPk4Irn2u6MuePfgeyx44Dt6fIA

Coghlan, D. A., Shani, A., & Roth, J. (2015). Institutionalizing insider action research initiatives

    in organizations: The role of learning mechanisms. *Systematic Practice & Action*

    Research, 29(2), 83-95. doi: 10.1007/s11213-015-9358-z

Collins, K. M. T. (2010). Advanced sampling designs in mixed research: Current practices and

    emerging trends in the social and behavioral sciences. In Tashakkori, A., & Teddlie, C.

    (Eds.). *Handbook of mixed methods in social and behavioral research.* (2nd ed., pp. 353-

    377). Thousand Oaks, CA: Sage.

Connecticut State Department of Education (2010). *2010 Common core of teaching: Foundation*

    skills. Hartford, CT: Connecticut State Department of Education. Retrieved from

    http://www.sde.ct.gov/sde/lib/sde/pdf/educatorstandards/board_approved_cct_2-3-

[2010.pdf](2010.pdf)

Connecticut State Department of Education (2013). *Data interaction for Connecticut mastery test, 4th generation*. Retrieved from

http://solutions1.emetric.net/CMTPublic/CMTCode/ChartSelections.aspx

Connecticut State Department of Education. (2014). *The Connecticut common core of teaching (CCT) rubric for effective teaching 2014*. Retrieved from

http://www.connecticutseed.org/wp-content/uploads/2014/05/CCT_Rubric_for_Effective_Teaching-May_2014.pdf

Common Core State Standards Initiative (2016). *Read the standards*. Retrieved from

http://www.corestandards.org/read-the-standards/

Cooney A (2011). Rigour and grounded theory. *Nurse Researcher, 18*(4), 17-22.

Cooper, K. S. (2014). Eliciting engagement in the high school classroom: A mixed-methods examination of teaching practices. *American Education Research Journal, 51*(2), 363-402. doi: 10.3102/0002831213507973

Corbin, J., & Strauss, A. (2008). *Basics of qualitative research* (3rd ed.). Thousand Oaks, CA: Sage Publications.

Creswell, J. W. (2009). *Research design: Qualitative, quantitative and mixed methods approaches.* (3rd ed.). New Delhi, India: Sage.

Creswell, J. W. (2012). *Educational research: Planning, conducting, and evaluating quantitative and qualitative Research*. (4th Ed.). New Delhi, India: Pearson Publishing

Daggett, W. R (2005). *Achieving academic excellence through rigor and relevance.* International Center for Leadership in Education. Retrieved from

http://www.leadered.com/pdf/academic_excellence.pdf

Daggett, W. R. (2014). *The Daggett system for effective instruction: Where research and best practices meet.* International Center for Leadership in Education. Retrieved from http://leadered.com/pdf/Daggett_System_for_Effective_Instruction_2014.pdf

Daggett, W. R. & Nussbaum, P. D. (2008). *How brain research relates to rigor, relevance, and relationships.* International Center for Leadership in Education. Retrieved from http://www.leadered.com/pdf/Brain%20Research%20White%20Paper.pdf

Daggett, W.R. & Gendron, S. (2010). Common Core state Standards Initiative classroom implications for 2014. International Center for Leadership in Education. Retrieved from http://www.leadered.com/pdf/Common%20Core%20Standards%20Paper%20FINAL.pdf

Darling-Hammond, L, Barron, B., Pearson, P. D., Schoenfeld, A. H., Stage, E. K., Zimmerman, T. D., Cervetti, G. N., & Tilson, J. L. (2008). *Powerful learning: What we know about teaching for understanding.* San Francisco, CA: Jossey-Bass.

Darling-Hammond, L, & Richardson, N. (2009). Teacher learning: What matters? *Educational Leadership*, *66*(5), 46-53.

Dick, B. & Greenwood D. J. (2015). Theory and method: Why action research does not separate them. *Action Research, 13*(2), 194-197. doi: 10.1177/1476750315573594

Dockter, J., Haug, D., & Lewis, C. (2010). Redefining academic rigor: Critical engagement, digital media and the new English language arts classroom. *Journal of Adolescent and Adult Literacy, 53*(5), 418-420. Retrieved from http://www.jstor.org.libproxy.bridgeport.edu/stable/pdf/25614575.pdf?_=14650682060016

Donaldson, S. I. & Grant-Vallone, E. J. (2002). Understanding self report bias in organizational

behavior research. *Journal of Business and Psychology, 17*(2), 245-260. Retrieved from

http://cgu.edu/include/Understanding%20self-report%20bias.pdf

Donovan, M. S., & Bransford, J. D. (Eds.). (2005). *How students learn: History, mathematics,*

and science in the classroom. Washington, DC: The National Academy Press.

Draeger, J., del Prado Hill, P., Hunter, L. R. & Mahler, R. (2013). The anatomy of academic

rigor: The story of one institutional journey. *Innovative Higher Education, 38*(4), 267-

279. Retrieved from

http://content.ebscohost.com/ContentServer.asp?T=P&P=AN&K=88900751&S=R&D=a

ph&EbscoContent=dGJyMNHX8kSeprI4yOvsOLCmr06ep7NSrqy4SLOWxWXS&Cont

entCustomer=dGJyMPPk4Irn2u6MuePfgeyx44Dt6fIA

Doll, W. E. (1993). *A post-modern perspective on curriculum.* New York, NY: Teachers College

Press.

Doyle, W. (1983). Academic work. *Review of Educational Research, 53*(2), 159-199. Retrieved

from http://www.jstor.org.libproxy.bridgeport.edu/stable/pdf/1170383.pdf

Doyle, W. (1984). *Effective classroom practices for secondary schools* (R&D Report 6191).

Washington, DC: National Institute of Education. Retrieved from

http://files.eric.ed.gov/fulltext/ED261052.pdf

Doyle, W. & Carter, K. (1984). Academic tasks in classrooms. *Curriculum Inquiry, 14*(2), 129-

149. Retrieved from http://www.jstor.org/stable/3202177?seq=1&cid=pdf-

reference#references_tab_contents

Doyle, M., & Holm, D. T. (1998). Instructional planning through stories: Rethinking the

traditional lesson plan. *Teacher Education Quarterly, 25*(3), 69-83. Retrieved from

http://www.jstor.org.libproxy.bridgeport.edu/stable/pdf/23478094.pdf

DuFour, R., & Marzano, R. J. (2011). *Leaders of learning: How district, school, and classroom leaders improve student achievement* [Nook Reader version]. Retrieved from http://www.barnesandnoble.com/w/leaders-of-learning-richard-dufour/1102249271?ean=9781935542681

Duncan, H. E., Range, B., & Hvidston, D. (2012). Exploring student perceptions of rigor online: Towards a definition of rigorous learning. *Journal on Excellence in College Teaching.* Retrieved from http://www.academia.edu/2896800/Exploring_Student_Perceptions_of_Rigor_Online_Towards_a_Definition_of_Rigorous_Learning

Early, D. M., Rogge, R. D., & Deci, E. L. (2014). Engagement, alignment, and rigor as vital signs of high-quality instruction: A classroom visit protocol for instructional improvement and research. *The High School Journal, 97*(4), 219-239. doi: 10.1353/hsj.2014.0008

Edwards, A., Elwyn, G., Hood, K., & Rollnick, S. (1999). Judging the weight of evidence in systematic reviews: Introducing rigour into the qualitative overview stage by assessing signal and noise. *Journal of Evaluation in Clinical Practice, 6*(2), 177-184.

Ehrenberg, S. D. (1981). Concept learning: How to make it happen in the classroom. *Educational Leadership, 39*(1), 36-43. Retrieved from http://eds.b.ebscohost.com.libproxy.bridgeport.edu/ehost/pdfviewer/pdfviewer?vid=4&sid=f120ad3e-bbbc-4ea5-aac4-0e83265a8b3f%40sessionmgr107&hid=113

Erickson, H. L. (2002). *Concept-based curriculum and instruction: Teaching beyond the facts*. Thousand Oaks, CA: Corwin Press, Inc.

Erickson, H. L. & Lanning, L. A. (2014). *Transitioning to concept-based curriculum and*

instruction: How to bring content and process together. Thousand Oaks, CA: Corwin.

Finley, S. (2011). Critical arts-based inquiry: The pedagogy and performance of a radical ethical aesthetic. In Denzin, N. K., & Lincoln, Y. S. (Eds.). *Sage Handbook of Qualitative Research* (4th ed.) (435-450). Thousand Oaks, CA: Sage.

Fullan, M. (2014). *The principal: Three keys to maximizing impact.* San Francisco, CA: Jossey-Bass.

Garet, M. S., Porter, A. C., Desimone, L., Birman, B. F., & Yoon, K. S. (2001). What makes professional development effective? Results from a national sample of teachers. *American Education Research Journal, 38*(4), 915-945. Retrieved from http://www.imoberg.com/files/Unit_D_ch._24_--_Garet_et_al._article.pdf

Gaventa, J. & Cornwall, A. (2013). Power and knowledge. In P. Reason, & H. Bradbury (Eds.), *The sage handbook of action research: Participative inquiry and practice* (pp. 172-189). Thousand Oaks, CA: Sage Publications.

Given, B. K. (2002). *Teaching to the brain's natural learning systems.* Alexandria, VA: ASCD.

Glaser, R. (1990). The reemergence of learning theory within instructional research. *American Psychologist, 45*(1), 29-39. Retrieved from http://content.ebscohost.com.libproxy.bridgeport.edu/pdf29_30/pdf/ddd/pdh/1990/1990-15676-001.pdf?T=P&P=AN&K=1990-15676-001&S=L&D=pdh&EbscoContent=dGJyMNLe80SeqLQ4yOvsOLCmr0yep65Sr6m4SLOWxWXS&ContentCustomer=dGJyMPPk4Irn2u6MuePfgeyx44Dt6fIA

Good, T. L. & Brophy, J. E. (1990). *Educational psychology: A realistic approach.* (4th ed.). White Plains, NY: Longman

Graham, C., & Essex, C. (2001). *Defining and ensuring academic rigor in online and on-*

campus courses: Instructor perspectives. Paper presented at the 24th National Convention
of the Association for Educational Communications and Technology, Atlanta, GA.
Retrieved from http://www.eric.ed.gov/PDFS/ED470163.pdf

Grant, J., Nelson, G., & Mitchell, T. (2013). Negotiating the challenges of participatory action
research: Relationships, power, participation, change and credibility. In P. Reason, & H.
Bradbury (Eds.), *The sage handbook of action research: Participative inquiry and
practice* (pp. 589-601). Thousand Oaks, CA: Sage Publications.

Greene, J. C. & Hall, J. (2010). Dialectics and pragmatism: Being of consequence. In
Tashakkori, A., & Teddlie, C. (Eds.). *Handbook of mixed methods in social and
behavioral research (2nd ed.).* (pp. 119-143). Thousand Oaks, CA: Sage.

Gredler, M. E. (1992). *Learning and instruction: Theory into practice* (2nd ed.). New York, NY:
Macmillan Publishing Company.

Hans, B. & Matts, S. (2005). Political entrepreneurship in action research: Learning from two
cases. *Journal of Organizational Change Management, 18*(5), 399-415. doi:
10.1108/09534810510614913

Hattie, J. A. C. (2009). *Visible learning: A synthesis of over 800 meta-analyses relating to
achievement* [Nook Reader version]. Retrieved from
http://www.barnesandnoble.com/w/visible-learning-john-
hattie/1100516167?ean=9781134024117

Hendricks, C. (2013). *Improving schools through action research: A reflexive practice approach*
(3rd ed.). Upper Saddle River, NJ: Pearson.

Herr, K. & Anderson, G. L. (2015). The action research dissertation: A guide for students and
faculty (2nd. Ed.). Thousand Oaks, CA: Sage Publications.

Hess, K. K., Carlock, D., Jones, B., & Walkup, J. R. (2009). *What exactly do "fewer, clearer, and higher standards" really look like in the classroom? Using a cognitive rigor Matrix to analyze curriculum, plan lessons, and implement assessments.* Paper presented at CCSSO, Detroit, MI. Retrieved from http://www.nciea.org/publication_PDFs/DOK_ApplyingWebb_KH08.pdf

Hess, K. K. (2013). *Cognitive Rigor Matrix (Reading CRM): Applying Webb's depth-of-knowledge levels to Bloom's cognitive process dimensions*. Retrieved from http://media.wix.com/ugd/5e86bd_f8856db71d39479698be466ac9443d75.pdf

Hess, K. K. (2013). *Hess cognitive rigor matrix. Linking research with practice: A local assessment toolkit to guide school leaders.* Retrieved from http://media.wix.com/ugd/5e86bd_f8856db71d39479698be466ac9443d75.pdf

Hess, K. & Gong, B. (2014). *Ready for college and career? Achieving the common core standards and beyond through deeper, student-centered learning*. Quincy, MA: Nellie Mae Educational Foundation. Retrieved from http://media.wix.com/ugd/5e86bd_4ce347d9d57f437787089cd057e50d18.pdf

Holian, R. & Coghlan, D.A. (2013). Ethical issues and role duality in insider action research: Challenges for action research degree programmes. *Systematic Practice and Action Research, 26*(5), 399-415. Retrieved from http://content.ebscohost.com/ContentServer.asp?T=P&P=AN&K=89980590&S=R&D=mfi&EbscoContent=dGJyMNHr7ESeprM4yOvsOLCmr06eprVSsam4S7SWxWXS&ContentCustomer=dGJyMPPk4Irn2u6MuePfgeyx44Dt6fIA

Hoy, W. K., & Hannum, J. W. (1997). Middle School Climate: An Empirical Assessment of Organizational Health and Student Achievement. *Educational Administration Quarterly,*

33(3), 290-311. doi: 10.1177/0013161X97033003003

Hoy, W. K., & Miskel, C. G. (2001). *Educational Administration: Theory, Research, and Practice* (6th ed.). Boston: McGraw Hill.

IowaCORE (n.d.). *Literature review: Rigorous and relevant curriculum.* Retrieved from http://www.gwaea.org/iowacorecurriculum/docs/RigorAndRelevance_LitReview.pdf

Jackson, R. R. (2011). *How to plan rigorous instruction.* Pdf. (ebook). Virginia: ASCD.

Jacobs, J. & Colvin, R. L. (2009, June). *Rigor: It's all the rage, but what does it mean?* (A Hechinger Institute Primer for Journalists). The Hechinger Institute on Education and The Media. New York, NY: Teacher's College, Columbia University. Retrieved from http://hechinger.tc.columbia.edu/primers/Hechinger_Institute_Rigor_Primer.pdf

James, E. A., Milenkiewicz, M. T., & Bucknam, A. (2008). *Participatory action research for educational leadership: Using data-driven decision making to improve schools.* Thousand Oaks, CA: Sage Publications.

Jensen, E. (2006). *Enriching the brain: How to maximize every learner's potential.* San Francisco, CA: Jossey-Bass

Joftus, S., & Berman, I. (1998). Great expectations? Defining and assessing rigor in state standards for mathematics and English language arts. *Council for Basic Education,* Washington, DC. Retrieved from http://www.eric.ed.gov/PDFS/ED416080.pdf

Johnson, L. (2010). *Improving rigor and engagement through communities of practice* (Order No. 3407135). Available from ProQuest Dissertations & Theses A&I. (305185339). Retrieved from http://search.proquest.com/docview/305185339?accountid=26484

Jolly, J. (2008). *Understanding and designing rigorous learning experiences.* Presentation. Retrieved from http://www.aaegt.net.au/Conference2008/PowerPoints/Jolly.pdf

Junker, B., Weisberg, Y., Matsumura, L. C., Crosson, A., Wolf, M. K., Levison, A., & Resnick,

L. (2008). Overview of the instructional quality assessment (CSE Technical Report 671).

Retrieved from University of California, Los Angeles:

https://www.cse.ucla.edu/products/reports/r671.pdf

Kelle, U. (2007). The development of categories: different approaches in grounded theory. In

Bryant, A., & Charmaz, K. (Eds.). The sage handbook of grounded theory. (pp. 191-213).

Thousand Oaks, CA: Sage.

Kenneally, A. (2013, June). The lived experience of insider action research in a local government

setting. In *Proceedings of the 3rd National Local Government Researcher Forum*.

Adelaide, South Australia. Retrieved from

https://epress.lib.uts.edu.au/conferences/index.php/acelg/PNLGRF/paper/viewFile/479/8

3

Kerr, S. T. (1981). How teachers design their materials: Implications for instructional design.

*Instructional Science, 10(*4), 363-378. Retrieved from

http://www.jstor.org.libproxy.bridgeport.edu/stable/pdf/23368250.pdf?_=146536330091

6

Kubiszyn & Borich, (2010) *Educational Testing and Measurement: Classroom Application and

Practice* (9th ed). Hoboken, NJ: Wiley.

Kvale, S. & Brinkmann, S. (2009). *Interviews: Learning the craft of qualitative research

interviewing* (2nd ed.). Thousand Oaks, CA: Sage Publications.

Lapan, S. D. (2012). Practitioner action research. In S. D. Lapan, M. T. Quartaroli, & F. J.

Riemer (Eds.), *Qualitative research: An introduction to methods and designs* (pp. 271-

290). San Francisco, CA: Jossey-Bass.

Lee, V. E., Smith, J. B., Perry, T. E., & Smylie, M. A. (1999). *Social Support, Academic Press, and Student Achievement: A View from the Middle Grades in Chicago. Improving Chicago's Schools. A Report of the Chicago Annenberg Research Project.* Chicago, IL: Consortium on Chicago School Research. Retrieved from https://consortium.uchicago.edu/sites/default/files/publications/p0e01.pdf

Lincoln, Y. S., Lynham, S. A., & Guba, E. G. (2011). Paradigmatic controversies, contradictions, and emerging confluences, revisited. In Denzin, N. K., & Lincoln, Y. S (Ed.), *The sage handbook of qualitative research* (4th ed., pp. 97-128). London: Sage.

Manthey, G. (2005). Moving towards cognitive alignment. *Leadership, 35*(2), 14-16. Retrieved From http://content.ebscohost.com.libproxy.bridgeport.edu/pdf17_20/pdf/2005/EEO/01Nov05/19051815.pdf?T=P&P=AN&K=19051815&S=R&D=aph&EbscoContent=dGJyMNHX8kSeqLQ4v%2BbwOLCmr0yep69SsK%2B4TLGWxWXS&ContentCustomer=dGJyMPPk4Irn2u6MuePfgeyx44Dt6fIA

Marlowe, B. A. & Page, M. L. (1998). *Creating and sustaining the constructivist classroom*. Thousand Oaks, CA: Corwin Press, Inc.

Marshall, C. & Rossman, G. B. (2010). *Designing qualitative research* (5th ed.). Thousand Oaks, CA: Sage Publications

Marshall, J. C., & Smart, J. B. (2013). Teachers' transformation to inquiry-based instructional practice. *Creative Education*. *4*(2), 132-142. Retrieved from http://www.google.com/#hl=en&tbo=d&sclient=psy-ab&q=promoting+inquiry-based+instructional+practice&oq=promoting+inquiry+based+&gs_l=hp.1.1.0i30l4.149205.153602.6.165218.24.18.0.6.6.0.238.1682.13j3j2.18.0.les%3B..0.0...1c.1.3.psy-

ab.oRM4PrXCYIw&pbx=1&bav=on.2,or.r_gc.r_pw.r_qf.&bvm=bv.42553238,d.dmg&f
p=172d09efa7c3f5c7&biw=1206&bih=647

Marzano, R. J., Pickering, D. J., & Pollock, J. E. (2001). *Classroom instruction that works:
Research-based strategies for increasing student achievement.* Alexandria, VA: ASCD.

Marzano, R. (2003). *What works in schools: Translating research into practice*. Alexandria, VA:
ASCD

Marzano, R., Waters, T., & McNulty, B. A. (2005). *School leadership that works: From
research to results.* Alexandria, VA: ASCD.

Marzano, R. J. (2007). *The art and science of teaching: A comprehensive framework for
effective instruction.* Alexandria, VA: ASCD.

Marzano, R. J. (2009). Designing & teaching learning goals & objectives. Indiana: The
Classroom Strategies Series.

Marzano, R. J. (2011). *The Marzano teacher evaluation model*. Retrieved from
http://pages.solution-tree.com/rs/solutiontree/images/MarzanoTeacherEvaluationModel.pdf

Marzano, R. J. & Toth, M. D. (2014). *Teaching for Rigor: A Call for a Critical Instructional
Shift.* http://www.marzanocenter.com/essentials/

Maxwell, J. A. (2013). Qualitative research design: An interactive approach. (3rd ed.).
Washington, DC: Sage.

Maye, D. (2013). Hitting the Mark: Strategic Planning for Academic Rigor. *Delta Kappa
Gamma Bulletin, 79*(4), 29-36. Retrieved from
http://content.ebscohost.com.libproxy.bridgeport.edu/pdf29_30/pdf/2013/H46/01Jun13/8
8216772.pdf?T=P&P=AN&K=88216772&S=R&D=aph&EbscoContent=dGJyMMvl7E

Sep644xNvgOLCmr0yeqLBSsq24SbWWxWXS&ContentCustomer=dGJyMPPk4Irn2u6 MuePfgeyx44Dt6fIA

Mayer, R. (1992). Cognition and instruction: The historic meeting within educational psychology. *Journal of Educational Psychology, 84*(4), 405-412. doi:10.1037/0022-0663.84.4.405

Mayer, R. (2004). Should there be a three-strikes rule against pure discovery learning? *American Psychologist, 59*(1), 14-19. Retrieved from http://projects.ict.usc.edu/itw/gel/MayerThreeStrikesAP04.pdf

Mayer, R. (2011). *Applying the science of learning.* Boston, MA: Pearson Education, Inc.

McIntyre, A. (2008). *Participatory action research: Qualitative research methods series 52.* Thousand Oaks, CA: Sage Publications.

Mertens, D. M.. (2012). Ethics in qualitative research in education and the social sciences. In Lapan, S. D., Quartaroli, M. T., & Riemer, F. J. (Eds.). *Qualitative research: An introduction to methods and designs* (pp. 19-39). San Francisco, CA: Jossey-Bass.

Mertler, C. A. (2012). *Action research: Improving schools and empowering educators* (3rd ed.). Thousand Oaks, CA: Sage Publications

Merrill, D. M. (2001). First principles of instruction. *Journal of Structural Learning & Intelligent Systems, 14*(4), 459-466. Retrieved from http://content.ebscohost.com.libproxy.bridgeport.edu/ContentServer.asp?T=P&P=AN&K =5887901&S=R&D=aph&EbscoContent=dGJyMMTo50Sep7U4v%2BbwOLCmr02epq 5Sr624SK%2BWxWXS&ContentCustomer=dGJyMPPk4Irn2u6MuePfgeyx44Dt6fIA

Merrill, D. M. (2007). A task-centered instructional strategy. *Journal of Research on Technology*

in Education, 40(1), 5-22. Retrieved from

http://content.ebscohost.com.libproxy.bridgeport.edu/ContentServer.asp?T=P&P=AN&K

=26702141&S=R&D=aph&EbscoContent=dGJyMMTo50Sep7U4v%2BbwOLCmr02epr

dSrqq4SbWWxWXS&ContentCustomer=dGJyMPPk4Irn2u6MuePfgeyx44Dt6fIA

McNulty, R. J. & Quaglia, R. J. (2007). Rigor, relevance and relationships: Three passwords that

unlock the door for engaged high school students to learn at appropriate levels. *The

School Administrator,* 64(8), 18-24. Retrieved from

http://www.lvbep.org/Portals/0/McNulty%20aasa%20feb%2009.pdf

Miller, G. & Shih, C. C. (1999). A faculty assessment of the academic rigor of on- and off-

campus courses in agriculture. *Journal of Agricultural Education, 40*(1), 57-65. Retrieved

from http://pubs.aged.tamu.edu/jae/pdf/vol40/40-01-57.pdf?origin=publication_detail

Mills, G. E. (2013). *Action research: A guide for the teacher researcher* (5th ed.). Boston, MA:

Pearson Education, Inc.

Mitchell, K., Shkolnik, J., Song, M., Uekawa, K., Murphy, R., Garet, M., & Means, B. (2005).

*Rigor, relevance, and results: The quality of teacher assignments and student work in

conventional high schools*. Washington, DC: American Institutes for Research. Retrieved

from https://docs.gatesfoundation.org/Documents/Rigor%20Rpt%2010_21.pdf

Murphy, J. F., Weil, M., Hallinger, P., Mitman, A. (1982). Academic press: Translating high

expectations into school policies and classroom practices. *Educational Leadership,

(40*(3), 22-26. Retrieved from

http://content.ebscohost.com.libproxy.bridgeport.edu/pdf9/pdf/1982/EDL/01Dec82/8518

453.pdf?T=P&P=AN&K=8518453&S=R&D=aph&EbscoContent=dGJyMNLr40SeqLI4

yOvqOLCmr0qep7VSsK64Ta6WxWXS&ContentCustomer=dGJyMPPk4Irn2u6MuePfg

eyx44Dt6fIA

National School Alliance (2006). *Defining rigor in high school: Framework and assessment tool.*

Washington, DC: Institute for Educational Leadership. Retrieved from

http://www.txechs.com/downloads/55_rigorframeworktool.pdf

No Child Left Behind Act of 2001, Pub. L. No. 107-110, 20 U.S.C. § 6301, 115 Stat. 1425

(2002). Retrieved from http://www2.ed.gov/policy/elsec/leg/esea02/107-110.pdf

Neuman, L. W. (2006). *Social research methods: Qualitative and quantitative approaches.*

(6th ed.). Boston, MA: Pearson.

Newmann, F. M., King, M. B., & Carmichael, D. L. (2009). Authentic intellectual work:

Common standards for teaching social studies. *Social Education, 73*(1), 43-49. Retrieved

from http://www.aea11.k12.ia.us/educators/AIW/documents/AIW_Standards_SS.pdf

Onwuegbuzie, A. J., & Collins, K. M. T. (2007). A typology of mixed methods sampling designs

in social science research. *The Qualitative Report, 12*(2), 281-316. Retrieved from

http://blackboard.bridgeport.edu/webapps/portal/frameset.jsp?tab_id=_2_1&url=%2fweb

apps%2fblackboard%2fexecute%2flauncher%3ftype%3dCourse%26id%3d_21686_1%2

6url%3d

Onwuegbuzie, A. J., & Combs, J. P. (2010). Emergent data analysis techniques in mixed

methods research. In Tashakkori, A., & Teddlie, C. (Eds.). *Sage Handbook of Mixed*

Methods in Social & Behavioral Research (2nd ed.) (397-430). Thousand Oaks, CA:

Sage.

Paige, D. D., Sizemore, J. M., & Neace, W. P. (2013). Working inside the box: Exploring the

relationship between student engagement and cognitive rigor. *NASSP Bulletin, 97*(2), 105-123. Retrieved from http://bul.sagepub.com/content/97/2/105.full.pdf+html

Pathways to College Network (n.d.). *Academic rigor.* Retrieved from http://www.pathwaystocollege.net/pdf/rigor.pdf

Patton, M. Q. (2002). *Qualitative research & evaluation methods* (3rd ed.). Thousand Oaks, CA: Sage Publications.

Peterson, P. L., Marx, R. W., & Clark, C. M. (1978). Teacher planning, teacher behavior, and student achievement. *American Educational Research Journal, 15*(3), 417-432. Retrieved from http://www.jstor.org.libproxy.bridgeport.edu/stable/pdf/1162495.pdf

Porter, A., McMaken, J., Hwang, J., & Yang, R. (2011). Common core standards: The new U.S. intended curriculum. *Educational Researcher, 40*(3), 103-116. doi:10.3102/0013189X11405038

Putnam, R. T. & Borko, H. (2000). What do new views of knowledge and thinking have to say about research on teacher learning? *Educational Researcher, 29*(1), 4-15. Retrieved from http://edu312spring13.pbworks.com/w/file/fetch/64649998/Borko%26Putnam.pdf

Quint, J., Thompson, S. L., & Bald, M. (2008). Relationships, rigor, and readiness: Strategies for improving high schools. *MDRC.* Retrieved from http://www.mdrc.org/sites/default/files/Relationships%20Rigor%20and%20Readiness.pdf

Rainwater, T. & Finnigan, A. (2008). *No longer at risk: A nation in peril.* Summary of Proceedings from the State Scholars Initiative National Summit on Academic Rigor and Relevance. Retrieved from http://www.wiche.edu/info/publications/SSI/summitProceedings.pdf

Rainwater, T., Mize, D. A., & Smith Brooks, N. S. (2008). *Education beyond the rhetoric: Making rigor something real.* Paper presented at the State Scholars Initiative National Summit on Academic Rigor and Relevance. Retrieved from http://www.wiche.edu/info/publications/SSI/EducationBeyondTheRhetoric.pdf

Raphael, L. M., Pressley, M., & Mohan, L. (2008). Engaging instruction in middle school classrooms: An observational study of nine teachers. *The Elementary School Journal, 109*(1), 61-81. doi: 10901-0004$10.00. Retrieved from http://www.nsrfharmony.org/pipermail/nsrfcoaches/attachments/20081210/ae84d625/attachment-0001.pdf

Raudenbush, S. W., Rowan, B., & Cheong, Y. F. (1993). Higher order instructional goals in secondary schools: Class, teacher, and school influences. *American Education Research Journal, 30*(3), 523-553. Retrieved from http://www.stanford.edu/group/suse-crc/cgi-bin/drupal/sites/default/files/higher-order.pdf

Reich, G. A., Sevim, V., & Turner, A. B. (2013). Academic rigor for all: A review of the literature. *Metropolitan Educational Research Consortium*. Virginia Commonwealth University. Retrieved from http://wp.vcu.edu/merc/files/2013/10/Reich-Academic-Rigor-for-All-Review-2-17-13.pdf

Ritchart, R., Church, M., & Morrison, K. (2011). *Making thinking visible: How to promote engagement, understanding, and independence for all learners.* San Francisco, CA: Jossey-Bass.

Saldaña, J. (2013). *The coding manual for qualitative researchers* (2nd ed.). Los Angeles, CA: Sage.

Salkind, N. J., (2011). *Statistics for people who think they hate statistics* (4th ed.). Thousand

Oaks, CA: Sage.

Savitz-Romer, M., Jager-Hyman, J., & Coles, A. (2009). *Removing roadblocks to rigor: Linking academic and social supports to ensure college readiness and success.* Washington, DC: Pathways to College Network, Institute for Higher Education Policy. Retrieved from http://www.pathwaystocollege.net/uploadedFiles /Pathways_To_ College_Network/About_Us/Pathways_Publicati ons/Roadblocks.pdf

Scheerens, J., & Bosker, R. (1997). *The Foundations of Educational Effectiveness* (Vol. 1). New York, NY: Elsevier Science Inc.

Shani, A. B. (Rami), & Coghlan, D. (2014). Action and collaboration between scholarship and practice: Core values of OD research. *OD Practitioner, 46*(4), 35-38.

Shavelson, R. J., & Stern, P. (1981). Research on teachers' pedagogical thoughts, judgments, decisions, and behavior. *Review of Educational Research, 51*(4), 455-498. Retrieved from http://www.jstor.org.libproxy.bridgeport.edu/stable/1170362?Search=yes&resultItemClic k=true&searchText=research&searchText=on&searchText=teachers'&searchText=pedag ogical&searchText=thoughts&searchUri=%2Faction%2FdoBasicSearch%3FQuery%3Dr esearch%2Bon%2Bteachers%2527%2Bpedagogical%2Bthoughts%26amp%3Bacc%3Do n%26amp%3Bwc%3Don%26amp%3Bfc%3Doff%26amp%3Bgroup%3Dnone&seq=1#p age_scan_tab_contents

Shouse, R. C. (1996). Academic Press and Sense of Community: Conflict, Congruence, and Implications for Student Achievement. *Social Psychology of Education, 1*(1), 47-68. Retrieved from http://files.eric.ed.gov/fulltext/ED387868.pdf

Souse, D. A. (2006). *How the brain learns* (3rd ed.). Thousand Oaks, CA: Corwin Press.

Snider, J. (2009, June). *Two governors explain what they mean by rigor.*

(A Hechinger Institute Primer for Journalists). The Hechinger Institute on Education and

The Media. New York, NY: Teacher's College, Columbia University. Retrieved from

http://hechinger.tc.columbia.edu/primers/Hechinger_Institute_Rigor_Primer.pdf

Stake, R. E. (2010). *Qualitative research: Studying how things work* [Nook Reader version].

Retrieved from http://www.barnesandnoble.com/w/qualitative-research-robert-e-

stake/1101462077?ean=9781606235478

Stone, J. R., Alfeld, C., Pearson, D. (2008). Rigor and relevance: Enhancing high school

students' math skills through career and technical education. *American Education*

Research Journal, 45(3), 767-795. Retrieved from

http://www.jstor.org.libproxy.bridgeport.edu/stable/27667150

Taba, H. (1966). Teaching *strategies and cognitive functioning in elementary school children*.

San Francisco, CA: San Francisco State College. Retrieved from

http://files.eric.ed.gov/fulltext/ED025448.pdf

The Goals 2000: Educate America Act of 1994, Pub. L. No. 103-227 (1994). Retrieved from

http://www.gpo.gov/fdsys/pkg/BILLS-103hr1804enr/pdf/BILLS-103hr1804enr.pdf

The National Commission on Excellence in Education (1983). *A nation at risk: The imperative*

for educational reform. Washington, D.C.: U.S. Department of Education. Retrieved

from http://datacenter.spps.org/uploads/sotw_a_nation_at_risk_1983.pdf

Thompson, M, & Goe, L. (2009). *Models for effective and scalable teacher professional*

development (ETS Research Report No. 09-07). Educational testing Service. Retrieved

from http://www.ets.org/Media/Research/pdf/RR-09-07.pdf

Thornberg, R., & Charmaz, K. (2012). Grounded theory. In Lapan, S. D., Quartaroli, M. T., &

Riemer, F. J. (Eds.). *Qualitative research: An introduction to methods and designs* (pp. 41-67). San Francisco, CA: Jossey-Bass.

Tuckett, A. G. (2005). Part II. Rigour in qualitative research: Complexities and solutions. *Researcher, 13*(1), 29-42.

Tucker, P. D. & Stronge, J. H. (2005). *Linking teacher evaluation and student learning*. Alexandria, VA: ASCD

U. S. Department of Education, National Center for Educational Statistics (2012). *Digest of Education Statistics, 2011* (NCES 2012-001), Introduction and Chapter 2 ; U.S. Department of Education, National Center for Education Statistics, Schools and Staffing Survey, Teacher Data Files, 2007–08. Retrieved from http://nces.ed.gov/fastfacts/display.asp?id=28

U.S. Department of Education. (2010). *ESEA blueprint for reform.* Washington, D.C.: Office of Planning, Evaluation and Policy Development Retrieved from http://www2.ed.gov/policy/elsec/leg/blueprint/blueprint.pdf

Wagner, T. (2006). Rigor on trial. *Education Week, 25*(18), 28-29.

Wagner, T. (2008a). *The global achievement gap*. New York, NY: Basic Books.

Wagner, T. (2008b). Rigor redefined. *Educational Leadership.* ASCD. *66*(2). pp. 20-24.

Washor, E. & Mojkowski, C. (2007). What do you mean by rigor? *Educational Leadership, 64*(4), 84-87. Retrieved from http://content.ebscohost.com.libproxy.bridgeport.edu/ContentServer.asp?T=P&P=AN&K=23453045&S=R&D=aph&EbscoContent=dGJyMNLe80SeqLQ4yOvsOLCmr0yep65Srq%2B4TLeWxWXS&ContentCustomer=dGJyMPPk4Irn2u6MuePfgeyx44Dt6fIA

Webb, N. (March 28, 2002). *Depth of knowledge levels for four content areas.* Unpublished

paper. Retrieved from

http://facstaff.wcer.wisc.edu/normw/All%20content%20areas%20%20DOK%20levels%2032802.doc

Weiss, R. S. (1994). *Learning from strangers: The art and method of qualitative interview studies.* New York, NY: The Free Press.

Weiss, I. R., & Pasley, J. D. (March, 2006). *Scaling up instructional improvement through teacher professional development: Insights from the local systemic change initiative* (CPRE Policy Brief No. RB-44). Pennsylvania, PA: Consortium for Policy Research in Education. Retrieved from

http://www.cpre.org/sites/default/files/policybrief/884_rb44.pdf

Wiggins, G., & McTighe, J. (2005). *Understanding by design* (2nd ed.). Alexandria, VA: ASCD.

Williamson, R., & Blackburn, B. (2012). *School leadership strategies for classroom rigor*. Larchmont, NY: Eye On Education.

Willen, L., & Snider, J. (2009, June). *Understanding the neuroscience of rigorous learning.* (A Hechinger Institute Primer for Journalists). The Hechinger Institute on Education and The Media. New York, NY: Teacher's College, Columbia University. Retrieved from

http://hechinger.tc.columbia.edu/primers/Hechinger_Institute_Rigor_Primer.pdf

Williander, M. & Styhre, A. (2006). Going green from the inside: Insider action research at the Volvo car corporation. *Systemic Practice and Action Research, 19*(3), 239-252. doi: 10.1007/s11213-006-9015-7.

Wraga, W. G. (2011). What's the problem with a "rigorous academic curriculum"?: Setting new terms for students' school experiences. *The Clearing House,* (84), 59-64. doi: 10.1080/00098655.2010.511307

Wolf, M. K, Crosson, A. C., & Resnick, L. B. (2005). Classroom talk for rigorous reading

    comprehension instruction. *Reading Psychology, 31,* 27-53. Retrieved from

    http://web.ebscohost.com.libproxy.bridgeport.edu/ehost/pdfviewer/pdfviewer?vid=3&hid

    =17&sid=f7e98b03-d427-4462-9f06-1e5b9dbec1b2%40sessionmgr12. doi:

    10.1080/02702710490897518

Wolfe, P. (2001). *Brain matters: Translating research into classroom practice.* Alexandria, VA:

    ASCD.

Woolfolk, A. E. (2009). *Educational psychology* (11th ed.). Upper Saddle River, NJ: Prentice

    Hall.

Wyatt, G., Saunders, D., & Zelmer, D. (2005). Academic preparation, effort and success.: A

    comparison of student and faculty perceptions. *Educational Research Quarterly, 29*(2),

    29-36. Retrieved from http://files.eric.ed.gov/fulltext/EJ739388.pdf

Wyatt, J. F., Wiley, A., Camara, W. J., & Proestler, N. (2012)*. The development of an index of*

    academic rigor for college readiness. (College Board Research Report No. 2011-11).

    New York: The College Board. Retrieved from

    http://research.collegeboard.org/sites/default/files/publications/2012/7/researchreport-

    2011-11-development-index-academic-rigor-college-success.pdf

Yilmaz, K. (2011). The cognitive perspective on learning: Its theoretical underpinnings and

    implications for classroom practices. *The Clearing House: A Journal of Educational*

    Strategies, Issues and Ideas, 84(5), 204-212. doi:10.1080/00098655.2011.568989

Yin, R. K. (2009). *Case study research: Design and methods.* (4th ed., pp. 1-57). Thousand Oaks,

    CA: Sage.

Yinger, R. (1979). Routines in teacher planning. *Theory into Practice, 18*(3), 163-169. Retrieved

from

http://www.jstor.org.libproxy.bridgeport.edu/stable/pdf/1475420.pdf?_=1465363200066

Yinger, R. (1980). A study of teacher planning. *The Elementary School Journal, 80*(3), 107-127.

Retrieved from http://www.jstor.org.libproxy.bridgeport.edu/stable/pdf/1001636.pdf

Zoo, H. D. & Hill, J. W. (2013). Relevance, Rigor, and Relationships: Student Perceptions

Following Participation in an Integrated Experiential Zoo-Based Academic High School

Science Program. *Educational Leadership Faculty Publications, 4*(4), 287-297. Paper 18.

Retrieved from

http://digitalcommons.unomaha.edu/cgi/viewcontent.cgi?article=1019&context=edadfacp
ub&seiredir=1&referer=http%3A%2F%2Fwww.google.com%2Furl%3Fsa%3Dt%26rct
%3Dj%26q%3Dexploring%2520student%2520perceptions%2520of%2520rigor%2520on
line%26source%3Dweb%26cd%3D42%26ved%3D0CCYQFjABOChqFQoTCL7vmN7p
2sYCFceqHgodvScIyw%26url%3Dhttp%253A%252F%252Fdigitalcommons.unomaha.e
du%252Fcgi%252Fviewcontent.cgi%253Farticle%253D1019%2526context%253Dedadf
acpub%26ei%3D0hulVb6-
FMfVer3PoNgM%26usg%3DAFQjCNGx1G5lWtjtncBSl8LGdqUDh4Shnw%26bvm%3
Dbv.97653015%2Cd.dmo#search=%22exploring%20student%20perceptions%20rigor%
20online%22

Appendix A

INITIAL CONTACT E-MAIL TO DISTRICT CENTRAL OFFICE GATEKEEPERS

August 2015

RE: Dissertation research

Dear Superintendent/Assistant Superintendent/Director of Secondary Education:

For the last three years, I have been excited about the work that our district has engaged in that has centered on the instructional core, and I have been especially delighted to be part of such an emphasis. And it is this excitement that drives my intrinsic enthusiasm and eagerness to study teachers' perspectives on and their development of academic rigor—how they describe it and their observed and reported use of it in lesson planning, instruction and assessment.

For my dissertation research, I would greatly appreciate your support in conducting an action research study that stems from a willingness to support the district's efforts in furthering the work you have pioneered. As such, I plan to collect data using volunteer participant semi-structured interviews in which to explore middle school teachers' understanding of academic or instructional rigor. Additionally, and with volunteer teachers, I will develop an intervention to increase the teachers' understanding of rigor and as well as their capacity to implement greater rigor in their instructional practice (planning, classroom instruction and assessment).

To ensure that this research does not interfere with the district's efforts to educate students nor interfere with the morale of the district's staff, the data and findings will be confidential, and all identities will remain undisclosed.

Thus, I am hoping that you would graciously grant me permission to support this district through this study. For additional specific information, please refer to an overview of the study *Participant Information Guidelines & Consent*, attached.

Yours Sincerely,

Ian M. Banner

Appendix B

INITIAL CONTACT E-MAIL TO BUILDING PRINCIPAL

August 2015

RE: Dissertation research

Dear Superintendent/Assistant Superintendent/Director of Secondary Education:

For the last three years, I have been excited about the work that our district has engaged in that has centered on the instructional core, and I have been especially delighted to be part of such an emphasis. And it is this excitement that drives my intrinsic enthusiasm and eagerness to study teachers' perspectives on and their development of academic rigor—how they describe it and their observed and reported use of it in lesson planning, instruction and assessment.

For my dissertation research, I would greatly appreciate your support in conducting an action research study that stems from a willingness to support the district's efforts in furthering the work you have pioneered. As such, I plan to collect data using volunteer participant semi-structured interviews in which to explore middle school teachers' understanding of academic or instructional rigor. Additionally, and with volunteer teachers, I will develop an intervention to increase the teachers' understanding of rigor and as well as their capacity to implement greater rigor in their instructional practice (planning, classroom instruction and assessment).

To ensure that this research does not interfere with the district's efforts to educate students nor interfere with the morale of the district's staff, the data and findings will be confidential, and all identities will remain undisclosed.

Thus, I am hoping that you would graciously grant me permission to support this district through this study. For additional specific information, please refer to an overview of the study *Participant Information Guidelines & Consent*, attached.

Yours Sincerely,

Ian M. Banner

Appendix C

INTERVIEW CONTACT E-MAIL TO SELECTED PARTICIPANTS

August 2015

RE: Dissertation research

Dear Colleague:

As part of my doctoral studies at the University of Bridgeport under the direction and guidance of Dr. Tom Christ, I am conducting my dissertation, which is an action research study that will explore how public middle school academic teachers (language arts, math, social studies or science teachers in grades six, seven or eight) perceive academic rigor, and how they implement it in lesson design and instruction. It will also support and develop the implementation of components of academic (or instructional) rigor into the instructional practice (lesson planning, instruction and assessment) of four to six volunteer teachers.

I am hoping that you, as selected member of our profession, will permit me your insight into this concept, and, therefore, would graciously participate as an accomplice in this study. This will include responding to semi-structured questions that permit you the liberty to elaborate as much as you see fit, and to discuss and review previous lesson plans that you have created as part of your daily planning that may support your responses. It will also require (if you so choose) you participating as an interventionist teacher (refer to *Two Levels of Involvement in This Research Study*) for specific details. Please note that your participation is strictly voluntary.

During and following this process, your identity will not be disclosed. However, I will be taping the interviews so that I can transcribe it to determine an insider perspective on academic rigor and its use. Also, selected building colleagues (the principal, myself, the math coach and the language arts coach) will observe some of your classes, and will be bound by confidentiality.

Should you need to contact me, my email is: Ibanner@my.bridgeport.edu

If you so kindly agree to participate, allow me to thank you for offering your time and insights in advance. For additional specific information, please refer to an overview of the study *Participant Information Guidelines & Consent*, attached.

Yours Sincerely,

Ian M. Banner

ACTION RESEARCH DISSERTATION

August 2015

Dear Volunteer,

I am very excited about our school's focus this year on enhancing rigor, and it is this excitement that drives my eagerness to request your involvement as a member of this study. In volunteering your time and energy, we would first explore and understand your perceptions of academic rigor, and second, we would collaborate to develop an instructional emphasis that aims to increase rigor in your classroom that would align with the district's curriculum. The overall purpose of this study is to promote a greater understanding and possible use of academic rigor as defined by the most current research and literature on this topic.

Permission to conduct this research has been granted by the district and our principal, and the details of this research is outlined below (refer to *Participant Information Guidelines & Consent*). The research will consist of interviews that will be conducted outside of the school day, and may be on-site, and at your convenience and comfort. Beyond the interviews (cycle one of the study), the following cycles, however, will be a focus on developing aspects of rigor as part of your daily instruction that will encourage greater use of the aspects outlined in the literature on academic rigor and the Marzano framework, mainly Design Question 4.

Furthermore, to ensure that this research does not interfere with the district's efforts to educate students nor interfere with the morale of the district's staff, the data and findings will be confidential, and all identities of the participants will remain undisclosed to others beyond those involved. Participation in this study also will not be in any way related to teacher evaluation requirements, even though classroom observations and professional meetings are involved. The work within the study is non-evaluative and purely for the sake of professional growth and development.

I truly hope that you will offer your support of this dissertation research, and if you have any questions after reading the following pages, please do not hesitate to forward them.

After you have read all of this information, I hope to obtain your signed support and consent (refer to page 5 of this document). If you agree to support, all you will need to do is sign it and send it back to me. Again, I thank you so much in advance for your consideration of this endeavor.

Yours Sincerely,

Ian M. Banner
Doctoral student

Appendix D

PARTICIPANT INFORMATION GUIDELINES & CONSENT

Refer to **Appendix C: Interview Contact E-mail to Selected Participants** of HRP-503 Template Protocol

Title of research	
	Teachers' Perspectives on and Their Development of Academic Rigor: An Action Research
Investigator	
	Ian M. Banner
Rationale	
	No study to date has drawn on the array of definitions of academic or instructional rigor to establish an encompassing definition that can be used to improve teachers' capacity to understand and use it. We also know little about how teachers actually define and use instructional rigor, especially teachers in suburban middle school. Additionally, no study has involved middle-level public school teachers in examining and exploring rigor in order to develop their understanding and use of it when planning for, instructing, and assessing student learning. Additionally, no study to date has devised and implemented a specific teacher-learning approach that has focused on increasing the rigor of their instructional practice in the teacher's natural context.
	Therefore, we invite you to take part in a research study because you are a 6-8 grade academic teacher in this school, which has placed a school-wide emphasis on increasing academic rigor, which aligns with the district's previously communicated goal.
1. What you should know about this research study	
	a. Someone will explain this research study to you
	b. You volunteer to be in a research study
	c. Whether or not you take part is up to you
	d. You can choose not to take part in the research study
	e. You can agree to take part now and later change your mind
	f. Whatever you decide it will not be held against you
	g. Feel free to ask all the questions you want before you decide
2. Who can I talk to?	
	If you have questions, concerns, or complaints, or think the research has hurt you, talk to the research investigator at *(203) 218-8086 or Ibanner@my.bridgeport.edu*
3. Approval	
	This research has been reviewed and approved by an Institutional Review Board. You may talk to the IRB Administrator at (203) 576-4937 or irb@bridgeport.edu or any of the following if:
	a. Your questions, concerns, or complaints are not being answered by the research team
	b. You cannot reach the research team
	c. You want to talk to someone besides the research team
	d. You have questions about your rights as a research subject

	e. You want to get information or provide input about this research
4. What is the purpose of this research?	
	The purpose of this research is to determine how teachers perceive and understand rigor. It is also aims to improve teachers' understanding and application of rigor in the teacher's natural context, and in order to increase the challenge and relevance of the tasks they assign to students in their classrooms.
5. How long in duration is this research?	
	The research will be conducted between September 2015 and January or February 2016. If additional cycles or interventions are required, this timeframe may be extended.
6. What data will be collected?	
	Data will be collected from a. The participant interviews and analyzed for codes and themes (Phase I). b. A pre-scheduled 40-minute observation of a portion of a lesson that involves a rigorous task (this is accompanied by an explanation of why the task was rigorous), c. Participant informal on-going reflective journal d. Weekly meetings to discuss insights, progress, questions
7. How many people will be studied?	
	15 participants
8. What happens if I say yes, I want to be in this research?	
	If you voluntarily agree to participate in this study, you will be asked to complete the following: a. An interview that I estimate will take approximately 30-45 minutes to complete, and a follow-up focus group interview to discuss the overall findings of the collective interviews. This will include responding to semi-structured questions that permit you the liberty to elaborate as much as you see fit. b. Participate in observations (being observed in your classroom and possibly, observing a peer) twice in cycle 2, 3 and, possibly, 4. c. Maintain a reflective journal (as directed by the researcher, Appendix L). d. Participate in weekly meetings (as part of your school obligation, Appendix L) e. During and following this process, your identity will *not* be disclosed. However, I will be recording the interview so that I can transcribe it to determine an insider perspective on rigor and its use. I will also be reading your reflective journals to understand your thinking and progress, as well as to determine next steps. f. ***The findings from the study will be available to you upon the study's conclusion, and*** you will have access to your transcriptions, as well as the codes and theme categories derived from them.
9. What happens if I say no, I do not want to be in this research?	
	a. You may decide not to take part in the research and it will not be held against you. b. Please note that your participation is strictly voluntary and you are free to withdraw at any time.
10. What happens if I say yes, but I change my mind later?	
	a. You may agree to take part in the research and even begin, but your participation is strictly voluntary throughout and so you are free to withdraw at any time. b. If you begin and decide to leave the research, there will be no penalty nor ill-feeling rendered. c. If you decide to leave the research, contact the investigator so that the investigator at:

	(203) 218-8086 or Ibanner@my.bridgeport.edu or simply do not participate.

11. Is there any way being in this study could be bad for me?

a.	*Your participation in this research will pose no risk to you.*
b.	*Your involvement will cost you only minimal time.*
c.	*Also, even though the researcher holds a supervisory role in the school, no positive nor negative implications can be derived that may have any bearing on your assignment or status within the school; this research and researcher's role is completely detached from all formal and informal evaluations.*

12. Will being in this study help me any way?

a.	We cannot promise any benefits to you or others from your taking part in this research.
b.	However, possible benefits may include helping to develop an understanding of how academic rigor can be best supported in teachers' work and to develop a workshop (or series of workshops) to support teachers' use of academic rigor as part of middle school professional development (if deemed necessary).

13. What happens to the information collected?

a.	Efforts will be made to limit your personal information, including research study and medical records, to people who have a need to review this information. We cannot promise complete secrecy.
b.	Organizations that may inspect and copy your information include the IRB and other representatives of this organization.
c.	All data from the interviews will be recorded on a Sony digital voice recorder and stored electronically on a password-protected MacBook Air. The researcher will transpose the data into a Microsoft Word 2011 document in order to transcribe the interviews verbatim before coding and analyzing them for themes and later merging them into broad categories.
d.	Categories will be further analyzed, compared and eventually reduced to 3-5 central themes. This will provide the basis for a narrative that summarizes the findings.
e.	The qualitative data will be subject to validity and reliability tests in that the interviews will follow a specific pre-determined protocol and steps taken within the interviews as well as the researcher's thoughts and perspectives will be carefully documented. Following transcription and analysis, the interviewees will be given both the transcription and themes resulting from the interviews to check for accuracy agreement (member checks).
f.	The interview data will be compared to additional pilot survey data findings to generate a theory relating to rigor and its understanding and use in the researched site.
g.	The data will be stored on the researcher's laptop, which is password protected. The transcripts that will be printed will remain at the home of the researcher and stored in a private desk that remains locked at all times. Following the completion of the Ed.D program (approximately four years – 2019-2020), this data will be shredded.
h.	All observations will be confidential. The observers will not be permitted to discuss their observations with anyone outside of the observation team, and all of their notes will be collected and stored securely by the researcher.
i.	Any lesson plans, and the content of weekly meeting discussions or forms or reflective journals will remain confidential between the participants and researcher. Each will sign confidentiality agreements.

14. Can I be removed from the research without my OK?	
	a. The person in charge of the research study or the sponsor can remove you from the research study without your approval.
	b. Possible reasons for removal include: Failing to respond to the questions appropriately and accurately; failure to attend the meetings and maintain the required documentation (reflective journals); failure to invest in seeking to increase an understanding of and a capacity to increase rigor
15. What else do I need to know?	
	No incentives will be afforded participants in this research.

TWO LEVELS OF INVOLVEMENT IN THIS RESEARCH STUDY

Limited involvement (as a non-participant volunteer)	Full involvement (as a participant/interventionist volunteer)
Agrees to…	Agrees to…
Participate in a 30-45 minute interview	Participate in a 30-45 minute interview
Participate in a 30-45 minute focus group discussion/interview	Participate in a 30-45 minute focus group discussion/interview
Be observed (mid-to-late September) for approximately 20 minutes and to explain the task's level of rigor (10 minutes)	Be observed (mid-to-late September) for approximately 20 minutes and to explain the task's level of rigor (10 minutes)
	Meet weekly to discuss thinking, insights, possible impact on students, questions, next steps (30 minutes)
	Maintain an on-going reflective journal (30+ minutes per week) regarding: (a) Changes in your thinking regarding your planning, instruction and/or assessment. (b) The impact your work within the research cycle is having on your students, and the evidence of this. (c) Challenges or questions that have and are arising during this work. (d) Other (determined by you).
Be observed (early-to-mid December, or later) for approximately 20 minutes and to explain the task's level of rigor (10 minutes)	Be observed (twice) for approximately 20 minutes and to explain the task's level of rigor (10 minutes). One observation would scheduled; the other unannounced.
Participate in a 20-30 minute interview	Participate in a 20-30 minute interview

Approximate time commitment: 2 hours, 20 minutes to 3 hours

Approximate time commitment: 4 hours, 20 minutes to 5 hours (for cycle 1-2).

NB. An intervention cycle time commitment is equal to ~1-1.5 hours per week beyond the usual requirements.

Signature Block for Capable Adult: Long Form

Your signature below documents your permission to take part in this research and to the use and disclosure of your protected health information: *[Remove latter section if there is no HIPAA authorization]*

DO NOT SIGN THIS FORM AFTER THIS DATE → | 9/7/15 |

_____   _____
Signature of subject   Date

_____
Printed name of subject

_____   _____
Signature of person obtaining consent   Date
                                                                                        | 9/1/15 |
_____
Printed name of person obtaining consent   Form Date

[Add the following block if you will obtain a witness to the signature (required for all Veterans Administration (VA) research)]

_____   _____
Signature of witness to signature   Date

_____
Printed name of person witnessing signature

[Add the following block if a witness will observe the consent process (required for the short form of consent documentation)]

My signature below documents that the information in the consent document and any other written information was accurately explained to, and apparently understood by, the subject, and that consent was freely given by the subject.

My signature below, also indicates that I agree to maintain full confidentiality and to not disclose any information to anyone regarding the participants in this study.

_____   _____
Signature of witness to consent process   Date

_____
Printed name of person witnessing consent process

_____ I wish to be a non-participant volunteer

_____ I wish to be a full participant/interventionist volunteer

Appendix E

PARTICIPANT INFORMATION

Section 1: Demographic Survey

Selected pseudonym: _____

Question	Response
Gender	
Certification area	
Years of teaching experience	
Subject currently teaching	
Grade level currently teaching	
Years teaching current subjects and grade	

Additional info:

Appendix F

SETTING AND PARTICIPANT DEMOGRAPHICS

Table F1

District Student Population for all grade levels and schools

	District student population levels				
School level	Combined elementary schools	Middle school: Research site	Middle school A	Middle school B	Combined high schools
No. of students	4733	804	883	691	2994

Note. The enrollment for the elementary and high schools was based on information on the district's website (as of 6/1/2015). However, the individual middle school's enrollment was based on their actual reported and available numbers in the district's electronic database, which fluctuated as enrollment changed. This information was reported as of 7/3/2015.

Table F2

District Demographic Data for Grades 6-8

Grade level	Middle school: Research site	Middle school A	Middle school B	Total
	No. of middle school teachers per grade level			
Grade 6	12	12	8	32
Grade 7	12*	12	12*	36
Grade 8	12	12	8	32

Note. These populations only included language arts, math, social studies, and science teachers.

* Only eight teachers were fulltime (1.0); four teachers only taught one period of a single subject (math, language arts, social studies, or science) per day for five days per week. This was due to enrollment numbers in grade seven.

Table F3

District Demographic Data for Grades 6-8 by Subject Area

	No. of middle school teachers per subject area and grade level								
	Middle school: Research site			Middle school A			Middle school B		
Grade	6	7	8	6	7	8	6	7	8
LA	3	3*	3	3	3	3	3	3*	3
Math	3	3*	3	3	3	3	3	3*	3
SS	3	3*	3	3	3	3	3	3*	3
Science	3	3*	3	3	3	3	3	3*	3

Note. The asterisk indicated that only eight teachers were fulltime (1.0); four teachers only taught one period of a single subject (math, language arts, social studies, or science) per day for five days per week. This was due to enrollment numbers in grade seven.

Table F4

Phase I and II Participant Demographic Profile

Participant #	Gender	Certification	Subject and grade level currently teaching	Total years of experience *	No. of years teaching current subject and grade **
1	M	Elementary K-6	Social studies 6	7	2
2	F	Elementary K-6	Language arts 6	7	6
3	F	Elementary K-6 SpEd K-12	Language arts 6	6	1
4	M	Social science 7-12	Social studies 7	15	15
5	M	History & social studies 7-12	Social studies 7	21	17
			Mean	11.2	8.2

Note. These populations only included language arts, math, social studies, and science teachers.

* ** Included current year (2015-2016)

Table F5

Phase I Comparison Participant Demographic Profile

Participant #	Gender	Certification	Subject and grade level currently teaching	Total years of experience *	No. of years teaching current subject and grade **
A	M	English 7-12	Language arts 8	20	19
B	M	Elementary K-6	Math 6	16	16
C	F	Biology 7-12 Middle school general science	Science 7	7	7
D	F	General science 7-12 SpEd K-12	Science 7	29	29
E	F	4-8	Science 6	6	2
			Mean	15.6	14.6

Note. These populations only included language arts, math, social studies, and science teachers.

* ** Included current year (2015-2016)

Appendix G

SEMI-STRUCTURED INTERVIEWS

The following script will be used for the interviews with the selected dissertation-research participants. The same protocol will be adhered to in all interviews to establish a better understanding of the participants' insights as to how they define and describe academic rigor and use it in their planning and instruction.

The questions, below, were selected to directly address the qualitative research questions driving this action research study:

1. How do teachers perceive and define *academic or instructional rigor*?
   a. What is *academic rigor* to them? How do they define it?
2. How do teachers perceive and describe their pre-certification preparation's influence on instructional rigor?
3. How do teachers perceive and describe their professional development preparation's influence on instructional rigor?

Directions
Before
1. Remind interviewee that the interview should last approximately 30-45 minutes and that it is being recorded.

2. Thank interviewee in advance for supporting the study.

3. Remind interviewee that the interview is not at all related to our roles within the school (supervisor and supervisee) and will not be judged.

4. Remind interviewee of the rationale for this study and how "we" can help support teachers based on what "we" discuss.

During
1. Conduct interview and spend more time watching and recognizing interviewee's body language, tone, level of comfort, than taking notes

After
1. Thank the interviewees for their time and insights and remind them that the information will remain confidential.

2. If deemed necessary, ask interviewees for a time to review artifacts that reflect rigor in their planning or their teaching (or they can be forwarded to me).

Interview Protocol (Phase I)

Date of Interview:
Time of Interview:
Interviewee:

Questions (Phase I)

1. What is academic rigor to you? How do you define it?
   Probe: Could you tell me more about that?

2. How does academic rigor feature into your planning?
   Probe: How do your physical lesson plans reflect this?

3. How would I see it in your classroom, specifically?
   Probe: Could you explain this in more detail?

4. How has your college and certification training prepared you to use academic rigor?
   Probe: Could you explain this in more detail?

5. How has your PD training prepared you to use academic rigor?
   Probe: Could you explain this in more detail?

6. If your supervisor told you that you had to increase academic rigor, what specifically would you do?
   Probe: Could you explain that a little more?

Final comments/thoughts
    What final statement would you make about academic rigor?

Thank the participants for their time and insights and remind them that the information will remain confidential. Ask them for a time to review artifacts (if none were available) that reflect rigor in their planning or their teaching (or they can be forwarded to me).

Section 2: Research Questions Provided to Participants Prior to Interview

The questions are driving this research study:
1. How do teachers perceive and define *academic or instructional rigor*?
    a. What is *academic rigor* to them? How do they define it?
2. How do teachers perceive and describe their pre-certification preparation's influence on instructional rigor?
3. How do teachers perceive and describe their professional development preparation's influence on instructional rigor?

Interviewee (pseudonym): _____ Date: _____

Phase I Interview Questions

1. What is academic rigor to you? How do you define it?

2. How does academic rigor feature into your planning?

3. How would I see it in your classroom, specifically?

4. How has your college and certification training prepared you to use academic rigor?

5. How has your PD training prepared you to use academic rigor?

6. If your supervisor told you that you had to increase academic rigor, what specifically would you do?

Final comments/thoughts
    What final statement would you make about academic rigor?

Table G1

Semi-Structured Interview Questions Categorized by Theme

Theme	Question
Understanding	1. What is rigor to you? How do you define it? 7. How well do you feel that you understand rigor? 8. How well do you feel that your colleagues understand rigor?
Praxis	2. How does rigor feature into your planning? 3. How would I see it in your classroom, specifically?
Preparation and training	4. How has your college and certification training prepared you to use rigor? 5. How has your professional development training prepared you to use rigor?
Support	6. If your supervisor told you that you had to increase rigor, what specifically would you do?

Note. Questions 7 and 8, both of which were focused on understanding rigor, were asked towards the end of the interview, and are numbered in the order that they were asked.

Interview Protocol (Phase II)

The following script will be used for the interviews in Phase 2 with the selected dissertation-research participants. The same protocol will be adhered to in all interviews to establish a better understanding of the participants' insights as to how they describe the intervention's impact on their thinking and their instructional practice, and to consider their suggestions for refinement.

The questions, below, were selected to directly address the qualitative research questions driving this action research study in phase 2:

1. x

Directions
Before
1. Remind interviewee that the interview should last approximately 30 minutes and that it is being recorded.

2. Thank interviewee in advance for supporting the study, and their work in this phase.

3. Remind interviewee that the interview is not at all related to our roles within the school (supervisor and supervisee) and will not be judged.

During
1. Conduct interview and spend more time acknowledging and recognizing the interviewee's body language, tone, level of comfort, than taking notes

After
1. Thank the interviewee for their time and insights, and remind them that the information will remain confidential.

Phase II Interview Questions

1. How was the intervention? What worked? What needs refinement or rethinking? Etc.

As the interviewee talks, listen for the following areas, below. If the interviewee does not answer a question, below, probe them using the questions listed. Also probe for added detail when responses are sparse or unclear.

2. Were there any changes to your thinking on rigor from this work?
   a. Has rigor become more clearly defined?

   b. Has it become more usable/operational?

3. Will this intervention be something that you continue to use in the future and beyond this research?
   a. If yes, how so?

   b. If No, why not?

4. What challenges did you encounter, and why?

5. Did you see any evidence of an impact on students (their performance and achievement, etc.)? what specifically did you notice?

6. How was the overall process with the intervention?

7. What recommendations do you suggest be made to the next phase (phase 3) for other teachers, and why?

8. Final thoughts, if any?

Appendix H

LESSON OBSERVATIONS

Observation Protocol

The focus of the observation will be on the level of thinking/cognitive challenge expected of students through the tasks they are assigned in the classroom. This will take place during the main learning segment of the lesson (following warm-up/introduction, and before closing) and for approximately 20 minutes.

Key questions to ask as you observe and on which to take note include:
1. What written teacher directions do you see that indicate the level of thinking/cognitive challenge expected of students (learning goal, essential question, rubric/measurement, etc.)?

2. What verbal teacher directions do you hear that indicate the level of thinking/cognitive challenge expected of students (what the teacher says)?

3. What is/are the task(s) that students are assigned?

4. What is the level of thinking/cognitive challenge that is expected of the student based on the work they are assigned?

5. How are the students doing with the task(s)?

Before the lesson observation:
- Be familiar with the observation form, protocols and procedure for observation (refer to *During* and *After* the lesson observation, below)
- Arrive on time (preferably a few minutes before the scheduled observation)

During the lesson observation:
- Refrain from interfering with the teacher's instructions and directions
- Observe the tasks that the students are assigned (what they are required to do and by what means)
- Note what the teachers says in accordance with the tasks
- Note how the students are doing with the task(s)
- Feel free to ask the students what they are doing, but do not provide any direction or answers.

After the lesson observation:
- Smile and thank the observed participant for his/her time
- Refrain from providing personal judgment on the lesson segment just observed.
- Discuss the observation and select a cell on Hess's Matrix (2009) that reflects your observation score
- Maintain full confidentiality with this information.

Lesson Observation Form

The observations in the first iteration of the intervention in phase two revealed that most of the focus had been placed on the rigor of the task, and less explicit emphasis had been given on the initial Lesson Observation Form to how the teacher implemented the tasks, and therefore the rigor of the implementation.

This revised Lesson Observation Form more appropriately distinguishes task rigor from implementation rigor, and further, more clearly defines the elements of both. These are operationally defined, below.

Task and Students

Task. What the students are given to do. For example, they are asked to solve a multi-step math problem.

Task requirement. What the students are required to do with the task. For example, the task requires the students to use a given (by the teacher) procedure to solve a multi-step problem.

Making sense of the information. When given a task, the students may work individually and independently to complete it. They may also be required to work in small groups to discuss ideas and possibilities before doing something.

Implementation and Teacher

       Presentation of task. How the teacher informs the students on what they are required to do. For example, the teacher may verbally inform the class what they are required to do and what step they must follow to complete the task. However, the teacher may also instruct the students on the exactly order in which the steps must be followed. The teacher may also provide a demonstration that may show exactly what students have to do and how.

       Monitoring and questioning. How the teacher monitors the progress of the students while they are working, which directly relates to what the teacher is looking for as he/she monitors (based on what he or she says to students—i.e. procedures being followed, quality of work, etc.). This also relates to what questions the teacher asks of the students (i.e. questions that require the students to employ either low-level or high-level thinking).

       Response to student questions. How the teacher encourages the students to think (to make decisions and justify their decisions), which directly relates to the types of questions (that require low-level or high-level student thinking responses) that the teacher asks of students in order to probe them to use their higher level cognitive capacity.

LESSON OBSERVATION FORM

Date of observation:
Time of observation:
Teacher being observed:

What is the written or verbal goal for the lesson?

Task and Students	Implementation and Teacher
1. What is the **task** that the students are given? 2. What does the **task require** the students to do and know? 3. How are the students required to **make sense of the information**? 4. How are the students doing with the task?	1. How does the teacher **introduce or present the task** to the students? 2. When **monitoring** the students' work/progress, what does the teacher do and what questions does the teacher ask? 3. How does the teacher **respond to students' questions**?

Task and Students	Implementation and Teacher

Using Hess's (2013) Matrix, what was the level of thinking/cognitive challenge that was required of the student based on the work they were assigned?

How well do you think the teacher forced the student to think (implementation rigor)?

POST-OBSERVATION FEEDBACK 1

Date of observation: 1/29/16

Time of observation: Period 1

Teacher being observed: Teacher x

Goal of the lesson: Students will be able to discover why there are different

temperatures and weather patterns in different parts of the US (written on board).

Students will analyze the data from their weather map and draw conclusions about how

location/region impacts temperatures in the US (written in handout).

Component	Score		Rationale
Task Rigor (Hess, 2013 Matrix)	Bloom's Taxonomy	Understand	We noted that the students were required during the lesson to:
	Webb's DoK level	2	1. Make predictions as to why different temps and weather patterns exist in the US (DoK level 2), 2. Retrieve data from their own previously contrived map, and list the temperatures for the given cities (DoK level 1), 3. Compare/Contrast temps in the various given cities within a specified month (DoK level 2), 4. Read textbook to find out how location, region, and season impact temperature (DoK level 2).

Considerations for increasing the level of student thinking

The lesson segments (steps 1-4, above) together seemed somewhat rushed, and it appeared that more time would be required for students to comfortably work through the steps in a way that allowed them to develop meaning at each stage. It seemed somewhat unclear how the second, third and fourth steps directly connected step one (their predictions) to the exit slip, because it was somewhat unclear how they discovered this information based on what they were required to do in the time they were required to do it.

Having said that, this sequence really encouraged students to be actively involved in their learning, because the task required them to work in partnerships and to use previously

constructed sources (weather maps) and compare and contrast information to answer questions. It also seemed that there was a great deal of thought and effort from the grade-level team to plan a developing logical learning sequence that aimed to increase the students' cognitive level of thinking. Bravo!

One suggestion to increase the cognitive complexity of this task (or series of tasks in this case) could be to clarify the outcome of the lesson sequence (refer to Goal of the lesson, above). Was the outcome to (a) discover why there are different temperatures and weather patterns in different parts of the US (written on board), (b) draw conclusions about how location/region impacts temperatures in the US (written in handout, page 1), or to (c) explain how location/region, and season impact temperature (written in handout, page 4)?

While these are all related, they need to be coherently organized in a logical sequence. For example, you may require students to first find out (conclude) and then explain how seasons impact temperature. Second, require students to find out (conclude) and then explain how location/region impacts temperatures in the US. This could then logically lead to students, in the third step, being able to conclude and explain why there are different temperatures and weather patterns in different parts of the US. In essence, this may take three to four days if you want students to competently demonstrate an understanding, with the most rigorous part being the latter step as they are synthesizing and organizing multiple reasons for impacts on weather pattern and temperature change.

A related suggestion that could increase the cognitive demands of the tasks could be to look, in the planning stage, at what the students are simply going to do. For example, after the students had made predictions in step one of the lesson we observed, the students took (or retrieved) the data from their own weather map, and listed the temperatures for the given cities. They then looked up the region in which these cities were located. While these are necessary tasks, they are not high-level thinking tasks with the latter simply able to be Googled. Therefore, being true to what the task simply requires students to do can sometimes give a more accurate picture of the level of thinking that will be demanded of them. And this then becomes the point on which to make a decision as to whether the task will cognitively demand enough (or too much) of the students.

Component	Score		Rationale
Implementation Rigor (rubric)	Presentation	2	We felt that the task and steps were mostly presented to the students in a way that required them to have to think about what to do, and the students were asked questions to encourage them to think about the topic.
	Monitoring and questioning	1/2	
	Responding to questions	1/2	Throughout, there was a sense of hurriedness, which seemed to prompt more teacher-directed control than students being allowed to work through the steps. Yet, it was noted that students were asked questions, such as: "Why are they the same?" it was noted that at other times, information was given, such as the discussion about El Nino, and that winds play a huge role in daily temperatures.

Considerations for increasing the level of student thinking

One suggestion to increase the cognitive level of challenge and demand on students' thinking could be to first, see clarification for learning goal, as this will likely reduce the sense of rushing and increase the focus of the overall learning. This will likely then help know what students are expected to demonstrate as understanding and having made sense of, which then allows questions to be asked, such as: "What are you making sense of right now?" "How is x effecting or causing y?" etc.

Being more clear as to the end result will clarify what to look for and what to ask, and when.

Big kudos for the work, thus far!

POST-OBSERVATION FEEDBACK 2

Date of observation: 2/26/16

Time of observation: Period 4

Teacher being observed: Teacher x

Goal of the lesson: Students will be able to analyze data and draw conclusions about the amount of destruction caused by different hurricanes…and why there were differences.

Worksheet 1 stated that students would be required to determine why their hurricane behaved the way it did and explain why it caused the destruction it did.

Component	Score		Rationale
Task Rigor (Hess, 2013 Matrix)	Bloom's Taxonomy	Analyze	The observer perspective was that the lesson mostly required the students to:
	Webb's DoK level	2	1. List the facts/data about their hurricane and describe their data (for approximately 12 minutes),
			2. Compare and contrast their hurricane to their group members' facts/data (approximately 6 minutes),
			3. Provide similarities and differences between group's hurricanes *if* asked by the teacher in a whole-class discussion (approximately 16 minutes).
			It was noted that the students did not independently (individually or in their group):
			(a) *Draw conclusions about the destruction caused by different hurricanes…and why there were differences* (as written in the learning goal).
			(b) *Determine why their hurricane behaved the way it did and explain why it caused the destruction it did* (as written on

	the first worksheet).
	Rather, they were only required to consider and address these aspects during the whole-class discussion if and when asked by the teacher, which was not the case for all or half of the students.

Considerations for increasing the level of student thinking

One suggestion to increase the cognitive complexity of this task could be to require the students—either individually or in their small group—to answer the why questions. For example, the students could have been required to independently (individually or in their group) *determine why their hurricane behaved the way it did and explain why it caused the destruction it did* (as written on the worksheet and emphasized verbally in the presentation of the task).

Additionally, the students could have been required to independently (individually or in their group) *draw conclusions about the destruction caused by different hurricanes, and explain why there were differences* (as written in the learning goal).

Both of these would have required the students to independently address the why that was stated and emphasized as the main focus at the beginning of the lesson (teacher said: "The focus is on the why today…find the why"). Therefore, this would ensure that there was consistency between what the students were told to do (what was written and what was verbally stated) and the work they actually did (the task).

Component	Score		Rationale
Implementation Rigor (rubric)	Presentation	2	The observer perspective was that the presentation of the task mostly provided information that potentially required the students to think about the task at hand.
	Monitoring and questioning	1/2	
	Responding to questions	1/2	Additionally, questions were posed during student monitoring, and were answered following a student's question that varied between requiring the students to understand and apply knowledge of hurricanes and recalling factual information of hurricanes.

Considerations for increasing the level of student thinking

One suggestion to increase the cognitive level of challenge and demand on students' thinking could be to first ensure that the expectations for students (as stated verbally or written) are consistent with the task (see comments above on Task Rigor). Secondly, and once the task required students to address the why component, more questions could be asked of students that require them to verbally state why. For example, a student could be asked the following related questions: "So, based on your data/information, why did your hurricane behave the way it did? What's your evidence? Would this always be the case?"

This would likely prompt students to directly ask or imply questions of the teacher that were of greater cognitive demand or required digging deeper, such as: "I don't know why my hurricane behaved the way it did…." This could then be followed by the teacher asking: "What information do you have? What does it seem to tell you"…why don't you discuss this with your group, and I'll check back in a few minutes."

KARIN HESS COGNITIVE RIGOR MATRIX (2013)

HESS COGNITIVE RIGOR MATRIX (READING CRM):
Applying Webb's Depth-of-Knowledge Levels to Bloom's Cognitive Process Dimensions

TOOL 1

Revised Bloom's Taxonomy	Webb's DOK Level 1 Recall & Reproduction	Webb's DOK Level 2 Skills & Concepts	Webb's DOK Level 3 Strategic Thinking/Reasoning	Webb's DOK Level 4 Extended Thinking
Remember Retrieve knowledge from long-term memory, recognize, recall, locate, identify	o Recall, recognize, or locate basic facts, terms, details, events, or ideas explicit in texts o Read words orally in connected text with fluency & accuracy	Use these Hess CRM curricular examples with most close reading or listening assignments or assessments in any content area.		
Understand Construct meaning, clarify, paraphrase, represent, translate, illustrate, give examples, classify, categorize, summarize, generalize, infer a logical conclusion), predict, compare/contrast, match like ideas, explain, construct models	o Identify or describe literary elements (characters, setting, sequence, etc.) o Select appropriate words when intended meaning/definition is clearly evident o Describe/explain who, what, where, when, or how o Define/describe facts, details, terms, principles o Write simple sentences	o Specify, explain, show relationships; explain why (e.g., cause-effect) o Give non-examples/examples o Summarize results, concepts, ideas o Make basic inferences or logical predictions from data or texts o Identify main ideas or accurate generalizations of texts o Locate information to support explicit-implicit central ideas	o Explain, generalize, or connect ideas using supporting evidence (quote, example, text reference) o Identify/ make inferences about explicit or implicit themes o Describe how word choice, point of view, or bias may affect the readers' interpretation of a text o Write multi-paragraph composition for specific purpose, focus, voice, tone, & audience	o Explain how concepts or ideas specifically relate to other content domains (e.g., social, political, historical) or concepts o Develop generalizations of the results obtained or strategies used and apply them to new problem-based situations
Apply Carry out or use a procedure in a given situation; carry out (apply to a familiar task), or use (apply) to an unfamiliar task	o Use language structure (pre/suffix) or word relationships (synonym/antonym) to determine meaning of words o Apply rules or resources to edit spelling, grammar, punctuation, conventions, word use o Apply basic formats for documenting sources	o Use context to identify the meaning of words/phrases o Obtain and interpret information using text features o Develop a text that may be limited to one paragraph o Apply simple organizational structures (paragraph, sentence types) in writing	o Apply a concept in a new context o Revise final draft for meaning or progression of ideas o Apply internal consistency of text organization and structure to composing a full composition o Apply word choice, point of view, style to impact readers' /viewers' interpretation of a text	o Illustrate how multiple themes (historical, geographic, social, artistic, literary) may be interrelated o Select or devise an approach among many alternatives to research a novel problem
Analyze Break into constituent parts, determine how parts relate, differentiate between relevant-irrelevant, distinguish, focus, select, organize, outline, find coherence, deconstruct (e.g., for bias or point of view)	o Identify whether specific information is contained in graphic representations (e.g., map, chart, table, graph, T-chart, diagram) or text features (e.g., headings, subheadings, captions) o Decide which text structure is appropriate to audience and purpose	o Categorize/compare literary elements, terms, facts/details, events o Identify use of literary devices o Analyze format, organization, & internal text structure (signal words, transitions, semantic cues) of different texts o Distinguish: relevant-irrelevant information; fact/opinion o Identify characteristic text features; distinguish between texts, genres	o Analyze information within data sets or texts o Analyze interrelationships among concepts, issues, problems o Analyze or interpret author's craft (literary devices, viewpoint, or potential bias) to create or critique a text o Use reasoning, planning, and evidence to support inferences	o Analyze multiple sources of evidence, or multiple works by the same author, or across genres, time periods, themes o Analyze complex/abstract themes, perspectives, concepts o Gather, analyze, and organize multiple information sources o Analyze discourse styles
Evaluate Make judgments based on criteria, check, detect inconsistencies or fallacies, judge, critique	"UG" – unsubstantiated generalizations = stating an opinion without providing any support for it!		o Cite evidence and develop a logical argument for conjectures o Describe, compare, and contrast solution methods o Verify reasonableness of results o Justify or critique conclusions drawn	o Evaluate relevancy, accuracy, & completeness of information from multiple sources o Apply understanding in a novel way, provide argument or justification for the application
Create Reorganize elements into new patterns/structures, generate, hypothesize, design, plan, produce	o Brainstorm ideas, concepts, problems, or perspectives related to a topic , principle, or concept	o Generate conjectures or hypotheses based on observations or prior knowledge and experience	o Synthesize information within one source or text o Develop a complex model for a given situation o Develop an alternative solution	o Synthesize information across multiple sources or texts o Articulate a new voice, alternate theme, new knowledge or perspective

Hess, K. K. (2013). *Cognitive Rigor Matrix (Reading CRM): Applying Webb's depth-of-knowledge levels to Bloom's cognitive process dimensions*. Copyright 2013 by K. K. Hess.

Note. Other Matrices used include Writing, Social Studies/Humanities, and Math/Science.

Appendix J

PARTICIPANT REFLECTION (ON-GOING JOURNAL)

Protocol

Your individual reflection should be on-going and frequent throughout the research phase. Your entries should be a minimum of 2-3 per week, and should be used as content and a guide for your weekly meetings/discussions.

The entries can be freely written capturing your thinking within the research phase, and should address the following points (keeping in mind that some of the prompts may be more pertinent at certain times than the others):

(a) Changes in your thinking regarding your planning, instruction and/or assessment.

(b) The impact your work within the research cycle is having on your students, and the evidence of this.

(c) Challenges or questions that have and are arising during this work.

(d) Other (determined by you).

Please include the date in parentheses at the end of each entry. And if you add to an entry, just add that date at the end of your addendum.

Please submit your log for the week on the following Monday. For example, the first submission should be on Monday 11/16/15.

REFLECTION ENTRIES

Participant: Teacher X

Week 1: Monday 11/9/2015 through Sunday 11/15/15

The focus of this week is…
x

Changes in my thinking regarding my planning, instruction and/or assessment have been…
x

The impact my work within the research cycle is having on my students has been…, and the evidence of this is….
x

Challenges or questions that have and are arising for me during this work have been/are…
x

Other thoughts (determined by me)…
x

Week 2: Monday 11/16/2015 through Sunday 11/22/15

The focus of this week is…
x

Changes in my thinking regarding my planning, instruction and/or assessment have been…
x

The impact my work within the research cycle is having on my students has been…, and the evidence of this is….
x

Challenges or questions that have and are arising for me during this work have been/are…
x

Other thoughts (determined by me)…
x

Appendix K

WEEKLY MEETING FORM

Participants: x and x

Date: x/x/2015

Week: 1

Driving question: *How is it going with rigor?*

Focus of the meeting:

Today, we are focusing on…   x

Main learning:

Our main learning has been…   x

Impact on students:

This has impacted students in the following ways…   x   The evidence is…   x

Area of challenge:

An area of challenge, or a question is …   x

Next Steps:

Our proposed next steps are…   x

1. Outside of the discussion on rigor, what was the meeting focused on? Provide examples.
   x

2. Did the teachers discuss rigor without being prompted? If so, what was the conversation focused on? Provide examples.
   x

Appendix L

RIGOR PLANNING MATRIX

Overview:

The Rigor Planning Matrix (RPM) should be used to capture and record the main tasks in each day's lesson that most represent the intended learning and outcomes for that day. The task should be described, and using the Hess (2013) Cognitive Rigor Matrix (Matrix), the level of cognitive rigor or thinking associated with the mental demands of the task should be noted. For example, E/4 could be written to represent Evaluation (Bloom's) and Level 4 (Webb's). The way the tasks were implemented should also be noted. For example, a sentence indicating how the main task was presented to the students should be written, as well as how the students' progress was monitored during the lesson, and how the teacher responded to students' questions (i.e. asking questions that probed the students' thinking, and responded to questions without providing answers, respectively).

Directions:

1. Complete the Matrix in advance of the week to be implemented, and refine and revise it throughout the week.

2. Use it to prompt support discussions with subject-area colleagues regarding task, task rigor and implementation rigor.

3. Send the completed Matrix at the end of the week.

Rigor Planning Matrix

Week 1   **Participant:** Teacher x   **Subject area:** x   **Grade level:** x

	Monday 1/11/2016	**Tuesday** 1/12/2016	**Wednesday** 1/13/2016	**Thursday** 1/14/2016	**Friday** 1/15/2016
Task Description *What was the main task, and what did it require the students to do?*					
Task Rigor *Using Hess' (2013) CRM), the level of thinking demanded from the task was...?*					
Task Implementation *How did I implement the task to increase the cognitive rigor?*					

SCORING GUIDE FOR RIGOR PLANNING MATRIX

Score Guide for Rigor Planning Matrix on Hess (2013) Matrix

Score	Description
Accurate	The participant's description of the task provided in the *Task Description* section matched the appropriate levels (DoK and Bloom's) on the Hess (2013) Matrix in the *Task Rigor* section, and was deemed an **Accurate** match. This was the case for all 5 of the five reported days.
Partially Accurate	The participant's description of the task provided in the *Task Description* section partially matched the appropriate levels (DoK and Bloom's) on the Hess (2013) Matrix in the *Task Rigor* section. For example, The task rigor was assigned an accurate DoK level, but not an accurate Bloom's level, or vice versa. However, either level was close and within one accurate level (i.e. a score of DoK 2 was assigned by the participant when a more fitting level was DoK 1). This was therefore deemed a **Partially Accurate** match. This was the case for 3 or 4 of the five reported days. The number of accurately days reported in appear in parentheses.
Inaccurate	The participant's description of the task provided in the *Task Description* section did not matched the appropriate levels (DoK and Bloom's) on the Hess (2013) Matrix in the *Task Rigor* section. Using the *Partially Accurate* description, above, the participant's assigned level (on either the DoK or Bloom's levels) was two or more levels above or below the more fitting level, and was therefore deemed an **Inaccurate** match. This was the case for only 1 or 2 of the five reported days. The number of accurately days reported in appear in parentheses.

Appendix M

IMPLEMENTATION RIGOR RUBRIC

Implementation component	1	2	3
Presenting How does the teacher inform the students on what they are required to do?	The teacher presents the task to the students at a cognitive level of challenge that is inappropriate for (a) making them think and (b) develop independence; it provides too much information or direction that is not unnecessary.	The teacher presents the task to the students at a cognitive level of challenge that is somewhat appropriate for (a) making them think and (b) develop independence; it provides some information or direction that is not necessary.	The teacher presents the task to students at a cognitive level of challenge that is appropriate for (a) making them think and (b) develop independence; it provides only the necessary information and direction.
Monitoring and questioning What does the teacher look for as he/she monitors? What questions does the teacher ask of the students?	The teacher monitors for and/or employs questions that are of low cognitive challenge, which require the students to remember or recall information about a familiar or given situation.	The teacher monitors for and/or employs questions that are of moderate cognitive challenge, which require the students to understand or apply knowledge to a familiar or given situation.	The teacher monitors for and/or employs questions that require high levels of cognitive challenge, that compel students to construct new meaning by analyzing, synthesizing, evaluating or creating to new situations.
Responding to questions What type of response does the teacher provide to students? Do they require low-level or high-level student thinking responses?	The teacher responds to students' questions by requiring them to use low levels of cognition and to remember or recall information about a familiar or given situation.	The teacher responds to students' questions by requiring them to use moderate levels of cognition and to understand or apply knowledge to a familiar or given situation.	The teacher responds to students' questions by requiring them to use high levels of cognition and to construct new meaning by analyzing, synthesizing, evaluating or creating to new situations.

Note. Adapted from *The Connecticut Common Core of Teaching (CCT) Rubric for Effective Teaching 2014* (Connecticut State Department of Education, 2014). Copyright by Connecticut State Department of Education, 2014.

Cognitive challenge and *Cognitively challenging* refer to the use of higher-order thinking (Analyze, Evaluate, Create according to Bloom's Revised Taxonomy, Krathwohl et al. 2001; Depth of Knowledge, Webb, 2002).

Appendix N

PHASE II PROPOSAL

Background

The phase one findings, which included individual interviews, observations and focus group interviews, signified that most of our teachers felt that they could define academic rigor, but were unsure whether their definition aligned with their evaluator's definition. It also indicated that their colleagues felt similarly. I would also assume that you are unsure if your definition of rigor aligns with the literature's definition.

The findings from phase one also indicated that little training and guidance has supported teachers' understanding and capacity to implement rigor in the tasks they assign to students (their instruction and formative assessments). As a result, they felt unsure and sometimes unclear how rigor featured into their planning, even though their intention to do so was present.

Lastly, they all equated rigor with thinking and mostly deeper thinking. Yet they expressed that this term and related terms, such as critical thinking, required clearer definition so it could be viewed and implemented similarly amongst all teachers.

Next Steps: The Intervention (iteration b)

The findings in phase one, which explored how teachers perceived and understood rigor, suggested that explicitly developing students' thinking should be an area of focus, as rigor is synonymous with high-level, higher-order, or critical thinking. Specifically, the cognitive rigor of the tasks should be examined and explicated in order to determine the cognitive level of thinking that the tasks demand of students.

This therefore requires that a research-based tool (The Hess Cognitive Rigor Matrix,

2013) specific to your subject area, be used to help you better understand and be able to articulate and define rigor (or higher-order, higher-level, deeper or critical thinking), in general. More importantly, however, you would use the tool to examine the current cognitive rigor of your tasks, and to plan upcoming lessons that demonstrate an increase in cognitive task rigor. Additionally, you would acknowledge how you implement the tasks to ensure that you avoid decreasing the rigor. You would also observe the impact that increased rigor is having on your students' thinking and performance.

Therefore, I am proposing the intervention as being a combination of the following three *daily* actions when planning for the next day's lesson:

1. The use of this prompt: *The task that I'm planning to use requires the students to do ___, and so to successfully complete it, the level of thinking (cognitive rigor) required will be ___,*

2. The utilization of Hess's Cognitive Rigor Matrix (Hess, 2013), which is to be used simultaneously with number 1, above, to determine the level of thinking from the task by seeing which task in a given cell most closely matches your intended task,

3. The consideration and determination of how you are going to implement the task to your students to avoid over-scaffolding and de-rigorizing their thinking.

The intended Outcome of the Intervention

The intended outcome for this intervention is for you to be able to increase the level of rigor in your instruction (the classroom tasks you assign, which includes in-class formative assessments) when appropriate by implementing the 3-step process in your planning process in order for you to more consciously determine the level of thinking or cognitive rigor that you will

demand of your students.

Justification for the Intervention

A focus on the cognitive level required for successful attention to and completion of academic classroom tasks is necessary, based on Boston and Wolf (2006), Doyle (1983), and Paige, Sizemore, and Neace (2013). Additionally, it is equally necessary to consider the way the tasks are implemented, as also indicated in Boston and Wolf (2006).

Hess et al. (2009), and Paige et al. (2013) support the use of Webb's (1997) Depth of Knowledge (DoK) levels when examining academic tasks. The CT state Department of Education has also adopted Webb's framework for analyzing and reporting on Smarter Balanced student scores, and analyzing the percentage of students that scored in the various levels (CT State Department of Education, 2014).

A method for developing teachers' capacity to think about the cognitive level of tasks is absent from the literature. Other studies that have emphasized rigor have focused mostly on whether or not rigor is present in classrooms and student work. For example, Paige et al. (2013) focused on the degree of students who were engaged in classwork, and in certain class-parts, based on the DoK level. A different focus was evident in Boston and Wolf's (2006) study, which focused on whether the Instructional Quality Assessment (IQA) was an effective tool for evaluating math programs (see also Junker & Weisberg, 2006). Similarly, Matsumura, Slater and Crosson (2008) focused on predictive relationships between teachers' actions and the classroom climate, rigorous instruction and student interactions. A consideration of the lesson's level of thinking was the focus in Maye's (2013) research, which illuminated the degree that her 24 lesson observations indicated that rigor was present (or absent). Also, Manthey (2005) examined

grade 7 students' math work to determine the level of rigor it exhibited. None of these studies focused on building teacher capacity to increase rigor.

Phase questions

2. Do the Hess (2013) Matrix and the three-step planning process positively impact the teachers' capacity to design rigorous classroom tasks?

3. Do the Hess (2013) Matrix and the three-step planning process positively impact the teachers' capacity to implement rigorous classroom tasks?

Measurement of the Intervention

The implementation of the intervention will be measured in the following ways:

1. Weekly reflection logs to reflect on your thinking regarding rigor and the use of the intervention.

2. Classroom observations (two) that demonstrate rigorous tasks and rigorous implementation.

3. Weekly planning matrix that document the task, the rigor of the task, and the rigor of the implementation.

4. Weekly planning (PIRR) meetings and researcher training with an emphasis on discussing the level of students' thinking required from the tasks assigned to them.

Your thoughts and learning throughout this process and captured in your weekly reflection logs will provide discussion and talking points, as well as questions, for our weekly planning meeting. At this meeting, we will always begin by responding to the question: *How is it going with rigor?*

It is hoped that you engage with your subject-area, grade-level colleagues to attend to the level of student thinking (rigor) as part of your instructional planning throughout the week and outside the specified meeting time.

Updates to the Intervention in Iteration b

This iteration will place a greater emphasis on the following areas:

1. Explicitly discussion on rigor during the weekly PIRR meetings to emphasize the "I" portion as *instruction* and pedagogy (task rigor and implementation rigor).

2. Understanding and developing the rigor of implementation (how the task is presented to the students before they begin, how their work is monitored and the type of questions asked of them, and the responses their questions receive, in order to encourage greater levels of students' thinking).

3. More explicit feedback and discussion on the level of rigor (task and implementation) following each observation.

We have also selected three weeks as opposed to four weeks for this iteration. However, we will permit one of the two observations to be scheduled outside of or beyond the three-week period to allow for it to more seamlessly align with your curriculum pacing.

Materials

The following materials will support your intervention work:

1. Phase 2 (iteration 2) Proposal (this document)

2. Permission/Consent form and research overview (IRB)

3. The Cognitive Rigor Matrix (Hess, 2013) (specific to your subject area)

4. Implementation Rigor Rubric

5. Article: *Depth of Knowledge Levels for Four Content Areas* (Webb, 2002, March 28). Retrieved from: Retrieved from

   http://facstaff.wcer.wisc.edu/normw/All%20content%20areas%20%20DOK%20levels%2032802.doc

6. Brief: *Thoughts on Rigor* (Superintendent's brief on rigor, 2013)

7. The Lesson Observation Form

8. The Weekly Reflection Form (electronic)

9. Weekly planning matrix

Additional materials that seem relevant to further support the intervention may be included throughout the three weeks.

Agenda and Timeline

Table 1

Phase II (b) agenda for developing increased rigor in a three-week intervention

Week	**Focus.** Preparing for the intervention and its requirements	
	Actions and outcomes	Measurement requirements
A 1/4/16 through 1/8/16	1. Read and analyze Hess's (2013) Matrix (subject specific). 2. Reflect on the tasks that you have recently assigned to your students, and consider the level of thinking and cognitive rigor that they required using Hess's (2013) Matrix. 3. Reflect on the way that you implemented the tasks that you have recently assigned to your students, and consider the level of thinking and cognitive rigor that this required. 4. Read the Phase II (b) Proposal. 5. Read the *Thoughts on Rigor* (rigor traps 1-3, 5, 7) (Superintendent's brief on rigor, 2013). 6. Read *Depth of Knowledge Levels for Four Content Areas* for your subject (Webb, 2002).	1. NA

Week	**Focus.** Implementing the intervention and reflecting deeply on its impact on your capacity to design rigorous/high-level thinking tasks, and implement the tasks in a way that encourages students to use their higher-level thinking capacity. This week should be used primarily to develop a deeper understanding of the intervention (the three-step process) and the Hess (2013) Matrix by implementing it.	
	Actions and outcomes	Teacher requirement
1 1/11/16 through 1/15/16	1. Implement the intervention (the three-step process). Consider the level of thinking that will be demanded from the task(s) you assign as student work during class. Consider also the way you will implement it to maximize students' thinking. 2. Read the articles (Superintendent's brief on rigor, 2013, and Webb, 2002) to help develop greater understanding of rigor and higher-level thinking. 3. Contemplate and try to develop deeper clarity of what is meant by (a) Task rigor (use Hess's [2013] Matrix and consider step one and two of the three-step process), and (b) Implementation rigor (consider step three of the three-step process).	1. Reflect on and respond in writing to the weekly log prompts (especially the first and second one, but all when possible). 2. Complete your Rigor Planning Matrix. 3. Meet with grade-level, subject-area colleagues to discuss rigor and your progress with the intervention. This is also encouraged outside of this meeting.

Note. This is the week that you should consider when your first observation might be scheduled.

However, it is advised that greater familiarity be developed first with regards to task rigor and

implementation rigor before undergoing your first observation.

Week		
	Focus. Implementing the intervention and reflecting deeply on its impact on your capacity to design rigorous/high-level thinking tasks, and implement the tasks in a way that encourages students to use their higher-level thinking capacity. This week should be focused on deepening your understanding of both task and implementation rigor, and utilizing both as much and as competently as possible in your planning and instruction.	
	Actions and outcomes	Teacher requirement
2 1/18/16 through 1/22/16	1. Implement the intervention (the three-step process). Consider the level of thinking that will be demanded from the task(s) you assign as student work during class. Consider also the way you will implement it to maximize students' thinking. 2. Read the articles (Superintendent's brief on rigor, 2013, and Webb, 2002) to help develop greater understanding of rigor and higher-level thinking. 3. Continue trying to develop deeper clarity of what is meant by (a) Task rigor (use Hess's [2013] Matrix and consider step one and two of the three-step process), and (b) Implementation rigor (consider step three of the three-step process).	1. Reflect on and respond in writing to the weekly log prompts (especially the first and second one, but all when possible). 2. Complete your Rigor Planning Matrix. 3. Meet with grade-level, subject-area colleagues to discuss rigor and your progress with the intervention. This is also encouraged outside of this meeting. 4. This may be the week for observation 1.

Week	**Focus.** Implementing the intervention and reflecting deeply on its impact on your capacity to design rigorous/high-level thinking tasks, and implement the tasks in a way that encourages students to use their higher-level thinking capacity. This week should remain focused on continuing to deepen your understanding of both task and implementation rigor, and utilizing both as much and as competently as possible in your planning and instruction.	
	Actions and outcomes	Teacher requirement
3 1/25/16 through 1/29/16	1. Implement the intervention (the three-step process). Consider the level of thinking that will be demanded from the task(s) you assign as student work during class. Consider also the way you will implement it to maximize students' thinking. 2. Read the articles (Superintendent's brief on rigor, 2013, and Webb, 2002) to help develop greater understanding of rigor and higher-level thinking. 3. Continue trying to develop deeper clarity of what is meant by (a) Task rigor (use Hess's [2013] Matrix and consider step one and two of the three-step process), and (b) Implementation rigor (consider step three of the three-step process).	1. Reflect on and respond in writing to the weekly log prompts (especially the first and second one, but all when possible). 2. Complete your Rigor Planning Matrix. 3. Meet with grade-level, subject-area colleagues to discuss rigor and your progress with the intervention. This is also encouraged outside of this meeting. 4. This may be the week for observation 1 or 2.

Note. If you haven't undergone observation 2 this week, you will need to consider planning it for

the following week.

Appendix O

PHASE III PROPOSAL

Background

  Phase I. The phase one findings signified that most of our teachers felt that they could define academic rigor, but were unsure whether their definition aligned with the literature's definition. It also indicated that their colleagues felt similarly. The findings also indicated that little training and guidance had supported teachers' understanding and capacity to design and implement rigorous tasks to their students. As a result, they felt unsure and sometimes unclear how rigor featured into their planning, even though their intention to do so was present. Lastly, they all equated rigor with thinking and mostly deeper thinking. Yet they expressed that this term and related terms, such as critical thinking, required clearer definition so it could be viewed and implemented similarly amongst all teachers.

  Phase II. A research-based tool (The Hess Cognitive Rigor Matrix, 2013) specific to a given subject area was used to help teachers better design rigorous tasks. Additionally, an implementation Rigor Rubric This also lead to teaches developing a better understanding of, and being able to articulate and define, rigor (or higher-order, higher-level, deeper or critical thinking), in general.

Next Steps

  Phase III. This next step seeks to situate the designing and implementing of rigorous tasks within a unit of study that (a) moves from the identification and unpacking of relevant subject standards (KUDs), (b) the designing of a final assessment performance task that is cognitively challenging (as measured by the Hess (2013) Matrix), authentic and realistic, and

requires the students to demonstrate a capacity to use various skills and knowledge/facts (identified in the standards), and demonstrate an understanding of key concepts and principles/generalizations, and (c) the development of a general sequence that leads to higher-level thinking and to be successful in solving the problem presented in the final assessment (also as measured by the Hess (2013) Matrix).

The intended Outcome of the Intervention

The intended outcome for this phase is for the teacher (a) to be able to design a coherent unit as outlined above, and (b) report a greater level of understanding on how rigor is systematically developed within a concept-based unit.

Justification for the Intervention

Based on the Phase I themes (*Individual interview* q*uestion 2:* Planning for it is difficult, and the *Focus group interview*: Planning for and implementing rigor are unclear and need defining), this phase seeks to deepen the planning process (Shavelson & Stern, 1981) for rigor and deepens the understanding of how rigor should be cultivated in order to develop conceptual understanding (Common Core State Standards, 2010; Erickson, 2002).

The research on instructional planning revealed similar issues to rigor with regards to a lack of clarity and focus. For example, Kerr (1981) drew on the insights gleaned from Macdonald who stated that teachers often think about what they are going to do when planning, and much less what they are trying to accomplish. He further noted that greater attention must be paid to instructional design if we want it to help teachers rather than provide only vague and general information about planning. Various other studies revealed that teachers typically do not

plan using structured models, such as the Tyler or Hunter models, and instead plan with a focus on covering content, and then on selecting activities (Brown, 1988, 1993; Clark, 1983; Clark & Peterson, 1984; Doyle & Holm, 1998; Kerr, 1981; Peterson, Marx, & Clark, 1978; Shavelson & Stern, 1981; Yinger, 1979, 1980). Clark (1983) and Clark and Peterson (1984) also indicated that for all its emphasis in teacher preparation programs, lesson planning is rarely perceived as being important to experienced teachers, and according to Peterson, Marx, and Clark (1978), the focus of the lesson was given the least amount of time in planning, and was superseded by the focus on subject matter. Limited research on teacher planning has unearthed deficiencies in this realm of instructional practice, but it has not considered how teacher planning contributes to effectively sequencing instructional episodes or tasks that lead to higher-level thinking or rigor, although Peterson, Marx, and Clark did find that teacher planning statements focused much more on Lower-Order Subject Matter than Higher-Order Subject Matter.

The result is that teachers require much more explicit support on how to consciously and deliberately plan for rigor and higher-level thinking, and beyond just considering content and activities, especially since "researchers have demonstrated that teachers' plans influence the content of instruction" (Clark & Peterson, 1984, p. 40).

Phase question

4. Do the teachers report that a planning framework for developing a concept-based unit of study and specific training support provide them with greater clarity and understanding on how to design a coherent unit that incorporates increasingly rigorous tasks?
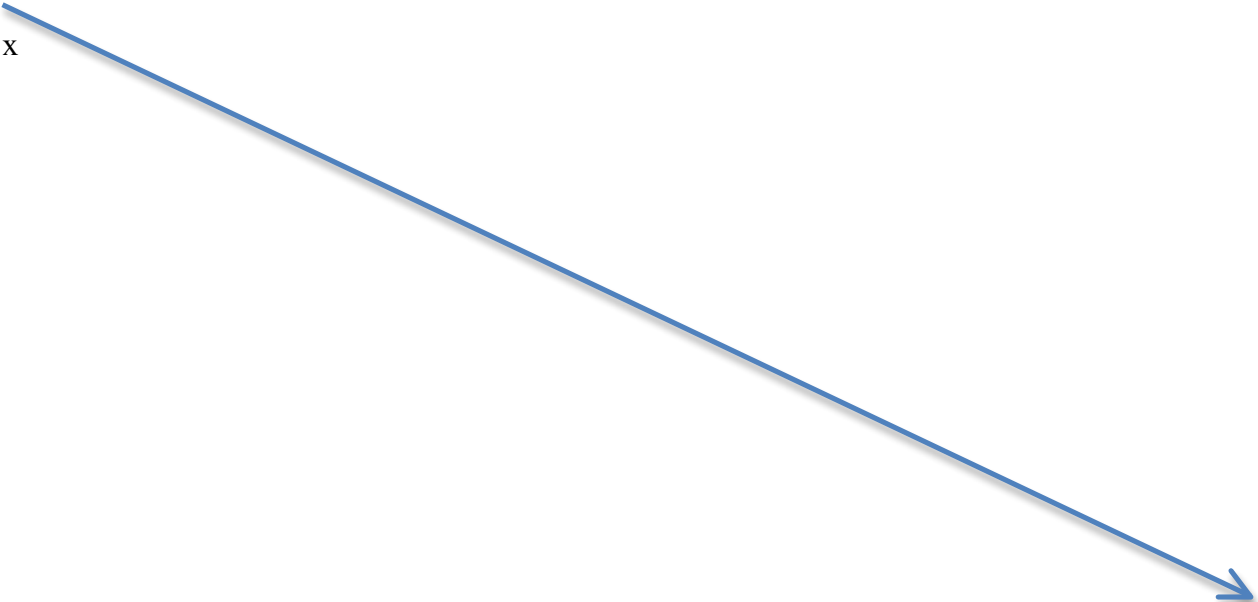
Measurement of the Intervention

The implementation of the intervention will be measured in the following ways:

1. Pre-reflections on your current planning process.

2. Weekly planning (PIRR) meetings and researcher training with an emphasis on discussing the development of the unit plans (UPPER).

3. Two developed unit plans (one from a previously taught unit, and one for an upcoming or current unit).

4. Scoring of the UPPER using the UPPER Rubric.

5. Post-reflections on your current planning process compared to the new process.

Your thoughts and learning throughout this process and captured in your pre-reflection will provide discussion and talking points, as well as questions, for our weekly planning meeting. At this meeting, we will always begin by responding to the question: *How is it going with planning for rigor?*

Materials and Resources

The following materials will support this phase's work:

1. Unit planner (UPPER)

2. UPPER Rubric

3. Selected samples of Erickson (2002) to explain how to design a concept-based unit and the essential considerations/elements

4. Training by the researcher

5. Pre- and Post-Reflections

Agenda and Timeline

Table 2

Phase III agenda for developing a rigorous concept-based unit in a four-week intervention

Week	**Focus.** Preparing for the intervention and its requirements	
	Actions	Data collection
1 4/4/16 through 4/8/16	1. Teachers will be presented with the purpose and rationale of this phase 2. Teachers will complete the pre-reflection (electronic document)	Teachers' complete pre-reflection on their current process for developing units of study, and explain how rigor features into their design

Week		
	Actions	Data collection
2 4/18/16 through 4/22/16	1. Teachers will use their previously taught unit (as part of their involvement in Phase II), and receive specific training on how to: (a) select and unpack relevant standards, (b) list the KUDs, SP, DI (c) design a rigorous final performance task/assessment, and (d) develop an increasingly rigorous and general sequence leading to the final assessment	Researcher reflection/meeting notes on teachers' involvement, their developing process and training

Week		
	Actions	Data collection
3 4/25/16 through 4/29/16	Teachers will use a current or upcoming unit and collectively design a coherent and rigorous unit by employing the following steps: (a) select and unpack relevant standards, (b) list the KUDs, SP, DI (c) design a rigorous final performance task/assessment, and (d) develop an increasingly rigorous and general sequence leading to the final assessment	2 units of study, and scored by The UPPER Rubric Evidence of rigor to be measured by the Hess (2013) Matrix

Week		
	Actions	Data collection
4 5/2/16 through 5/6/16	Teachers will complete the post-reflection (electronic document)	Teachers' complete post-reflection on their revised process for developing units of study, and explain how rigor featured into their design Teachers state whether the new method is more effective than their current method

Develop a response to the question: *Do the teachers report that a planning framework for developing a concept-based unit of study and specific training support provide them with greater clarity and understanding on how to design a coherent unit that incorporates increasingly rigorous tasks?*

Appendix P

UNIT PLANNING PROCESS TO ENSURE RIGOR (UPPER)

The emphasis should be on the application of knowledge and skills to solve realistic problems/issues that exist in the world, which directly align with relevant standards. The process should emphasize inquiry and students developing a conceptual understanding of content.

Subject: x   Grade level: x

1. Unit Topic		
x		
2. Standard(s) *(underline teachable nouns and circle verbs that students are to do)*		
x		

Knowledge *Concepts, Facts, Procedures*	**Skills** *Do*	**Student Needs**
x	x	x

3. Understanding/Big Ideas
x
4. Guiding or Essential Question(s)
x
5. Final Performance Task
x
6. Tasks and Sequence (includes tasks and formative assessments)
x

Note. Following the unit plan (UPPER), the teacher's next steps is to actualize this long range plan into weekly plans using the Rigor Planning Matrix, and individual lessons.

Appendix Q

UNIT PLANNING PROCESS TO ENSURE RIGOR (UPPER) RUBRIC

x

Implementation component	1	2	3	4
Unpacking the standards	The standard is incorrectly or inappropriately unpacked, and does not explicate the essential KUDs	The standard is unpacked, but only explicates one or two of the essential KUDs	The standard is unpacked, and explicates most of the essential KUDs	The standard is accurately unpacked and clearly explicates the essential KUDs
Developing compelling/guiding or essential questions	The questions are not compelling, guiding or essential, and do not support the fostering of inquiry	The compelling, guiding or essential questions provide only a limited means to inquiry that most likely will not foster much of it	The compelling, guiding or essential questions provide a general means to inquiry that will most likely foster it, sporadically	The compelling, guiding or essential questions provide a clear means to fostering inquiry
Developing a final performance assessment *As measured by the Hess (2013) Matrix*	The final performance task is not cognitively challenging, authentic and realistic, and does not require the students to demonstrate a capacity to use various skills and knowledge/facts (identified in the standards), and demonstrate an understanding of key concepts and principles/ generalizations	The final performance task provides limited cognitive challenge, and may be only somewhat authentic and realistic. It only partially requires the students to demonstrate a capacity to use various skills and knowledge/facts (identified in the standards), but does not require them to demonstrate an understanding of key concepts and principles/ generalizations	The final performance task is somewhat cognitively challenging, and is mostly authentic and realistic. It only requires the students to demonstrate a capacity to use various skills and knowledge/facts (identified in the standards), but require them to demonstrate only a partial understanding of key concepts and principles/ generalizations	The final performance task is cognitively challenging, authentic and realistic, and clearly requires the students to demonstrate a capacity to use various skills and knowledge/facts (identified in the standards), and demonstrate an understanding of key concepts and principles/ generalizations
Designing a sequence of tasks (including formative assessments) that lead to higher level thinking/rigor *As measured by the Hess (2013) Matrix*	The general sequence does not lead to increasingly higher-level thinking, and does not prepare the students to successfully solve the problem presented in the final assessment	The general sequence may lead to some higher-level thinking, but will likely not prepare the students to successfully solve the problem presented in the final assessment	The general sequence mostly leads to increasingly higher-level thinking, and will likely prepare the students to successfully solve the problem presented in the final assessment	The general sequence effectively leads to increasingly higher-level thinking, and will certainly prepare the students to successfully solve the problem presented in the final assessment

Appendix R

UNIT PLANNING PROCESS REFLECTION

Teacher: x   Subject: x   Grade level: x

Pre-Reflection	Thoughts, codes, categories
1. Describe your current process for planning and designing your units of study. Be sure to address each of the following in as much detail as possible: a) Your decisions about the final assessment in the unit, b) Your decisions about the activities and tasks and their sequence (from the beginning to the end of the unit), c) Your decisions about how you measure the students' progress (formative assessments) throughout the unit, d) How your unit planning includes rigor. 2. Are there any aspects of your planning for and designing your units that you feel are particularly positive? Challenging?	
x	

Teacher: x   Subject: x   Grade level: x

Post-Reflection	Thoughts, codes, categories
1. How does your current process for planning and designing your units of study compare to the newly trained process? Be sure to address each of the following in as much detail as possible: a) The final assessment in the unit, b) The activities and tasks and their sequence (from the beginning to the end of the unit), c) The measures of students' progress (formative assessments) throughout the unit, d) The inclusion of rigor. 2. Were there any aspects of the newly trained planning process for and designing your units that you feel were more effective than your current process? More challenging?	
x	

Appendix S

RESEARCHER REFLECTION (MEMOS)

The following entries captured the researcher's on-going reflection throughout the study, and used Coghlan and Brannick's (2010) Meta cycle for action research framework to organize the entries. Coghlan and Brannick defined the content portion as the researcher's thoughts on issues within the study, and what he/she thought was happening. They defined the process portion as an on-going reflection on the strategies and procedures being used, and "how things are being done" (p. 12). They further defined the premise as the awareness and critique of the underlying assumptions and perspectives, which seemed to or actually did govern and influence thought and action.

Entries

Date	**Content** *Thoughts on issues and on what is happening*	**Process** *Thoughts on the strategies and procedures being used*	**Premise** *Thoughts on assumptions and perspectives driving thoughts and action*

Actual entries not shown

Appendix T

RIGOR PLANNING MATRIX SCORES

Table T1

Phase IIa Rigor Planning Matrix Scores on Hess (2013) Matrix by Week

	Week of Intervention			
	1	2	3	4
			$n = 25$	$n = 25$
Participant				
1			Partially Accurate (4)	Accurate
2			Accurate	Accurate
3			Partially Accurate (3)	Accurate
4			Accurate	Partially Accurate (4)
5			Accurate	Partially Accurate (4)
No. Accurate			22	23

Note. $n = 25 = 5$ days x 5 participants

Table T2

Phase IIb Rigor Planning Matrix Scores on Hess (2013) Matrix by Week

	Week of Intervention			
	1	2	3	
	n = 45	*n* = 45	*n* = 45	
Participant				
A	Partially Accurate (3)	Partially Accurate (3)	Accurate	
C	Partially Accurate (3)	Partially Accurate (3)	Partially Accurate (4)	
D	Partially Accurate (3)	Partially Accurate (3)	Partially Accurate (3)	
E	Partially Accurate (3)	Inaccurate (1)	Partially Accurate (4)	
F	Accurate	Accurate	Partially Accurate (4)	
G	Accurate	Partially Accurate (3)	Partially Accurate (4)	
H	Accurate	Partially Accurate (3)	Partially Accurate (3)	
I	Partially Accurate (4)	Accurate	Partially Accurate (3)	

Table T2 continued

K	Partially Accurate (3)	Partially Accurate (3)	Inaccurate (1)	
No. Accurate	34	29	31	

Note. $n = 45 = 5$ days x 9 participants

Appendix U

TRIANGULATION MATRIX TO COLLECT AND COMPARE FINDINGS

Table U1

Phase I

	Phase-specific question a	Phase-specific question b	Phase-specific question c	Main research question 1
	How do teachers perceive and define instructional rigor?	*How do teachers perceive and describe their pre-certification preparation's influence on instructional rigor?*	*How do teachers perceive and describe their professional development preparation's influence on instructional rigor?*	What is the teachers' current understanding of academic rigor, and how do they describe the basis for their understanding?
PD questions (1, 4)	*Question 1* Multiple paths and outcomes, Problem solving Application Thinking Challenge Out of comfort zone Focus			*Question 4* How to plan and implement rigor Frequency and balance of using rigor
Individual interviews	*Question 1* Individual and Student Dependent Beyond students' comfort zone Deeper thinking focused *Question 3*	*Question 4* Not addressed Basics skills Classroom environment	*Question 5* PD not helpful Rigor a recent focus Building better than district	*Question 6* Clarification and help Reviewing student roles and work

	Higher order thinking		
	Independence		
	Student centered		
	Student collaboration		
	Question 7 Unclear		
	Difficulty translating it into action		
	Understandable		
	Question 8 Unclear		
	Difficulty translating it into action		
	Frustration		
	Question 2 Planning for it is difficult		
	Content and basics first		
	Objectives driven		
	Thinking focused		
Classroom observations	4 teachers (40%) scored at level 1 2 teachers (20%) scored at level 2 4 teachers (40%) scored at level 3		6 teachers (60%) demonstrated low levels of rigor (level 1 or 2

Focus group interviews	Planning for and implementing rigor are unclear and need defining Deeper thinking relates to Bloom's Taxonomy			Challenges of knowing students to get to rigor New thinking about student thinking New thinking about student thinking

Table U2

Phase IIa

	Main research question 2	Main research question 3
	Do the Hess (2013) CRM and the three-step planning process positively impact the teachers' capacity to ==design== rigorous classroom tasks?	Do the Hess (2013) CRM and the three-step planning process positively impact the teachers' capacity to ==implement== rigorous classroom tasks?
Weekly reflection logs	*Positives* Thinking more about rigor in planning Perceived positive impact on students Collegial planning was helpful *Challenges* Time challenge Curriculum Unfamiliarity Interpreting the Hess (2013) CRM Other challenges	Changes to instruction
Classroom observations	More teachers (four or 80%) scored in DoK level 3 in the second observation than in the first (3 or 60%). Additionally, two (40%) teachers remained in DoK level 3/Evaluate category, but improved from their initial observation score in Phase I.	Not able to be observed
Rigor planning matrix	90% of the assigned scores were deemed accurate	Only 13 (26%) out of the 50 total days somewhat addressed how the teacher implemented the task to encourage and stimulate rigor
Weekly meeting minutes	*Positives* Better understanding of rigor Positively impacted teachers' thinking A perceived positive impact on students *Challenges* Time challenge	
Individual interviews	*Positives* Intervention was positive (it changed	

	thinking and planning; new and traditional roles for teacher and students)	
	Rigor became clearer and operational	
	Positive impact on students	
	Challenges Time challenge	
	Journal and reflection logs were challenging	
	New curriculum impeded rigor	
	Interpreting the Hess (2013) CRM	
	Task development and differentiation vs. rigor was difficult	

Other considerations
Rigor needed to be a focus in weekly meetings

Shorter duration of intervention

Flexible with observations (can't all be in the assigned time frame)

Table U3

Phase IIb

	Main research question 2	Main research question 3
	Do the Hess (2013) CRM and the three-step planning process positively impact the teachers' capacity to <mark>design</mark> rigorous classroom tasks?	Do the Hess (2013) CRM and the three-step planning process positively impact the teachers' capacity to <mark>implement</mark> rigorous classroom tasks?
Weekly reflection logs	*Positives* Thinking more about rigor in planning Perceived positive impact on students *Challenges* Time challenge Rigor can be restrictive Interpreting the Hess CRM was a challenge	Changes to instruction
Classroom observations	Eight of the nine participants (89%) demonstrated an observed increase in the capacity to design more rigorous tasks when comparing observations one and two, and six (67%) increased their tasks DoK level of complexity.	26% of the implementation scores in the first observation were in the level 1 category. This decreased to 11% in the second observations. Although the percentage of level 2 scores remained the same (63%) for both observations, the level 3 implementation scores increased from 11% to 33% in the second observation.
Rigor planning matrix	70% of the assigned scores were deemed accurate	Much of what the participants wrote only somewhat addressed how the teacher implemented the task to encourage and stimulate rigor
Weekly meeting minutes	*Positives* Better understanding of rigor Positive impact on teachers' thinking A perceived positive impact on students The resources were helpful *Challenges* Interpreting the Hess CRM was a challenge	Better understanding of rigor Positive impact on teachers' thinking

	Time challenge	
Individual interviews	*Positive* Intervention was helpful	
	Implementation rigor was biggest change	
	CRM and IRR helped planning and defining rigor	
	Rigor not necessarily everyday	
	Positive student impact	
	Challenge CRM (and task rigor) was a challenge	
	Time challenge	
	Journaling and reflection logs were a challenge	
	Making basic learning rigorous	
	Accommodating differences and increasing some students' thinking was a challenge	

Other considerations
All staff should work on rigor

Lesson study

Phase III and Researcher/Leader questions not included

Adapted from "Action research: A guide for the teacher researcher (5th ed.)", by G. E. Mills, 2013, Copyright 2013 by Pearson Education, Inc.

Appendix V

DEVELOPING TEACHERS' CAPACITY TO UNDERSTAND AND INCREASE RIGOR

The literature on academic rigor has revealed that teachers and practitioners evidence difficulty defining and clearly understanding the term (Bower & Powers, 2009; Draeger, del Prado Hill, Hunter, & Mahler, 2003), which is likely the result of so many varied definitions. Rainwater, Mize, and Smith Brooks (2008) stated that many states, districts, educators, and policy professionals agree that rigor is necessary, but there is often disagreement as to what it is and how it is and should be defined. Additionally, Duncan, Range, and Hvidston (2012) wrote that: "Rigor is a term used prolifically, yet there is little common conception of what it actually means" (p. 24).

Developing rigor in teachers' instructional practice requires that they understand it, which means that they can define and describe it, develop rigorous tasks, implement them in rigorous ways, and develop rigor appropriately through their instructional planning. However, the literature on rigor is more able to contend that a lack of it exists in classroom work (Draeger, del Prado Hill, Hunter & Mahler, 2013; Hess, Carlock, Jones, & Walkup, 2009; Manthey, 2005; Maye, 2013; Paige et al., 2013; Wagner, 2008), but much less able to suggest ways to increase and sustain it. Jacobs and Colvin indicated that the solution to these problems is to increase the rigor in classrooms (Jacobs & Colvin, 2009), which suggests that the tasks assigned to students as classwork be made more cognitively demanding or rigorous. Banner (2016) found that teachers in his setting reported that it was appropriate for them to develop an understanding of task and implementation rigor, which included using the Hess (2013) Matrix, the Implementation Rigor Rubric, and the Rigor Planning Matrix, before learning how to develop rigor as part of a

307

longer-range unit plan, which required the use of the Unit Planning Process to Ensure Rigor (UPPER).

This intervention document provides a means for developing the rigor of the task and the rigor of how the task is implemented in the classroom with students. Furthermore, it provides an extended method for developing rigor through longer-range planning (units of study) that emphasize student understanding through a concept-based approach, which aligns with the Common Core State Standards for English and Math, the Next Generation Science Standards, and the C3 Social Studies Standards. This document is divided into three sections: (1) The Instructional Intervention, (2) The Planning Intervention, and (3) collecting and analyzing information on the intervention's impact. The following list delineates the components of each intervention:

The Instructional Intervention

This includes: (a) Lesson observation protocol and form, (b) The Hess (2013) Matrix, (c) The Implementation Rigor Rubric (IRR), (d) The Rigor Planning Matrix (RPM), and (e) The Scoring Guide for RPM.

The Planning Intervention

This includes: (a) The Unit Planning Process to Ensure Rigor (UPPER), and (b) The UPPER Rubric

Collecting and Analyzing the Information on the Intervention's Impact

This includes: (a) An overview of how the work is scored, (b) Teacher Reflection Entries, and (c) The Weekly Meeting Data Collection Form.

INSTRUCTIONAL INTERVENTION

The instructional intervention suggests that explicitly developing students' thinking should be an area of focus, as rigor is synonymous with high-level, higher-order, or critical thinking. Specifically, the cognitive rigor of the tasks should be examined and explicated in order to determine the cognitive level of thinking that the tasks demand of students.

This therefore requires that a research-based tool, such as The Hess Cognitive Rigor Matrix, 2013, which is specific to given subject areas, can be used to help teachers better understand and be able to articulate and define rigor (or higher-order, higher-level, deeper or critical thinking), in general. More importantly, however, this tool can be used to examine the current cognitive rigor of teachers' classroom tasks, and to plan upcoming lessons that demonstrate an increase in cognitive task rigor.

An additional consideration would be to acknowledge how the tasks are implemented to ensure that rigor is maximized in the way that the teacher presents the focus and work for the lesson, the questions he/she asks while the students work to maximize the students' thinking capacities, and how he or she responds to the students' questions as they work. This can be accomplished with the use of the Implementation Rigor Rubric.

To use these two tools appropriately, the teacher must plan the next day's daily lesson using the following prompt or guide:

1. The teacher first clarifies the specific task and says: *The task that I'm planning to use requires the students to do ___.*

2. The teacher then says: *To successfully complete the task, the level of thinking (cognitive rigor) required will be ___.* To accomplish this, the teacher determines as close of a match

as possible between the task that he/she has developed (in #1) to one described on the Hess (2013) Matrix, which will reveal the level of thinking on both the Bloom's scale and Webb's DoK level.

3. The teacher then considers how to best implement the task in order to maximize the students' thinking throughout the lesson by using the Implementation Rigor Rubric, and by asking: *How will I implement this task so that the students' cognitive demand is maximized?*

Justification for the Intervention

A focus on the cognitive level required for successful attention to and completion of academic classroom tasks is necessary, based on Boston and Wolf (2006), Doyle (1983), and Paige, Sizemore, and Neace (2013). Additionally, it is equally necessary to consider the way the tasks are implemented, as also indicated in Boston and Wolf (2006).

Hess, Carlock, Jones, and Walkup (2009), and Paige et al. (2013) support the use of Webb's (1997) Depth of Knowledge (DoK) levels when examining academic tasks. The CT state Department of Education has also adopted Webb's framework for analyzing and reporting on Smarter Balanced student scores, and analyzing the percentage of students that scored in the various levels (CT State Department of Education, 2014).

A method for developing teachers' capacity to think about the cognitive level of tasks is absent from the literature. Other studies that have emphasized rigor have focused mostly on whether or not rigor is present in classrooms and student work. For example, Paige et al. (2013) focused on the degree of students who were engaged in classwork, and in certain class-parts, based on the DoK level. A different focus was evident in Boston and Wolf's (2006) study, which

focused on whether the Instructional Quality Assessment (IQA) was an effective tool for evaluating math programs (see also Junker & Weisberg, 2006). Similarly, Matsumura, Slater and Crosson (2008) focused on predictive relationships between teachers' actions and the classroom climate, rigorous instruction and student interactions. A consideration of the lesson's level of thinking was the focus in Maye's (2013) research, which illuminated the degree that her 24 lesson observations indicated that rigor was present (or absent). Also, Manthey (2005) examined grade 7 students' math work to determine the level of rigor it exhibited. None of these studies focused on building teacher capacity to increase rigor.

The intended Outcome of the Intervention

The intended outcome for this intervention is for you to be able to increase the level of rigor in your instruction (the classroom tasks you assign, which includes in-class formative assessments) when appropriate by implementing the 3-step process in your planning process in order for you to more consciously determine the level of thinking or cognitive rigor that you will demand of your students.

Important Considerations

This intervention will place a greater emphasis on the following areas:

1. Explicitly discussing rigor during the weekly planning meetings to emphasize instruction and pedagogy (task rigor and implementation rigor), and not just procedural items, such as field trips, activities, and curriculum pacing.

2. Understanding and developing the rigor of implementation (how the task is presented to the students before they begin, how their work is monitored and the type of questions

asked of them, and the responses their questions receive, in order to encourage greater levels of students' thinking).

3. Providing teachers with explicit feedback and discussion on the level of rigor (task and implementation) following each observation.

This intervention can be accomplished in three to to four weeks. However, observations that should reflect high levels of rigor, during this period may need to be scheduled outside of or beyond the specified period to allow for it to more seamlessly align with the teachers' unit pacing.

Materials

The following materials will support the instructional intervention work:

1. Overview (this document)

2. The Cognitive Rigor Matrix (Hess, 2013) (specific to the subject area)

3. Article: *Depth of Knowledge Levels for Four Content Areas* (Webb, 2002). Retrieved from http://facstaff.wcer.wisc.edu/normw/All%20content%20areas%20%20DOK%20levels%2032802.doc

4. Article: *Thoughts on Rigor* (Superintendent's brief on rigor, 2013).

5. The Lesson Observation Form

6. The Weekly Reflection Form

7. Weekly Rigor Planning Matrix

Additional materials that seem relevant to further support the intervention may be included throughout the three weeks.

Agenda and Timeline

Table 1

Agenda for developing increased rigor in a three-four week intervention

Week	**Focus.** Preparing for the intervention and its requirements	
	Teacher actions and outcomes	Measurement requirements
A M/D/YY through M/D/YY	Teacher should 1. Read and analyze Hess's (2013) Matrix (subject specific). 2. Reflect on the tasks that they have recently assigned to their students, and consider the level of thinking and cognitive rigor that they required using Hess's (2013) Matrix. 3. Reflect on the way that they implemented the tasks that they have recently assigned to their students, and consider the level of thinking and cognitive rigor that this required. 4. Read the Justification for the Intervention. 5. Read the *Thoughts on Rigor* (rigor traps 1-3, 5, 7) (Superintendent's brief on rigor, 2013). 6. Read *Depth of Knowledge levels for Four Content Areas* your subject (Webb, 2002).	1. NA

Week	**Focus.** Implementing the intervention and reflecting deeply on its impact on teachers' capacity to design rigorous/high-level thinking tasks, and implement the tasks in a way that encourages students to use their higher-level thinking capacity. This week should be used primarily to develop a deeper understanding of the intervention (the three-step process) and the Hess (2013) CRM by implementing it.	
	Actions and outcomes	Teacher requirement
1 M/D/YY through M/D/YY	Teachers should 1. Implement the intervention (the three-step process). Consider the level of thinking that will be demanded from the task(s) they assign as student work during class. Consider also the way they will implement it to maximize students' thinking. 2. Read the articles (Superintendent's brief on rigor, 2013, and Webb, 2002) to help develop greater understanding of rigor and higher-level thinking. 3. Contemplate and try to develop deeper clarity of what is meant by (c) Task rigor (use Hess's [2013] CRM and consider the step one prompt of the intervention), and (d) Implementation rigor (consider the step three prompt of the intervention).	1. Reflect on and respond in writing to the weekly log prompts (especially the first and second one, but all when possible). 2. Complete your Rigor Planning Matrix. 3. Meet with grade-level, subject-area colleagues to discuss rigor and your progress with the intervention. This is also encouraged outside of this meeting.

Note. This is the week that teachers should consider when their first observation might be scheduled. However, it is advised that greater familiarity be developed first with regards to task rigor and implementation rigor before undergoing their first observation.

Week	**Focus.** Implementing the intervention and reflecting deeply on its impact on teachers' capacity to design rigorous/high-level thinking tasks, and implement the tasks in a way that encourages students to use their higher-level thinking capacity. This week should be focused on deepening your understanding of both task and implementation rigor, and utilizing both as much and as competently as possible in your planning and instruction.

	Actions and outcomes	Teacher requirement

2
 	
M/D/YY
through
M/D/YY
	Teachers should
	1. Implement the intervention (the three-step process).
	
	   Consider the level of thinking that will be demanded from the task(s) they assign as student work during class.
	
	   Consider also the way they will implement it to maximize students' thinking.
	
	2. Read the articles (Superintendent's brief on rigor, 2013, and Webb, 2002) to help develop greater understanding of rigor and higher-level thinking.
	
	3. Continue trying to develop deeper clarity of what is meant by
	
	   (c) Task rigor (use Hess's [2013] Matrix and consider step one and two of the three-step process), and
	
	   (d) Implementation rigor (consider step three of the three-step process).
		1. Reflect on and respond in writing to the weekly log prompts (especially the first and second one, but all when possible).
		
		2. Complete your Rigor Planning Matrix.
		
		3. Meet with grade-level, subject-area colleagues to discuss rigor and your progress with the intervention. This is also encouraged outside of this meeting.
		
		4. This may be the week for observation 1.

Week	**Focus.** Implementing the intervention and reflecting deeply on its impact on teachers' capacity to design rigorous/high-level thinking tasks, and implement the tasks in a way that encourages students to use their higher-level thinking capacity. This week should remain focused on continuing to deepen your understanding of both task and implementation rigor, and utilizing both as much and as competently as possible in your planning and instruction.	
	Actions and outcomes	Teacher requirement
3 M/D/YY through M/D/YY	Teachers should 1. Implement the intervention (the three-step process). Consider the level of thinking that will be demanded from the task(s) they assign as student work during class. Consider also the way you will implement it to maximize students' thinking. 2. Read the articles (Superintendent's brief on rigor, 2013, and Webb, 2002) to help develop greater understanding of rigor and higher-level thinking. 3. Continue trying to develop deeper clarity of what is meant by (e) Task rigor (use Hess's [2013] Matrix and consider step one and two of the three-step process), and (f) Implementation rigor (consider step three of the three-step process).	1. Reflect on and respond in writing to the weekly log prompts (especially the first and second one, but all when possible). 2. Complete your Rigor Planning Matrix. 3. Meet with grade-level, subject-area colleagues to discuss rigor and your progress with the intervention. This is also encouraged outside of this meeting. 4. This may be the week for observation 1 or 2.

Note. If teachers haven't undergone observation 2 this week, they will need to consider planning it for the following week.

LESSON OBSERVATION PROTOCOL

The focus of the observation will be on the level of thinking/cognitive challenge expected of students through the tasks they are assigned in the classroom. This will take place during the main learning segment of the lesson (following warm-up/introduction, and before closing) and for approximately 20 minutes.

Key questions to ask as you observe and on which to take note include:

1. What written teacher directions do you see that indicate the level of thinking/cognitive challenge expected of students (learning goal, essential question, rubric/measurement, etc.)?

2. What verbal teacher directions do you hear that indicate the level of thinking/cognitive challenge expected of students (what the teacher says).

3. What is/are the task(s) that students are assigned?

4. What is the level of thinking/cognitive challenge that is expected of the student based on the work they are assigned?

5. How are the students doing with the task(s)?

Before the lesson observation:

- Be familiar with the observation form, protocols and procedure for observation (refer to *During* and *After* the lesson observation, below)

- Arrive on time (preferably a few minutes before the scheduled observation)

During the lesson observation:

- Refrain from interfering with the teacher's instructions and directions

- Observe the tasks that the students are assigned (what they are required to do and by what means)

- Note what the teachers says in accordance with the tasks

- Note how the students are doing with the task(s)

- Feel free to ask the students what they are doing, but do not provide any direction or answers.

After the lesson observation:

- Smile and thank the observed participant for his/her time

- Refrain from providing personal judgment on the lesson segment just observed.

- Discuss the observation and select a cell on Hess's Matrix (2009) that reflects your observation score

- Maintain full confidentiality with this information.

LESSON OBSERVATION FORM

The observations in the first iteration of the intervention in phase two revealed that most of the focus had been placed on the rigor of the task, and less explicit emphasis had been given on the initial Lesson Observation Form to how the teacher implemented the tasks, and therefore the rigor of the implementation.

This revised Lesson Observation Form more appropriately distinguishes task rigor from implementation rigor, and further, more clearly defines the elements of both. These are operationally defined, below.

Task and Students

Task. What the students are given to do. For example, they are asked to solve a multi-step math problem.

Task requirement. What the students are required to do with the task. For example, the task requires the students to use a given (by the teacher) procedure to solve a multi-step problem.

Making sense of the information. When given a task, the students may work individually and independently to complete it. They may also be required to work in small groups to discuss ideas and possibilities before doing something.

Implementation and Teacher

      Presentation of task. How the teacher informs the students on what they are required to do. For example, the teacher may verbally inform the class what they are required to do and what step they must follow to complete the task. However, the teacher may also instruct the students on the exactly order in which the steps must be followed. The teacher may also provide a demonstration that may show exactly what students have to do and how.

      Monitoring and questioning. How the teacher monitors the progress of the students while they are working, which directly relates to what the teacher is looking for as he/she monitors (based on what he or she says to students—i.e. procedures being followed, quality of work, etc.). This also relates to what questions the teacher asks of the students (i.e. questions that require the students to employ either low-level or high-level thinking).

      Response to student questions. How the teacher encourages the students to think (to make decisions and justify their decisions), which directly relates to the types of questions (that require low-level or high-level student thinking responses) that the teacher asks of students in order to probe them to use their higher-level cognitive capacity.

LESSON OBSERVATION DATA COLLECTION

Date of observation:
Time of observation:
Teacher being observed:

What is the written or verbal goal for the lesson?

Task and Students	Implementation and Teacher
1. What is the **task** that the students are given? 2. What does the **task require** the students to do and know? 3. How are the students required to **make sense of the information**? 4. How are the students doing with the task?	1. How does the teacher **introduce or present the task** to the students? 2. When **monitoring** the students' work/progress, what does the teacher do and what questions does the teacher ask? 3. How does the teacher **respond to students' questions**?

Task and Students	Implementation and Teacher

Using Hess's (2013) Matrix, what was the level of thinking/cognitive challenge that was required of the student based on the work they were assigned?

How well do you think the teacher forced the student to think (implementation rigor)?

POST-OBSERVATION FEEDBACK

Date of observation: x/x/20xx

Time of observation: x

Teacher being observed: x

Goal of the lesson: x

Component	Score			Rationale
Task Rigor (Hess, 2013 Matrix)	Bloom's Taxonomy	x	x	
	Webb's DoK level	x		
Considerations for increasing the level of student thinking				

x

One suggestion to increase the cognitive complexity of this task could be to…

Component	Score			Rationale
Implementation Rigor (rubric)	Presentation	x	x	
	Monitoring and questioning	x		
	Responding to questions	x		
Considerations for increasing the level of student thinking				

x

One suggestion to increase the cognitive level of challenge and demand on students' thinking could be to…

KARIN HESS COGNITIVE RIGOR MATRIX (2013): TASK RIGOR

TOOL 1

HESS COGNITIVE RIGOR MATRIX (READING CRM):
Applying Webb's Depth-of-Knowledge Levels to Bloom's Cognitive Process Dimensions

Revised Bloom's Taxonomy	Webb's DOK Level 1 Recall & Reproduction	Webb's DOK Level 2 Skills & Concepts	Webb's DOK Level 3 Strategic Thinking/Reasoning	Webb's DOK Level 4 Extended Thinking
Remember Retrieve knowledge from long-term memory, recognize, recall, locate, identify	o Recall, recognize, or locate basic facts, terms, details, events, or ideas explicit in texts o Read words orally in connected text with fluency & accuracy	Use these Hess CRM curricular examples with most close reading or listening assignments or assessments in any content area.		
Understand Construct meaning, clarify, paraphrase, represent, translate, illustrate, give examples, classify, categorize, summarize, generalize, infer a logical conclusion), predict, compare/contrast, match like ideas, explain, construct models	o Identify or describe literary elements (characters, setting, sequence, etc.) o Select appropriate words when intended meaning/definition is clearly evident o Describe/explain who, what, where, when, or how o Define/describe facts, details, terms, principles o Write simple sentences	o Specify, explain, show relationships; explain why (e.g., cause-effect) o Give non-examples/examples o Summarize results, concepts, ideas o Make basic inferences or logical predictions from data or texts o Identify main ideas or accurate generalizations of texts o Locate information to support explicit-implicit central ideas	o Explain, generalize, or connect ideas using supporting evidence (quote, example, text reference) o Identify/ make inferences about explicit or implicit themes o Describe how word choice, point of view, or bias may affect the readers' interpretation of a text o Write multi-paragraph composition for specific purpose, focus, voice, tone, & audience	o Explain how concepts or ideas specifically relate to other content domains (e.g., social, political, historical) or concepts o Develop generalizations of the results obtained or strategies used and apply them to new problem-based situations
Apply Carry out or use a procedure in a given situation; carry out (apply to a familiar task), or use (apply) to an unfamiliar task	o Use language structure (pre/suffix) or word relationships (synonym/antonym) to determine meaning of words o Apply rules or resources to edit spelling, grammar, punctuation, conventions, word use o Apply basic formats for documenting sources	o Use context to identify the meaning of words/phrases o Obtain and interpret information using text features o Develop a text that may be limited to one paragraph o Apply simple organizational structures (paragraph, sentence types) in writing	o Apply a concept in a new context o Revise final draft for meaning or progression of ideas o Apply internal consistency of text organization and structure to composing a full composition o Apply word choice, point of view, style to impact readers' /viewers' interpretation of a text	o Illustrate how multiple themes (historical, geographic, social, artistic, literary) may be interrelated o Select or devise an approach among many alternatives to research a novel problem
Analyze Break into constituent parts, determine how parts relate, differentiate between relevant-irrelevant, distinguish, focus, select, organize, outline, find coherence, deconstruct (e.g., for bias or point of view)	o Identify whether specific information is contained in graphic representations (e.g., map, chart, table, graph, T-chart, diagram) or text features (e.g., headings, subheadings, captions) o Decide which text structure is appropriate to audience and purpose	o Categorize/compare literary elements, terms, facts/details, events o Identify use of literary devices o Analyze format, organization, & internal text structure (signal words, transitions, semantic cues) of different texts o Distinguish: relevant-irrelevant information; fact/opinion o Identify characteristic text features; distinguish between texts, genres	o Analyze information within data sets or texts o Analyze interrelationships among concepts, issues, problems o Analyze or interpret author's craft (literary devices, viewpoint, or potential bias) to create or critique a text o Use reasoning, planning, and evidence to support inferences	o Analyze multiple sources of evidence, or multiple works by the same author, or across genres, time periods, themes o Analyze complex/abstract themes, perspectives, concepts o Gather, analyze, and organize multiple information sources o Analyze discourse styles
Evaluate Make judgments based on criteria, check, detect inconsistencies or fallacies, judge, critique	"UG" – unsubstantiated generalizations = stating an opinion without providing any support for it!		o Cite evidence and develop a logical argument for conjectures o Describe, compare, and contrast solution methods o Verify reasonableness of results o Justify or critique conclusions drawn	o Evaluate relevancy, accuracy, & completeness of information from multiple sources o Apply understanding in a novel way, provide argument or justification for the application
Create Reorganize elements into new patterns/structures, generate, hypothesize, design, plan, produce	o Brainstorm ideas, concepts, problems, or perspectives related to a topic , principle, or concept	o Generate conjectures or hypotheses based on observations or prior knowledge and experience	o Synthesize information within one source or text o Develop a complex model for a given situation o Develop an alternative solution	o Synthesize information across multiple sources or texts o Articulate a new voice, alternate theme, new knowledge or perspective

Hess, K. K. (2013). *Cognitive Rigor Matrix (Reading CRM): Applying Webb's depth-of-knowledge levels to Bloom's cognitive process dimensions.* Copyright 2013 by K. K. Hess.

Note. Other Matrices used include Writing, Social Studies/Humanities, and Math/Science.

IMPLEMENTATION RIGOR RUBRIC

Implementation component	1	2	3
Presenting How does the teacher inform the students on what they are required to do?	The teacher presents the task to the students at a cognitive level of challenge that is inappropriate for (a) making them think and (b) develop independence; it provides too much information or direction that is not unnecessary.	The teacher presents the task to the students at a cognitive level of challenge that is somewhat appropriate for (a) making them think and (b) develop independence; it provides some information or direction that is not necessary.	The teacher presents the task to students at a cognitive level of challenge that is appropriate for (a) making them think and (b) develop independence; it provides only the necessary information and direction.
Monitoring and questioning What does the teacher look for as he/she monitors? What questions does the teacher ask of the students?	The teacher monitors for and/or employs questions that are of low cognitive challenge, which require the students to remember or recall information about a familiar or given situation.	The teacher monitors for and/or employs questions that are of moderate cognitive challenge, which require the students to understand or apply knowledge to a familiar or given situation.	The teacher monitors for and/or employs questions that require high levels of cognitive challenge, that compel students to construct new meaning by analyzing, synthesizing, evaluating or creating to new situations.
Responding to questions What type of response does the teacher provide to students? Do they require low-level or high-level student thinking responses?	The teacher responds to students' questions by requiring them to use low levels of cognition and to remember or recall information about a familiar or given situation.	The teacher responds to students' questions by requiring them to use moderate levels of cognition and to understand or apply knowledge to a familiar or given situation.	The teacher responds to students' questions by requiring them to use high levels of cognition and to construct new meaning by analyzing, synthesizing, evaluating or creating to new situations.

Note. Adapted from *The Connecticut Common Core of Teaching (CCT) Rubric for Effective Teaching 2014* (Connecticut State Department of Education, 2014). Copyright by Connecticut State Department of Education, 2014.
Cognitive challenge and *Cognitively challenging* refer to the use of higher-order thinking (Analyze, Evaluate, Create according to Bloom's Revised Taxonomy, Krathwohl et al. 2001; Depth of Knowledge, Webb, 2002).

RIGOR PLANNING MATRIX

The Rigor Planning Matrix (RPM) should be used to capture and record the main tasks in each day's lesson that most represent the intended learning and outcomes for that day. The task should be described, and using the Hess (2013) Cognitive Rigor Matrix (Matrix), the level of cognitive rigor or thinking associated with the mental demands of the task should be noted. For example, E/4 could be written to represent Evaluation (Bloom's) and Level 4 (Webb's). The way the tasks were implemented should also be noted. For example, a sentence indicating how the main task was presented to the students should be written, as well as how the students' progress was monitored during the lesson, and how the teacher responded to students' questions (i.e. asking questions that probed the students' thinking, and responded to questions without providing answers, respectively).

Directions:

1. Complete the Matrix in advance of the week to be implemented, and refine and revise it throughout the week.

2. Use it to prompt support discussions with subject-area colleagues regarding task, task rigor and implementation rigor.

3. Send the completed Matrix at the end of the week.

Rigor Planning Matrix

Participant: Teacher x   **Subject area:** x   **Grade level:** x

	Monday 1/11/2016	**Tuesday** 1/12/2016	**Wednesday** 1/13/2016	**Thursday** 1/14/2016	**Friday** 1/15/2016
Task Description *What was the main task, and what did it require the students to do?*					
Task Rigor *Using Hess' (2013) CRM), the level of thinking demanded from the task was…?*					
Task Implementation *How did I implement the task to increase the cognitive rigor?*					

SCORING GUIDE for RIGOR PLANNING MATRIX

Score Guide for Rigor Planning Matrix on Hess (2013) Matrix

Score	Description
Accurate	The participant's description of the task provided in the *Task Description* section matched the appropriate levels (DoK and Bloom's) on the Hess (2013) Matrix in the *Task Rigor* section, and was deemed an **Accurate** match. This was the case for all 5 of the five reported days.
Partially Accurate	The participant's description of the task provided in the *Task Description* section partially matched the appropriate levels (DoK and Bloom's) on the Hess (2013) Matrix in the *Task Rigor* section. For example, The task rigor was assigned an accurate DoK level, but not an accurate Bloom's level, or vice versa. However, either level was close and within one accurate level (i.e. a score of DoK 2 was assigned by the participant when a more fitting level was DoK 1). This was therefore deemed a **Partially Accurate** match. This was the case for 3 or 4 of the five reported days. The number of accurately days reported in appear in parentheses.
Inaccurate	The participant's description of the task provided in the *Task Description* section did not matched the appropriate levels (DoK and Bloom's) on the Hess (2013) Matrix in the *Task Rigor* section. Using the *Partially Accurate* description, above, the participant's assigned level (on either the DoK or Bloom's levels) was two or more levels above or below the more fitting level, and was therefore deemed an **Inaccurate** match. This was the case for only 1 or 2 of the five reported days. The number of accurately days reported in appear in parentheses.

PLANNING INTERVENTION

This next step seeks to situate the designing and implementing of rigorous tasks within a unit of study that (a) moves from the identification and unpacking of relevant subject standards (KUDs), (b) the designing of a final assessment performance task that is cognitively challenging (as measured by the Hess (2013) Matrix), authentic and realistic, and requires the students to demonstrate a capacity to use various skills and knowledge/facts (identified in the standards), and demonstrate an understanding of key concepts and principles/generalizations, and (c) the development of a general sequence that leads to higher-level thinking and to be successful in solving the problem presented in the final assessment (also as measured by the Hess (2013) Matrix).

Justification for the Intervention

This intervention seeks to deepen the planning process (Shavelson & Stern, 1981) for rigor and deepens the understanding of how rigor should be cultivated in order to develop conceptual understanding (Common Core State Standards, 2010; Erickson, 2002).

The research on instructional planning revealed similar issues to rigor with regards to a lack of clarity and focus. For example, Kerr (1981) drew on the insights gleaned from Macdonald who stated that teachers often think about what they are going to do when planning, and much less what they are trying to accomplish. He further noted that greater attention must be paid to instructional design if we want it to help teachers rather than provide only vague and general information about planning. Various other studies revealed that teachers typically do not plan using structured models, such as the Tyler or Hunter models, and instead plan with a focus

329

on covering content, and then on selecting activities (Brown, 1988, 1993; Clark, 1983; Clark & Peterson, 1984; Doyle & Holm, 1998; Kerr, 1981; Peterson, Marx, & Clark, 1978; Shavelson & Stern, 1981; Yinger, 1979, 1980). Clark (1983) and Clark and Peterson (1984) also indicated that for all its emphasis in teacher preparation programs, lesson planning is rarely perceived as being important to experienced teachers, and according to Peterson, Marx, and Clark (1978), the focus of the lesson was given the least amount of time in planning, and was superseded by the focus on subject matter. Limited research on teacher planning has unearthed deficiencies in this realm of instructional practice, but it has not considered how teacher planning contributes to effectively sequencing instructional episodes or tasks that lead to higher-level thinking or rigor, although Peterson, Marx, and Clark did find that teacher planning statements focused much more on Lower-Order Subject Matter than Higher-Order Subject Matter.

The result is that teachers require much more explicit support on how to consciously and deliberately plan for rigor and higher-level thinking, and beyond just considering content and activities, especially since "researchers have demonstrated that teachers' plans influence the content of instruction" (Clark & Peterson, 1984, p. 40).

The intended Outcome of the Intervention

The intended outcome for this phase is for the teacher (a) to be able to design a coherent unit as outlined above, and (b) report a greater level of understanding on how rigor is systematically developed within a concept-based unit.

Materials and Resources

   The following materials will support this phase's work:

1. Unit planner (UPPER)

2. UPPER Rubric

3. Selected samples of Erickson (2002) to explain how to design a concept-based unit and the essential considerations/elements

4. Training by the researcher

5. Pre- and Post-Reflections

Agenda and Timeline

Table 2

Agenda for developing a rigorous concept-based unit in a four-week intervention

Week	**Focus.** Preparing for the intervention and its requirements	
	Actions	Data collection
1 M/D/YY through M/D/YY	1. Teachers will be presented with the purpose and rationale of this phase 2. Teachers will complete the pre-reflection (electronic document)	Teachers' complete pre-reflection on their current process for developing units of study, and explain how rigor features into their design

Week		
	Actions	Data collection

2
 	
M/D/YY through M/D/YY
	Teachers will use their previously taught unit (as part of their involvement in Phase II), and receive specific training on how to:
	  (a) select and unpack relevant standards,
	  (b) list the KUDs, SP, DI
	  (c) design a rigorous final performance task/assessment, and
	  (d) develop an increasingly rigorous and general sequence leading to the final assessment
		Researcher reflection/meeting notes on teachers' involvement, their developing process and training

Week		
	Actions	Data collection

3
 	
M/D/YY through M/D/YY
	Teachers will use a current or upcoming unit and collectively design a coherent and rigorous unit by employing the following steps:
	  (a) select and unpack relevant standards,
	  (b) list the KUDs, SP, DI
	  (c) design a rigorous final performance task/assessment, and
	  (d) develop an increasingly rigorous and general sequence leading to the final assessment
		2 units of study, and scored by
		
		The UPPER Rubric
		
		Evidence of rigor to be measured by the Hess (2013) Matrix

Week		
	Actions	Data collection
4 M/D/YY through M/D/YY	Teachers will complete the post-reflection (electronic document)	Teachers' complete post-reflection on their revised process for developing units of study, and explain how rigor featured into their design Teachers state whether the new method is more effective than their current method

Develop a response to the question: *Do the teachers report that a planning framework for developing a concept-based unit of study and specific training support provide them with greater clarity and understanding on how to design a coherent unit that incorporates increasingly rigorous tasks?*

UNIT PLANNING PROCESS TO ENSURE RIGOR (UPPER)

The emphasis should be on the application of knowledge and skills to solve realistic

problems/issues that exist in the world, which directly align with relevant standards. The process

should emphasize inquiry and students developing a conceptual understanding of content.

Subject: x   Grade level: x

1. Unit Topic		
x		
2. Standard(s) *(underline teachable nouns and circle verbs that students are to do)*		
x		
Knowledge *Concepts, Facts, Procedures*	**Skills** *Do*	**Student Needs**
x	x	x
3. Understanding/Big Ideas		
x		
4. Guiding or Essential Question(s)		
x		
5. Final Performance Task		
x		
6. Tasks and Sequence (includes tasks and formative assessments) x		

Note. Following the unit plan (UPPER), the teacher's next steps is to actualize this long range

plan into weekly plans using the Rigor Planning Matrix, and individual lessons.

UNIT PLANNING PROCESS TO ENSURE RIGOR (UPPER) RUBRIC

Subject: x   Grade level: x

Implementation component	1	2	3	4
Unpacking the standards	The standard is incorrectly or inappropriately unpacked, and does not explicate the essential KUDs	The standard is unpacked, but only explicates one or two of the essential KUDs	The standard is unpacked, and explicates most of the essential KUDs	The standard is accurately unpacked and clearly explicates the essential KUDs
Developing compelling/guiding or essential questions	The questions are not compelling, guiding or essential, and do not support the fostering of inquiry	The compelling, guiding or essential questions provide only a limited means to inquiry that most likely will not foster much of it	The compelling, guiding or essential questions provide a general means to inquiry that will most likely foster it, sporadically	The compelling, guiding or essential questions provide a clear means to fostering inquiry
Developing a final performance assessment *As measured by the Hess (2013) Matrix*	The final performance task is not cognitively challenging, authentic and realistic, and does not require the students to demonstrate a capacity to use various skills and knowledge/facts (identified in the standards), and demonstrate an understanding of key concepts and principles/ generalizations	The final performance task provides limited cognitive challenge, and may be only somewhat authentic and realistic. It only partially requires the students to demonstrate a capacity to use various skills and knowledge/facts (identified in the standards), but does not require them to demonstrate an understanding of key concepts and principles/ generalizations	The final performance task is somewhat cognitively challenging, and is mostly authentic and realistic. It only requires the students to demonstrate a capacity to use various skills and knowledge/facts (identified in the standards), but require them to demonstrate only a partial understanding of key concepts and principles/ generalizations	The final performance task is cognitively challenging, authentic and realistic, and clearly requires the students to demonstrate a capacity to use various skills and knowledge/facts (identified in the standards), and demonstrate an understanding of key concepts and principles/ generalizations
Designing a sequence of tasks (including formative assessments) that lead to higher level thinking/rigor *As measured by the Hess (2013) Matrix*	The general sequence does not lead to increasingly higher-level thinking, and does not prepare the students to successfully solve the problem presented in the final assessment	The general sequence may lead to some higher-level thinking, but will likely not prepare the students to successfully solve the problem presented in the final assessment	The general sequence mostly leads to increasingly higher-level thinking, and will likely prepare the students to successfully solve the problem presented in the final assessment	The general sequence effectively leads to increasingly higher-level thinking, and will certainly prepare the students to successfully solve the problem presented in the final assessment

COLLECTING AND ANALYZING INFORMATION ON THE INTERVENTION'S

IMPACT

The intervention's impact should be monitored closely and through the means specified here. The Instructional Intervention's impact is best determined through the scoring of two or more classroom observations of the teacher teaching a self-determined rigorous lesson using the Hess (2013) Matrix to measure task rigor, and the Implementation Rigor Rubric to measure the rigor of the teacher's implementation. Additional considerations on the impact should be gleaned from the scoring of the Rigor Planning Matrices (see Scoring Guide for the RPM), the teachers' weekly journal reflections (see Teacher Reflection Entries), and through the weekly planning meetings (see Weekly Meeting Data Collection Form).

The Planning Intervention's impact is best determined through the scoring of two the units of study plans (UPPER) using the UPPER Rubric. Additional considerations on the impact should be gleaned from the comparison of the pre- and post-reflections (see Unit Planning Process Reflections), and through the weekly planning meetings (see Weekly Meeting Data Collection Form).

Other ways to glean and measure the impact of both interventions is encouraged.

Measurement of the Instructional Intervention

The implementation of the intervention can be measured in the following ways:

1. Teachers engage in weekly reflection logs to reveal their thinking regarding rigor and the use of the instructional intervention.

2. Teachers schedule and conduct two classroom observations that demonstrate both tasks and implementation rigor using The Hess (2013) Matrix and The Implementation Rigor Rubric to score the lesson.

3. Teachers engage in weekly planning using the Rigor Planning Matrix document, to develop the rigor of the task, and the rigor of its implementation.

4. Teachers engage in weekly planning meetings and researcher training with an emphasis on them planning for rigor and discussing the level of students' thinking required from the tasks assigned to them.

The teachers' thoughts and learning throughout this process and captured in weekly reflection logs will provide discussion and talking points, as well as questions, for the weekly planning meetings. At this meeting, it is recommended that the members always begin by responding to the question: *How is it going with rigor?* It is hoped that teachers engage with their subject-area, grade-level colleagues to attend to the level of student thinking (rigor) as part of their instructional planning throughout the week and outside the specified meeting time.

TEACHER REFLECTION ENTRIES (Instructional Intervention)

Participant: Teacher X

Week 1: x

<div style="border:1px solid black; padding:10px">

This week, I have focused on (specific the aspect of rigor)?
x

Changes in my thinking regarding my planning, instruction and/or assessment have been…
x

The impact my work on rigor is having on my students has been…, and the evidence of this is….
x

Challenges or questions that have and are arising for me during this work have been/are…
x

Other thoughts (if any, determined by teacher)…
x

</div>

Week 2: x

<div style="border:1px solid black; padding:10px">

This week, I have focused on (specific the aspect of rigor)?
x

Changes in my thinking regarding my planning, instruction and/or assessment have been…
x

The impact my work on rigor is having on my students has been…, and the evidence of this is….
x

Challenges or questions that have and are arising for me during this work have been/are…
x

Other thoughts (if any, determined by teacher)…
x

</div>

Measurement of the Planning Intervention

The implementation of the intervention will be measured in the following ways:

1. Teachers complete a pre-reflection on their current planning process.

2. Teachers engage in weekly planning meetings and researcher training with an emphasis on discussing the development of the concept-based unit plans (UPPER) to incorporate rigor.

3. Teachers develop two rigorous concept-based unit plans (one from a previously taught unit, and one for an upcoming or current unit).

4. Teachers and researcher score the two unit plans (UPPERs) using the UPPER Rubric.

5. Teachers complete a post-reflection on their current planning process compared to the new process.

The teachers' thoughts and learning throughout this process and noted in their pre-reflections will provide discussion and talking points, as well as questions, for the weekly planning meetings. At this meeting, it is recommended that the members always begin by responding to the question: *How is it going with planning for rigor?* It is hoped that teachers engage with their subject-area, grade-level colleagues to attend to the level of student thinking (rigor) as part of their instructional planning throughout the week and outside the specified meeting time.

UNIT PLANNING PROCESS REFLECTION

Teacher: x   Subject: x   Grade level: x

Pre-Reflection	Thoughts, codes, categories
1. Describe your current process for planning and designing your units of study. Be sure to address each of the following in as much detail as possible: 　　a) Your decisions about the final assessment in the unit, 　　b) Your decisions about the activities and tasks and their sequence (from the beginning to the end of the unit), 　　c) Your decisions about how you measure the students' progress (formative assessments) throughout the unit, 　　d) How your unit planning includes rigor. 2. Are there any aspects of your planning for and designing your units that you feel are particularly positive? Challenging?	
x	

Teacher: x   Subject: x   Grade level: x

Post-Reflection	Thoughts, codes, categories
1. How does your current process for planning and designing your units of study compare to the newly trained process? Be sure to address each of the following in as much detail as possible: 　　a) The final assessment in the unit, 　　b) The activities and tasks and their sequence (from the beginning to the end of the unit), 　　c) The measures of students' progress (formative assessments) throughout the unit, 　　d) The inclusion of rigor. 2. Were there any aspects of the newly trained planning process for and designing your units that you feel were more effective than your current process? More challenging?	
x	

WEEKLY MEETING DATA COLLECTION FORM (Instructional & Planning Intervention)

Participants: x and x

Date: x/x/2016

Week: 1

Driving question: *How is it going with rigor?* or *How is it going with planning for rigor?*

Focus of the meeting:

Today, we are focusing on… x

Main learning:

Our main learning in this work, thus far, has been… x

Impact on students:

This has impacted students in the following ways… x The evidence is… x

Area of challenge:

An area of challenge, or a question is … x

Next Steps:

Our proposed next steps are… x

Notes
1. Outside of the discussion on rigor, what was the meeting focused on? Provide examples.
   x

2. Did the teachers discuss rigor without being prompted? If so, what was the conversation focused on? Provide examples.
   x