THE RELATIONSHIP BETWEEN TEACHER PEDAGOGY SKILLS, AS REPORTED BY THE NETWORK FOR EDUCATOR EFFECTIVENESS TEACHER EVALUATION SYSTEM, AND EIGHTH GRADE SCIENCE ACHIEVEMENT SCORES IN MISSOURI

by

Grant Lavoy Stock

Liberty University

A Dissertation Presented in Partial Fulfillment

Of the Requirements for the Degree

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ABSTRACT

Every year in thousands of schools across the United States high stake decisions are made regarding the retention, promotion, professional development, and training of staff using teacher evaluation instruments. Therefore, it is vital to determine if these evaluation instruments as well as the teaching strategies they measure are effective in improving student achievement. The purpose of this study was to see if there is a correlation between the scores eighth grade science teachers receive on the Network for Educator Effectiveness observation instrument for the teaching practices of cognitive engagement, problem solving and critical thinking, and formative assessment and how well their eighth grade science students performed on Missouri's state accountability test. The participants in the study consisted of 37 schools in the state of Missouri. There were 57 teachers who had their teacher evaluation scores on the Network for Educator Effectiveness observation instrument tied to their students' scores on the eighth grade science test for the state of Missouri. This study used archival data. The researcher utilized a linear regression analysis for this study to test the three null hypotheses to describe the strength and relationship between each predictor variable and the criterion variable. It was discovered that all three predictor variables of cognitive engagement, problem solving, and critical thinking, and formative assessment were significantly correlated to the criterion variable of students' scores on the eighth grade science test for the state of Missouri. It was concluded that resources spent by educators in developing this teaching practices would help increase their student's performance. In addition, further studies into the effectiveness of the Network for Educator Effectiveness teacher evaluation system should be examined

Keywords: teacher evaluations, student achievement, science, teaching strategies, Network for Educator Effectiveness, Missouri Assessment Program, Teacher Indicators.

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List of Abbreviations

American Association for the Advancement of Science (AAAS)

Assessment Resource Center (ARC)

Department of Elementary and Secondary Education (DESE)

Depth-of-knowledge (DOK)

Elementary and Secondary Education Act (ESEA)

Gross domestic product (GDP)

Interstate Teacher Assessment and Support Consortium (InTASC)

Missouri Assessment Program (MAP)

Missouri Comprehensive Data System (MCDS)

Missouri Learning Standards (MLS)

Missouri Model Teacher and Leader Standard (MMTLS)

National Defense Education Act (NEDA)

National Research Council (NRC)

National Science Foundation (NSF)

Network for Educator Effectiveness (NEE)

New Interstate Teacher Assessment and Support Consortium (InTASC)

No Child Left Behind (NCLB)

Regional Professional Development Center (RPDC)

Science Technology Engineering and Mathematics (STEM)

CHAPTER ONE: INTRODUCTION

Overview

The purpose of this quantitative correlational study was to examine the relationship between the eighth grade science teacher's observation scores and academic achievement scores of their students on the Missouri Assessment Program eighth grade science test. This chapter includes a background on how science standards and the Network for Educator Effectiveness came about in the state of Missouri. It also includes statement of the problem this study seeks to address and the significance of this study. The chapter concludes with the research question this study seeks to answer, the null hypothesis, and some common definitions associated with the chapter.

Background

The United States, as well as many other countries, have made a habit of turning to education for change when threats emerge, both real and challenged (Barrow, Concannon, & Wissehr, 2011; Marx & Harris, 2006; Permuth & Dalzell, 2013). Some examples can be found in the changes made to education in the wake of events such as Sputnik (Barrett, 2012; Barrow et al., 2011) and A Nation at Risk (National Commission on Excellence in Education, 1983). Both of these events created major changes in educational programs and policies. Most recently the United States has been wringing its collective hands over the emergence of a new global economy and the idea of economic competitiveness (Marx & Harris, 2006).

Reports regarding low science literacy among students have led to the development of national science standards and a push for an increase in STEM education. For example, employers in STEM fields claim they often hire international students over students from the United States because U.S. students lack STEM literacy (U.S. Department of Education, 2011).

According to the National Assessment of Educational Progress, only 35% of eighth grade students are proficient in STEM. (U.S. Department of Education, 2011). Trends in the International Mathematics and Science Study and the Program for International Student Assessment show U.S. students lag behind those of other countries in math and science (Marx & Harris, 2006). As a result of the national push for science standards, the state of Missouri has implemented the Missouri Learning Standards (MLS) in science as well as other subject areas and developed the Missouri Assessment Program (MAP) to evaluate how well students are doing in the area of science (Department of Elementary and Secondary Education, 2015).

In 1993, the Department of Elementary and Secondary Education (DESE) began working with teachers, school administrators, parents, and business professionals to develop the Missouri Learning Standards (MLS) (Department of Elementary and Secondary Education, 2016). The MLS delineates the knowledge, skills, and abilities students need to acquire at each grade level and/or course to progress toward being college and career ready along with targets for the statewide summative assessments (Department of Elementary and Secondary Education, 2015a). The MLS provide the minimum content expectations for each grade and course and provide the clarity and consistency teachers need to make sure their students are on track and equipped with the knowledge and skills they need to succeed (Department of Elementary and Secondary Education, 2015b).

In 2001, the federal No Child Left Behind (NCLB) legislation was enacted requiring states to have in place science assessments. These assessments were to be administered at least once in grades three to five, once in grades six to nine, and once in high school (Department of Elementary and Secondary Education, 2016). The Missouri State Board of Education determined to modify their assessment program to meet the requirements of NCLB. The

Missouri Assessment Program Grade-Level Assessments are a result of that decision (Department of Elementary and Secondary Education, 2016).

The Missouri Assessment Program (MAP) Grade-Level Assessment incorporates both the Missouri Learning Standards (MLS) and the requirements of NCLB (Department of Elementary and Secondary Education, 2016). The MAP Grade-Level Assessments measure "student mastery toward post-secondary readiness, identifies students' strengths and weaknesses, communicates expectations for all students, serves as the basis for state and national accountability plans, and providing professional development for teachers" (Department of Elementary and Secondary Education, 2016, p 3). By incorporating these components into the MAP assessment, Missouri was able to satisfy the requirements of NCLB and still maintain the standards they wanted to promote as a state.

Because of the push to improve STEM education in the U.S. and the recognition of the important role science education plays in our future economy (Bisaccio, Donovan, Mateos, & Osborne, 2014; Marx & Harris, 2006), it essential to look for ways to improve Missouri student mastery of scientific concepts. In 2014, 52.5% of Missouri students scored either proficient or advanced on the eighth grade Missouri Assessment Program (MAP) for science. In 2015, 48.9% of Missouri students scored either proficient or advanced on the eighth grade Missouri Assessment Program (MAP) for science (Department of Elementary and Secondary Education, 2016). These low proficiency scores on the eighth grade science test scores as well as the decline in proficiency suggest that this is an area where Missouri needs to improve.

In 1983, the Missouri legislature adopted a statute directing the board of education of each school district to create a comprehensive performance-based evaluation for each teacher employed by each district (Department of Elementary and Secondary Education, 2014). In June

2010, state Senate Bill 291 was passed, requiring school districts to adopt specific teaching standards as a part of each districts teacher evaluation program (Department of Elementary and Secondary Education, 2015c). In response to this need, the Department of Elementary and Secondary Education (DESE) organized and initiated a working group of key stakeholders which included all major educational organizations in the state, nearly two-thirds of the educator preparation institutions, and representation from over 30 public school districts (University of Missouri College of Education, 2012). This working group developed what is now known as the Missouri Model Teacher and Leaders Standards. There are seven essential principles which are:

Standard #1: Content Knowledge and Perspectives Aligned with Appropriate Instruction

Standard #2: Understanding and Encouraging Student Learning, Growth and Development

Standard #3: Implementing the Curriculum

Standard #4: Teaching for Critical Thinking

Standard #5: Creating a Positive Classroom Learning Environment

Standard #6: Utilizing Effective Communication

Standard #7: Use of Student Assessment Data to Analyze and Modify Instruction.

(Department of Elementary and Secondary Education, 2015, pp. 5-6)

These seven standards are broken down further into 36 indicators in order to more fully define each standard. These seven essential principals and 36 indicators make up the Missouri Model Teacher and Leader Standards (Department of Elementary and Secondary Education, 2015b) University of Missouri College of Education, 2012; Vandeven, 2015;). These standards were approved in June 2011 by the Missouri State Board of Education (Vandeven, 2015, p. 99).

In 2012, Missouri set forth the Missouri Model Teacher and Leader Standards as a part of the Elementary and Secondary Education Act (ESEA) flexibility waiver which established a new set of accountability requirements to replace those set forth by No Child Left Behind (NCLB) (U.S. Department of Education, 2012). A mandatory teacher evaluation system for school districts, based upon these learning standards, was a part of the ESEA flexibility waiver. The Network for Educator Effectiveness was developed by the University of Missouri to help school districts meet this need of having a mandatory teacher evaluation system based upon the requirements of the ESEA flexibility waiver (University of Missouri, 2015).

The Network for Educator Effectiveness (NEE) is a teacher evaluation system developed by two separate auxiliary units of the College of Education at the University of Missouri; the Heart of Missouri Regional Professional Development Center (RPDC) and the Assessment Resource Center (ARC). In addition, the program was developed with input of educators from Missouri school districts and faculty from the University of Missouri College of Education (University of Missouri College of Education, 2015). The classroom observation instrument, which is part of the web-based tools developed by NEE, is based upon the Missouri Model Teacher and Leader Standard (MMTLS) approved by the state Board of Education in June 2011. This system has become the most widely used system in the state of Missouri for teacher evaluations (Network for Educator Effectiveness [NEE], 2016).

The State of Missouri has implemented the Missouri Learning Standards (MLS) and developed the Missouri Assessment Program (MAP) to evaluate how well their students are doing in science, as well as other subject areas. In addition, the State of Missouri has chosen to adopt a teacher evaluation model to determine the effectiveness of classroom teachers. The Network for Educator Effectiveness (NEE) has the largest number of school districts enrolled of any specific teacher evaluation model in the state of Missouri; 269 school districts participating in their model (University of Missouri College of Education, 2015). Therefore, it stands to reason the effectiveness of the NEE model to improve student achievement, in the area of science, needs to be studied.

Problem Statement

The teacher may be the single most important factor affecting student achievement that schools can control (Danielson, 2007; Hattie, 2013; Marzano, 2007). Numerous studies have used value-added models to examine a teachers' influence on student achievement; however, few empirical studies have linked what effective versus less effective teachers do differently (Stronge, 2013). Although there is a general agreement teacher quality (pedagogy) matters, there is no consensus on which aspects of teacher quality have the greatest impact on student learning (Muñoz, Scoskie, & French, 2013).

One way to observe teacher qualities in the classroom is through teacher evaluation systems. Although there have been many teacher evaluation systems put into place over the years, there continues to be an overall dissatisfaction with teacher evaluations systems (Marshall & Oliva, 2010). Research clearly shows the current body of teacher evaluation systems is ineffective when it comes to helping teachers know and understand changes they need to make in their instructional strategies (Stoelinga, 2012). In addition, the feedback they receive is not delivered in a timely fashion (Marshall, 2009). This lack of effective evaluation systems is what fuels supervisor practices that harass teachers in hopes of driving them out of the profession (Stoelinga, 2012).

Current teacher evaluations lack the evidence to support any validity to the process (Aseltine, Faryniarz, & Rigazio-Digilio, 2006; Danielson & McGreal, 2000; Marshall, 2009).

The criteria are not based in research, and the evaluators are typically inadequately trained (Marzano, Frontier, & Livingston, 2011; Danielson & McGreal, 2000; Jacobson, 2005). As a result, incompetent teachers receive ratings which are too lenient and superior ratings are rewarded to average teachers (Jacob & Lefgren, 2006; Marshall, 2009; Stronge, Ward, Tucker, & Hindman, 2008). All this lends itself to a process which has little effect upon improving the quality of teaching in the classroom (Aseltine et al., 2006; Nuthal, 2004; Stoelinga, 2012).

Yet, Marshall (2009) stated the most important time one can spend as an administrator is in the classroom observing teachers and students. In addition, it has been shown accountability and performance measurements are inextricably linked (Aseltine et al., 2006; Marzano et al., 2011). In fact, the interpretation of performance requires accountability as its reference (De Villiers, Harrison, & Rouse, 2012).

One theme that emerged as the research was studied regarding the use of teacher evaluations to improve student performance is the different components of teacher evaluations, such as pedagogy, matter (Christie, Hayes, & Smith, 2013; Hadfield, Hutchins, & Snyder, 2012; Little, Goe, & Bell, 2009; Ripley, 2012; & Washington, 2011). Additional studies need to be conducted to examine the relationship between the score a teacher receives on his or her classroom observations and student achievement to help establish what pedagogies have the greatest impact on student learning as there are currently a small number of existing studies done in this area (Evans, 2014; Garnet, 2013; Peplinski, 2009; Stronge et al., 2008).

In addition, there is growing concern the United States of America is not preparing a sufficient number of students, teachers, and practitioners in the areas of science (U.S. Department of Education, 2011; Marx & Harris, 2006). This educational concern is driven by the large number of secondary school students who fail to reach proficiency in science (Hernandez et al., 2013).

Purpose Statement

The purpose of this quantitative correlational study was to examine the relationship between the predictor variable (scores received by eighth grade science teachers on the Network for Educator Effectiveness observation instrument for Indicator 1.2, Indicator 4.1, and Indicator 7.4) to the criterion variable (academic achievement scores of their students on the Missouri Assessment Program eighth grade science test). Indicator 1.2 is defined as "the teacher cognitively engages students in the subject matter" (University of Missouri College of Education, 2012, p. 11), Indicator 4.1 is defined as "the teacher uses instructional strategies leading to student problem-solving and critical thinking" (University of Missouri College of Education, 2012, p. 13), and Indicator 7.4 is defined as "the teacher monitors the effect of instruction on individual/class learning - Formative assessment" (University of Missouri College of Education, 2012, p. 15). The sampling for this study consisted of archived data collected from 37 schools in the state of Missouri utilizing the Network for Educator Effectiveness (NEE) model for teacher evaluations for the 2015-2016 school year.

Significance of the Study

Administrators use evaluation instruments to make high-stakes decisions regarding professional development the retention and promotion of staff and school goals. Since it has been shown teachers are the single greatest contributing factor to student achievement in schools (Hattie, 2013; Coggshall, Colton, Jacques, Milton, & Rasmussen, 2012; Marzano et al., 2011), it is vital to see if teacher observations are effective and what teaching practices tend to have the greatest impact on student achievement. Numerous studies have used value-added models to examine a teacher's influence on student achievement; however, few empirical studies have linked what effective versus less effective teachers do differently (Stronge et al., 2008). Although there is a general agreement teacher quality matters, there is no consensus on which aspects of teacher quality (pedagogy) have the greatest impact on student achievement (Muñoz et al., 2013). This study will aid in the future refinement of a system to promote those teacher qualities that have the greatest impact on student learning. Such a system will increase teacher effectiveness, therefore increasing student achievement.

Macroeconomic studies have established a clear link between student achievement on science tests and per capita gross domestic product (GDP) growth (Bisaccio et al., 2014). However, studies show U.S. students frequently rank below other countries on international science exams (Program for International Student Assessment [PISA], 2012; Provasnik, Gonzales, & Miller, 2009; Trends in International Mathematics and Science Study [TIMSS], 2011). With this in mind, finding ways to improve science achievement on science tests is crucial. This study will help to determine if there is a correlation between a teacher's pedagogy skills as reported by scores on classroom observation instruments and student achievement on eighth grade student science test scores.

Research Questions

RQ1: Is there a relationship between the criterion variable (the average achievement scores for an eighth grade class on the eighth grade science Missouri Assessment Program test) and the predictor variable (eighth grade science teachers' observation scores for Indicator 1.2, cognitive engagement) for the 2015-2016 school year?

RQ2: Is there a relationship between the criterion variable (the average achievement scores for an eighth grade class on the eighth grade science Missouri Assessment Program test) and the predictor variable (eighth grade science teachers' observation scores for Indicator 1.4, problem solving and critical thinking) for the 2015-2016 school year?

RQ3: Is there a relationship between the criterion variable (the average achievement scores for an eighth grade class on the eighth grade science Missouri Assessment Program test) and the predictor variable (eighth grade science teachers' observation scores for Indicator 7.4, formative assessment) for the 2015-2016 school year?

Null Hypotheses

$H_0$1: There is no significant relationship between the criterion variable (the average achievement scores for an eighth grade class on the 8th grade science Missouri Assessment Program test) and the predictor variable (eighth grade science teachers' observation scores for Indicator 1.2, cognitive engagement) for the 2015-2016 school year.

$H_0$2: There is no significant relationship between the criterion variable (the average achievement scores for an eighth grade class on the eighth grade science Missouri Assessment Program test) and the predictor variable (eighth grade science teachers' observation scores for Indicator 1.4, problem solving and critical thinking) for the 2015-2016 school year.

$H_0$3: There is no significant relationship between the criterion variable (the average achievement scores for an eighth grade class on the eighth grade science Missouri Assessment Program test) and the predictor variable (eighth grade science teachers' observation scores for Indicator 7.4, formative assessment) for the 2015-2016 school year.

Definitions

The following terms are terms pertinent to this study.

1. *Assessment Resource Center (ARC)* - The Assessment Resource Center is a division of the University of Missouri; the ARC provides assessment, survey, and data services to

educational agencies, health organizations, and other non-profit institutions (University of Missouri, 2012.

2. *Cognitively engagement* - Cognitive engagement in the classroom is a students' active mental involvement in the learning activities or mental effort such as meaningful processing, strategy use, concentration, and metacognition (University of Missouri, 2015).
3. *Department of Secondary and Elementary Education (DESE)* - DESE is Missouri's governing body for K-12 public education. They provide resources, governance, and support to Missouri's public school districts (DESE, 2015a).
4. *Formative Assessment* - Formative assessment is an ongoing process of collectively analyzing specific evidence to determine the targeted learning needs of each child and the effectiveness of the instruction the child receives in meeting these needs (Buffum, Mattos, & Weber, 2012).
5. *Indicator 1.2* - Indicator 1.2 is when the teacher cognitively engages students in the subject matter (University of Missouri College of Education, 2012).
6. *Indicator 4.1* - Indicator 4.1 is when the teacher uses instructional strategies that leads to student problem-solving and critical thinking (University of Missouri College of Education, 2012).
7. *Indicator 7.4* - Indicator 7.4 is when the teacher monitors the effect of instruction on individual/class learning by using formative assessment (University of Missouri College of Education, 2012).
8. *Missouri Assessment Program (MAP)* - The Missouri Assessment Program assesses students' progress toward mastery of the Show-Me Standards, which are the educational

standards in Missouri. The Grade-Level Assessment is a yearly, standards-based test which measures specific skills defined for each grade by the state of Missouri. All students in grades three through eight in Missouri take the grade level assessment (DESE, 2014)

9. *Missouri Model Teacher and Leader Standards* - The Missouri Model Teacher and Leader Standards outline what educators should know and be able to do to ensure students in Missouri public schools continually grow and improve. The standards outline the basic principles of teaching and best practices for helping students be successful (MODESE, 2014).
10. *Network for Educator Effectiveness (NEE)* – The NEE is an online system for teacher evaluation and was developed by the University of Missouri. It is based upon the Missouri educator standards and indicators and includes an observation instrument and other measures of teacher performance (University of Missouri, 2015).
11. *Problem Solving and Critical Thinking* - Critical thinking is purposeful, reasoned, and goal oriented. It is the kind of thinking used to problem solve, formulate inferences, calculate likelihoods, and make decisions (Halper, 1998).
12. *Professional Development* - For this study, professional development is defined as the teacher's or supervisor's focus on the development of professional expertise using problem solving and inquiry (Peplinski, 2009). Most educational organizations have a set program and committee to oversee this process. Most are tied to the vision and goals of the organization as well as it teacher evaluation system.
13. *STEM literacy* - STEM literacy is defined as "the knowledge and understanding of scientific and mathematical concepts and processes required for personal decision making, participation in civic and cultural affairs, and economic productivity" (National Research Council, 2011, p. 5).

14. *Supervision* - Ryan and Gottfried's (2012) definition of supervision is a common vision developed collaboratively and brought into reality together. It forms connections in order to focus organizational and individual goals, objectives, and efforts into an overarching strategy (Ryan & Gottfried, 2012). Kilminster's definition of supervision is: The provision of guidance and feedback on matters of personal, professional and educational development in the context of the trainee's experience of providing safe and appropriate education to students (Rudland, Bagg, Child, de Beer, & Hazell, 2010).
15. *Teacher Evaluation System* - A teacher evaluation system is a system of methods and strategies a school or organization uses to provide supervision, evaluation, and professional development to its staff (Peplinski, 2009).

CHAPTER TWO: LITERATURE REVIEW

Overview

The cry for greater accountability in reference to student achievement, especially in science education, has reached new heights over the last two decades. The debate is not a new one and extends back to the 1960s when the federal government began examining if federal funds were producing desired results (Lewis & Young, 2013). This examination led to reports, programs, and policies such as The National Defense Education Act (Barrow, Concannon, & Wissehr, 2011), A Nation at Risk (Goldberg & Harvey, 1983), No Child Left Behind (Marx & Harris, 2006), New Interstate Teacher Assessment and Support Consortium (InTASC) standards (Department of Elementary and Secondary Education, 2015b), the Common Core (Albers, Dooley, Flint, Holbrook, & May, 2016), and Science Technology Engineering and Mathematics (STEM) education (Bisaccio et al., 2014). All this points to the political and social push for schools to change and become more accountable for what they are doing to improve student achievement (Munro, 2013). Accountability is no longer an elusive concept but has become an essential component of educational policies (Wong, 2013).

As a result of this current climate of educational change, schools are scrambling for ways to meet the demands of increased accountability for student achievement. As states failed to meet the demands set by No Child Left Behind (NCLB), the federal government's Department of Education allowed states to draft waivers of what they would do to meet the needs of our failing students (ESEA Flexibility Waver, 2015). As a part of Missouri's request for flexibility from NCLB, one of the nine components they agreed to implement into their educational plan was the use of an effective teacher evaluation system to help create more highly-qualified teachers (ESEA Flexibility Waver, 2015; DESE, 2015b).

The history of teacher evaluation is a common and complex one our nation has studied, changed, and sought to perfect for hundreds of years (Peplinski, 2009). The common thread in teacher supervision in schools today is the desire to improve classroom instruction (Marshall, 2009; Marzano et al., 2011). Looking at the history of supervision in the United States helps establish the components of teacher evaluations of today (Tracy, 1995). The purpose of this quantitative correlational study was to examine the relationship between the eighth grade science teachers' observation scores and academic achievement scores of their students on the Missouri Assessment Program eighth grade science test.

This chapter includes a history of teacher evaluation systems, a description of the Network for Educator Effectiveness teacher evaluation system, and efforts in Missouri to reform science and teacher standards. A literature review of the teaching standards that this study focuses on: student engagement, problem solving and critical thinking, and formative assessment. It reviews efforts that have been made to use value added models to teacher evaluations and the relationship between the Missouri Department of Education and the Network for Educator Effectiveness.

Related Literature

History of Teacher Evaluations

Education was not considered a professional field of study in the early days of the United States (Marzano et al., 2011). The Massachusetts School Law of 1647 required towns to establish schools and instructed community leaders to monitor these schools as well. Generally, the community leadership was composed of clergy, merchants, and representatives of other professions (Tracy, 1995). Usually the community leader the towns used to supervise the teacher was the clergyman. These individuals seemed ideal to oversee teachers since they had extensive education and the ability to religiously guide those teaching at the school (Marzano et al., 2011).

Several assumptions underlay the supervision practices of teachers during this time. First, supervisors had a right to intervene directly in the classroom (Burke & Krey, 2005). Second, the teacher was the servant of the community and was expected to respond to the community's directives (Bolin & Panaritis, 1992). Third, effective instruction was established by the community and was defined in terms of desired outcomes (Tanner & Tanner, 1987). The power vested in the committee to immediately dismiss the teacher meant the observers' suggestions were meant to be taken seriously (Tracy, 1995).

Through the 1800s, a rising industrial base and common school movements toward larger urban areas necessitated more complex school systems (Marzano et al., 2011). During this time period, the responsibility for the overall operation of schools shifted from the community leaders to a more hierarchical system that included superintendents, principals, and teacher trainers (Tracy, 1995). During this time period in America, pedagogical skills were determined as necessary skills for effective teaching (Blumberg, 1985). There was no formal discussion regarding what these specifically pedagogical skills for effective teaching were, only an agreement that pedagogical skills were important (Blumberg, 1985). This recognition was a beginning step in helping to develop the concept of teacher effectiveness (Marzano et al., 2011).

There were three assumptions underlying the practices occurring for supervision of teachers during this time period. First, good teaching was at the heart of the public schools ideal (Blumberg, 1985). Second, education was becoming too complex to be overseen by laypersons and therefore required professional educators to supervise teachers (Blumberg, 1985). Third, the most pragmatic way to improve instruction was by training teachers through institutions and teacher training programs (Tracy, 1995). These three assumptions helped drive the teacher evaluations during this time (Tracy, 1995).

The transfer of scientific principles associated with business management - control, accountability, and efficiency - into the supervision of education was the trend that defined the beginning of the 1900s (Tanner & Tanner, 1987). This trend in education came from Taylor's (1911)belief that the measurement of behaviors of factory workers would lead to the best solutions to improve productivity. Taylor argued if there were 100 ways to do a task, some methods would be more efficient than others (Taylor, 1911). This popular concept, developed by Taylor, found its way into education during the early 1900s (Tanner & Tanner, 1987). Schools began to be seen as factories whose product was students and their education.

Cubberley (1916) proposed that schools should be modeled after factories. The raw product they were to shape and fashion to meet the various needs of society were the children who they were responsible to educate (Cubberley, 1916). Using this analogy, schools began to emphasis the use of measurement and analysis of data to ensure they were being efficient at educating students to be prepared for the various demands of life. This emphasis on scientific measurement led to increased prominence for the supervisor to do classroom observations and gather data (Wetzel, 1929). Many educators turned to observation checklists to help them obtain this data, a common practice still used today (Tracy, 1995).

The assumptions that drove the scientific phase were first that research and measurement could provide supervisors with a firm base on which to judge the quality of instruction (Wetzel, 1929). Second, teachers would find their best assistance in this area from those who knew the best procedures to use for any given educational task, namely supervisors (Cubberley, 1916).

This may be viewed as a precursor for using data to give feedback in teacher evaluation methods today.

In the 1930s and 1940s, there was a swing of the pendulum away from the scientific measurement and data-driven feedback to the teacher as a person or individual (Tracy, 1995). This shift was fostered by the Great Depression, an increased awareness of the inequalities found in our society, and the development of the social sciences (Marzano et al., 2011). In addition, some of the theories derived from the well-known Hawthorn studies seemed to fly in the face of Taylor's (1911) philosophy and suggested the importance of paying attention to workers' needs (Lindner, 1998).

Barr, Burton, and Brueckner (1947) described this period as one where the emphasis switched from a teacher-centered model to one focusing on the school's cultural environmental, specifically from authority to collaboration. Cooperation was the theme of teacher evaluation systems during this particular time. Clement and Clement (1930) pointed out the social and psychological needs of teachers became a high priority at this time to insure teachers were effective. Supervisors concentrated on building positive relationships with their staff and emphasizing the individuality of each teachers (Coleman, 1945). One unfortunate consequence of this relationship was supervisors sometimes feared upsetting the relationship and therefore did not conduct direct classroom observation. All too often this type of relationship resulted in a *laissez-faire* type mentality in regards to providing assistance to teachers through evaluation (Tracy, 1995).

In the second wave of scientific evaluations, the teacher, not just the principal, became responsible for observing and analyzing their own classroom data to improve the quality of teaching in the school (Tracy, 1995). The effective teaching research of the 1970s and 1980s were prime examples of the scientific side of this balancing act (Hunter, 1982; Tracy 1995). Although Hunter was best known for the seven step model of lesson preparation, Hunter contributed many significant ideas to teacher evaluations as well (Hunter, 1982). Hunter championed professional development as a way to articulate a common language of study, identified a variety of purposes for supervisory conferences, and developed observation and script taping. In short, Hunter's model became the component for teacher evaluations in most states across the country (Fehr, 2001). Teacher evaluation models would follow this pattern for many years.

The first human relations phase had little success because it allowed teachers freedom without equipping them with the tools to be effective. The scientific phases developed the tools but lacked teacher freedom (Marzano et al., 2011). The emergence of clinical supervision was the tool which allowed the ability to combine the two (Tracey, 1995). Few innovations in the history of education spread as quickly as clinical supervision. It was to the humanistic movement what the Hunter model was to the scientific movement (Bruce & Hoehn, 1980). By 1980, one study found 90 percent of school administrators used some form of clinical supervision (Bruce & Hoehn, 1980). The process involved a purposeful relationship between supervisor and teacher, where discussion and observation were used to help both parties reach higher levels of growth and effectiveness (Cogan, 1973).

The primary purpose of clinical supervision was to assist teachers by having the supervisor and teacher analyze performance together (Cogan, 1973). Clinical supervision creates a sustained cycle of support between the administrator and teacher to improve teaching in the classroom through the shared insights of both (Goldhammer, 1969). Additionally, a positive teacher/supervisor association is vital for effective supervision. This model requires the supervisor to be highly skilled in data collection, feedback, and relationship building (Goldhammer, 1969).

The balance between the scientific and humanistic aspect of teacher evaluations represents the striving of education to find a balance between the scientific values of measurement, data, and performance with the humanistic values of the uniqueness of the individual and their personal needs (Tracy, 1995). Each of these new swings can be thought of as extensions of previous stages and not necessarily new phases. Many may describe it as a pendulum swing, but a balancing act seems to fit better (Lucas, 2013).

In 1996, an evaluation was published by Danielson (Danielson, 2007) that focused on measuring the competency of pre-service teachers. Given the past and current popularity of Danielson's work, the Danielson model could be the reference point for any new proposals regarding supervision and evaluation (Marzano et al., 2011). Danielson's framework consisted of four domains: planning and preparation, the classroom environment, instruction, and professional responsibility (Danielson, 2007). The intent of the framework was: to honor the complexity of teaching, to create a language for professional education, and to provide a framework for assessment and reflection of professional practices (Danielson, 1996). Where Hunter (1982) helped clarify the steps in the teaching process, and clinical supervision helped establish the supervisory process, Danielson (Danielson, 2007) helped to capture the dynamic process of classroom teaching.

There have been many different practices throughout the history of education that have led to the current model of teacher evaluations today (Danielson, 2007; Hunter, 1982; Marzano et al., 2011; Tracy, 1995). Some of these started with the simple concept of the need to have supervisors and that those supervisors be professionals familiar with good teaching practices

(Marzano et al., 2011; Tracy, 1995). Others were more concrete models such as clinical supervision (Bruce & Hoehn, 1980) and models developed from the work done by known experts in their field such as Danielson (2007) and Hunter (1982). All these past experiences in public education helped to build the foundation for the supervision systems used today (Danielson, 1996; Hunter, 1982; Marzano et al., 2011; & Tracy, 1995).

The Network for Educator Effectiveness

In 2012, teacher evaluations received greater attention in the state of Missouri due to the new ESEA flexibility waiver which established a new set of accountability requirements which replaced those set forth by NCLB (Department of Elementary and Secondary Education, 2015b). In response to the need to develop teaching and leader standards for the ESEA waiver, the Missouri Department of Elementary and Secondary Education (DESE) organized a workgroup of key stakeholders which included all major educational organizations in the state, nearly two-thirds of the educational preparation institutes, and representation from over 30 public school districts. This group developed the Missouri Model Teacher and Leader Standards (Department of Elementary and Secondary Education, 2015b). These teaching standards consisted of nine standards and 36 indicators. All evaluation models in the state of Missouri are required by DESE to evaluate teachers based upon these 36 indicators as well as to provide support and training on these indicators as needed (Department of Elementary and Secondary Education, 2015b). All teacher evaluation systems adopted by school districts in the state of Missouri are required to contain the following components: classroom observations, a professional development plan for teachers, student and teacher artifacts, evaluations of teachers by students, and student academic assessments.

The Network for Educator Effectiveness (NEE) out of the University of Missouri was established in order to help school districts meet the obligations set forth by the DESE regarding teacher evaluation systems. NEE is a comprehensive educational assessment system designed by a partnership of experts on professional development and assessment within the University of Missouri's College of education (Network for Educator Effectiveness, 2015). NEE offers professional development specific to the 36 indicators set forth by Missouri teaching standards. The program provides training, evaluation, and data management resources for measuring teacher professional practices on the 36 indicators set forth by Missouri Model Teacher and Leader Standards. Over 220 Missouri public school districts (25,000 teachers evaluated) are using the Network for Educator Effectiveness model to meet the criteria set forth by DESE in regards to teacher evaluations (Network for Educator Effectiveness, 2015).

Because a teacher's influence on student achievement is important, looking at teacher evaluation systems as a way to improve teacher effectiveness may be a vital component in the educational system. Looking at science reform and standards can also give additional insights into the importance of teacher evaluations as it relates to student achievement.

Reform Efforts to Produce Science Standards

According to the National Assessment of Educational Progress, only 35% of eighth grade students are proficient in mathematics, and there are significant gaps in scores between White students and other subgroups (e.g., African American, Hispanic, and low-income; U.S. Department of Education, 2011). Trends in International Mathematics and Science Study as well as the Program for International Student Assessment show students in the U.S. lag behind those of other countries in science education (TIMSS, 2011; PISA, 2012). This poor performance on international tests and the notion that many of U.S. students are ill-prepared for today's global economy has caused many to push for new and higher standards for science (Trust, 2014).

Of course this push for science standards in U.S. education is not a new one. In 1892, the Committee of Ten was organized by the National Education Association to address the issue of having uniform college entrance requirement (Cooley, Dealey, Ellwood, Fairchild, Giddings, Hayes, Ross, Small, Weatherly, & Dowd 1912). Some of the important recommendations the Committee of Ten made were:

- biology should precede chemistry and physics,
- the usefulness of the laboratory component should be emphasized, comprising at least 60% of class time,
- physiology should be taught during the latter part of the high school years,
- the primary purpose of any science course was acquisition of knowledge and intellectual growth from the careful observation of nature, and
- students should make careful sketches and drawings of observed specimens. (Cooley, Dealey, Ellwood, Fairchild, Giddings, Hayes, Ross, Small, Weatherly, & Dowd 1912)

Although many argue today the Committee of Ten made many mistakes that continue today, such as putting biology ahead of physics and chemistry, the major point to understand is it was a beginning step to establish a national science curriculum (Vazquez, 2006)

Another important advocate in the early efforts to produce science standards was Dewey. One of his beliefs in life was to help deepen the hold and develop the scientific habit of mind in the American society. Dewey felt science teaching has suffered because science was so frequently presented as ready-made knowledge, subject matter, fact, and laws, rather than as an effective method of inquiry into any subject matter (Dewey, 1910). Dewey's philosophy is a discussion that continues today when it comes to developing science standards (Vazquez, 2006).

Harvard President James Conant (1946) encouraged the establishment of the National Science Foundation and the establishment of a scholarship fund created by Congress to encourage a greater number of youth to take up science education. Conant urged the promotion of science in education, stating that the nation did not have the scientific manpower to fulfill the jobs that would be needed to insure America's future (Conant, 1946). Conant felt the bottleneck in scientific advancement was simply a manpower problem. Conant's answer was to locate the scientists when they were young and give them a long and expensive science education (Conant, 1946). Conant (1946) suggested America's welfare as a free society in an industrial age depended upon the continuous advance of science and the application of this new knowledge to a useful end, the quality and quantity of scientists and engineers available in a nation a long and expensive education beyond high school available to those pursuing a career in science, and removing the financial barrier preventing many boys and girls of high ability from going on with an advanced education must be overcome.

Although many of the early reformers had a great impact on the developments in science education and the pushing forward of science standards, perhaps nothing has had as great an impact as the launching of the Soviet satellite Sputnik on October 4, 1957 (Barrow, Concannon, & Wissehr, 2011). The launch deeply shook the American people's confidence in their technological superiority to Soviet Russia and left government officials, politicians, scientists, and educators scrambling to find ways to close the gap (Barrett, 2012). Toward this end, Congress passed the National Defense Education Act (NEDA) in 1958, which encouraged the development of high-quality science and mathematical programs to encourage scientific careers (Barrow et al., 2011).

The strains of the Great Depression followed up with World War II had caused college science faculty and students majoring in science to decline during the war. This decline continued into the postwar era as well (Barrett, 2012). In an attempt to address these issues, U.S. President Harry S. Truman authorized the establishment of the President's Scientific Research Board. The Board recommended higher salaries for college science faculty, increased funding for scientific research, and establishment of the National Science Foundation (NSF) with the purpose of coordinating science research grants for universities and colleges. In addition, a successful program of scientific research began in the elementary and secondary classrooms of K-12 schools to encourage an interest in pursuing scientific studies in higher education (Barrow et al., 2011)

In 1959, the "Education for the Age of Science" was released, which outlined the national goals in education which would serve to help strengthen education in science and engineering. This statement, created by a group of scientists, engineers, and educators, chaired by Lee A. DuBridge and overseen by the president's science advisory committee, discussed the needs and goals important to the advancement of education (Briber, 1959). This report had several major themes, which were:

(1) Strengthening education in science and engineering
(2) The current need to improve subject matter
(3) Meeting the shortage of competent teachers
(4) Better opportunities for bright students (Briber, 1959).

In regards to the report “Education for the Age of Science,” President Dwight D. Eisenhower stated,

> This report made clear strengthening of science and engineering education requires the strengthening of all education. As an excellent statement of educational goals and needs, I hope it will be widely read and that it will stimulate a wider understanding of the importance of excellence in our educational system. (Briber, 1959, p. 1)

President Eisenhower went on to say,

> One subject discussed in the report warrants special emphasis. The importance of raising the standing of our teachers in their communities. Higher salaries are a first requirement. Also, there needs to be a recognition of the great importance of what teachers do and to accord them the encouragement, understanding, and recognition which will help to make the teaching profession attractive to increasing numbers of first-rate people. (Briber, 1959, p. 1)

Some of the long term effects of Sputnik were that it spurred the development of scientific standards and tied science to all other subject areas. The National Science Education Standards and Benchmarks for Science Literacy and accompanying state standards help to carry on their purposes today (Barrow et al., 2011).

Perhaps the only event stimulated as much attention to education as the heady days following the launching of Sputnik was the release of the report entitled “A Nation at Risk” (Goldberg & Harvey, 1983). The report was intended to remind the American people of the importance of education as the foundation of the United States leadership, change, and technical invention as well as the source of the its prosperity, security, and civility (Goldberg & Harvey, 1983).

The conclusion drawn from this report was that elementary and secondary schools in the United States were beset by shortcomings so serious as to threaten America's position in the world economy. These concerns were based upon falling test scores; reductions in student enrollments in high school mathematics, science, and foreign language courses; and shorter school days and school years in the United States when compared with other industrialized countries (Levin, 1984). There were three essential messages stressed in the report. The first was inattention to the schools puts the very well-being of our nation at risk. Second, mediocrity, not excellence, was the norm in American education. Third, America could do what was required (Goldberg & Harvey, 1983). This report and the emphasis it placed on having accountability standards helped set the stage for No Child Left Behind (Marx & Harris, 2006).

No Child Left Behind (NCLB) was probably the most ambitious federal education legislation the United States has ever enacted with its goal of reaching every school-age child in the country (Marx & Harris, 2006). Its goal was to decrease the gap between minorities and their fellow students, which was continuing to widen in the United States (Marshall, 2009). Ultimately, NCLB failed, but one result was the establishment of the American Association for the Advancement of Science (AAAS) and the National Research Council (NRC) which led to the development of national standards for science instruction today. Their efforts resulted in standards-based frameworks outlining recommendations for what all students should know and be able to do in science as well as guidelines for the teaching of science. (Marx & Harris, 2006).

Over the last decade, macroeconomic studies have established a clear link between student achievement on science and math tests and per capita gross domestic product (GDP) growth (Bisaccio et al., 2014). Since science and technology facilitates increase GDP and slow ecological degradation, then it is imperative for the 21st-century that STEM education makes students aware of the possible outcomes of their actions. Scientists and technologists should empower students to assess, preserve, and restore ecosystems and hence the services they render to society (Bisaccio et al., 2014).

Under the pressure to change education, improve student achievement, and inspire a new generation in the area of science, schools are scrambling for solutions. Educational research continues to emerge suggesting teachers are the ones who have the most profound effect on students and their achievement at school. In fact, Marzano (2007) suggested the teacher is probably the single most important factor affecting student achievement or at least the most important factor schools can influence. In order to address this issue, the state of Missouri created the model teacher and leaders standards.

Missouri Model Teacher and Leaders Standards

Numerous studies have used value-added models to examine a teacher's influence on student achievement; however, few empirical studies have linked what effective versus less effective teachers do differently (Stronge et al., 2008). Although there is a general agreement that teacher quality matters, there is no consensus on which aspects of teacher qualities matter most (Muñoz et al., 2013). Although there is no universal agreement regarding what constitutes the qualities of effective teachers, there are common elements identified by the National Model for Teaching Standards developed by the Interstate Teacher Assessment and Support Consortium (InTASC) of the Council of Chief State School Officers (Council of Chief State School Officers, 2011) that have been statistically and logically linked to student achievement. Some of these standards are:

(a) Does the teacher engage their students in the subject matter?

(b) Does the teacher teach a curriculum requiring students to problem solve and critically think?

(c) Does the teacher develop strong, positive relationships with their students?

(d) Does the teacher monitor the effect on individual and class learning (Network for Educator Effectiveness [NEE], 2015)?

Indicator 1.2 of the Missouri model teacher and leaders standards addresses student engagement. One of the things which must occur when it comes to discussing cognitive engagement is to clearly define it. Many times words such as motivation, attention, interest, efforts, enthusiasm, participation, and involvement are used in place of the word engagement. Conner and Pope (2013) described student engagement as “a commitment to, valuing of, and connecting with the people, educational goals, and outcomes promoted by a school or teacher” (p. 144). According to Blumenfield, Fredericks, and Paris (2004), “cognitive engagement draws on the idea of investment; it incorporates thoughtfulness and willingness to exert the effort necessary to comprehend complex ideas and master difficult skills” (p. 60). This definition points out engagement, in a large part, has to do with helping students connect to the material they are studying.

The Network for Educator Effectiveness (2015), in their training modules for teachers, explained cognitive engagement in the classroom as a student’s active, mental involvement in the learning activities or mental effort such as meaningful processing, strategy use, concentration, and metacognition. Using this definition for cognitive engagement allows teachers and administrators to identify specific actions of students in a classroom, helping them to identify when cognitive engagement is occurring. In order to insure high levels of cognitive engagement, a teacher might:

- incorporate appropriate learning and instructional strategies to encourage deep thinking
- support students in monitoring their own levels of cognitive engagement
- recognize if some students are not cognitively engaged, and try alternate strategies to increase or maintain students' thinking about content
- use cognitive engagement strategies such as advanced organizers, K-W-L charts, share-out, shoulder-partner work
- cognitively engages students so they are active in the lesson or activity
- build activities appropriate for all depth of knowledge levels (NEE, 2015).

It is important to note cognitive engagement is different from both behavioral engagement and emotional engagement. Behavioral engagement is about participation; it includes involvement in academic and social extracurricular activities. It also is associated with working hard and adhering to school and classroom rules. This type of engagement is considered crucial achieving positive academic outcomes and preventing students from dropping out of high school (Blumenfield et al., 2004; Conner & Pope, 2013; NEE, 2015). Emotional engagement focuses primarily on a sense of belonging, interest, and enjoyment (Blumenfield et al., 2004; Conner & Pope 2013). It encompasses positive and negative reactions to teachers, classmates, academics, and school. It creates ties to an institution, teachers, and students and influence willingness to do the work (Kahu, 2013).

Cognitive engagement has received considerable attention for its potential to improve student achievement (Appleton & Lawrenz, 2011; Conner & Pope, 2013). Recent studies and reviews have gone as far as to suggest the value and effect of engagement on student achievement is no longer questioned (Kahu, 2013). Marzano and Pickering (2011) stated that student engagement has long been recognized as one of the core elements necessary in quality education. Research on how to motivate and engage students is essential in order to understand and solve some of the most vexing challenges educators will face when it comes to school reform. Hattie (2009), in a synthesis of over 800 meta-analyses, listed cognitive engaging strategies in the top five of the most effective learning strategies.

Even though student engagement is considered to be an integral part in helping to improve student achievement, it is actually fairly rare (Conner & Pope, 2013; Blad, 2014; Yazzie-Mintz, 2010). According to Conner and Pope (2013) “40 to 60 percent of high school students are chronically disengaged; they are inattentive, exert little effort, do not complete tasks, and claim to be bored” (p. 1427). In a study done by Gallup (Gallup Poll, 2014), the researchers found 28 percent of students in schools said they were not engaged, and 17 percent said they were actively disengaged. Yazzie-Mintz (2010) reported in a survey of high school students that 66 percent of students reported being bored at least every day in class in high school. The most common explanations cited for this boredom was the material not being interesting (81%) and the lack of challenge in their assignments (33%).

Student engagement has been connected to the many positive outcomes despite its fairly rare occurrence. For example, engagement has been found to reduce youth from participating in risky behaviors and unhealthy outcomes such as drugs and alcohol abuse (Guo, Hawkins, Hill, & Abbott, 2001; Conner & Pope, 2013). Engaged students have also been linked to factors such well-being, life satisfaction, and lower depression (Lewis, Huebner, Malone, & Valois, 2011). In academics, engagement is related to desired outcomes such as differences in goal orientation, investment in learning, academic achievement, grades, school motivation, and persistence in the face of challenges (Appleton & Lawrenz, 2011). In a study of 78,106 students in 80 schools across eight states, researchers found a one-percentage-point increase in a student’s score on

Gallup's engagement index was associated with a six-point increase in reading achievement and an eight-point increase in math achievement scores (Blad, 2014; Gallup Poll, 2009).

Academic engagement and achievement have become recognized as central markers of success in most industrialized societies (Appleton & Lawrenz, 2011; Blad, 2014; Conner & Pope, 2013; Yazzie-Mintz, 2010). Youths who are cognitively engaged in domains such as mathematics and science achieve better outcomes in those domain-related activities. When they enter adulthood and the employment field, they also receive better employment ratings and higher socioeconomic status (Appleton & Lawrenz, 2011). For these reasons schools have deemed cognitive engagement as a high priority for teachers in the classroom (NEE, 2015).

Indicator 4.1 of the Missouri model teacher and leaders standards addresses problem solving and critical thinking. It is difficult to pinpoint the exact meaning of the skills involved in problem solving and critical thinking since the concept is highly complex. Glaser (1942), in order to help define the complex process of problem solving and critical thinking, stated it contains at least three components. First, it contains an attitude of being disposed to consider in a thoughtful way the problems and subjects that come within the range of one's experiences. Second, it contains knowledge of methods of logical inquiry. Third, it contains some skills in applying those methods.

Facione (1990) identified critical thinking as "the process of purposeful, self-regulatory judgment. This process gives reasoned consideration to evidence, context, conceptualizations, methods, and criteria" (p. 5). Facione further argued that a true definition of critical thinking involves both skills and the habits of our mind. Paul (1992) asserted that just as one disciplines and trains a body to be adept at certain skills, critical thinking is an intellectually-disciplined process. It is a process of actively and skillfully conceptualizing, applying, analyzing, synthesizing, and evaluating information. Halpern (1998) believed critical thinking must be purposeful, reasoned, and goal oriented. It is the kind of thinking used to problem solve, formulate inferences, calculate likelihoods, and make decisions.

In general, critical thinking is process of thinking about any subject, content, or problem in which the thinker improves the quality of their thinking by skillfully taking charge of the organization and imposing intellectual standards upon their thinking (Karbalaei, 2012). Thinking is not separate from content; it should be an integrated part of the learning process. Promoting critical thinking and problem-solving skills is difficult and fairly uncommon in typical classrooms (NEE, 2015). Too often, students asked to simply write down facts rather than to question, analyze, and reflect on their work, and, as a result, they are incapable of drawing inferences and of engaging in complex conversations about the materials they are studying (Karbalaei, 2012).

Over the last decade, the amount of information available through technology has exploded and this information explosion is likely to continue in the future (Daggett, 2008). One of the greatest challenges facing students today and in the future is how to weed through the information, separate truth from error, and determine what is critical, important, and just nice to know (Oliver & Utermohlen, 1995).

Another result of the explosion of technology over the last decade has been the emergence of a global society (Carlgren, 2013; Daggett, 2008). Fearsome swings in the markets of the world can result from a single community far across the globe such as Jakarta, Singapore, or Moscow. A stumble in the economy can immediately affect the entire world, reaching down to each individual (Hinckley, 1998). This is due to the ever-increasing ability to communicate and transact business around the world. Because of this explosion in information and the increasing aspect of a truly global community, the skills of communication, critical thinking, and problem solving are essential for students to learn if they want to be a productive and active citizens in the 21st-century (Carlgren, 2013).

Education exists in the largest context of society. When society goes through fundamental structural changes, education to must change if it is to remain viable (Daggett, 2008). Higher educational institutions of learning in the United States today expect their students to be capable of tackling the challenges of the 21st -century (Shukdeb & Sulakshana, 2015). Unfortunately, most students today do not seem to have these necessary skills to meet the demand to be critical thinkers and problem solvers (Carlgren, 2013). Many employers complain their employees are not equipped with critical thinking skills when they leave school and enter the workforce (Shukdeb & Sulakshana, 2015). Because of these needs in society, educators agree the development of higher order or cognitive intellectual abilities is a chief priority and critical thinking is central to both personal success and national needs (Karbalaei, 2012).

The Network for Educator Effectiveness (NEE, 2015) suggested teachers need to engage students in learning activities that promote problem-solving and critical thinking skills continuously throughout their lessons. They suggest it is a crucial component in teacher evaluation systems since it is so highly valued in so many professions. Although these skills are fairly uncommon in a classroom (Karbalaei, 2012; NEE, 2015; Shukdeb & Sulakshana, 2015), there are a variety of ways teachers can promote critical thinking. Teachers can give students complex, demanding tasks requiring persistent effort, concentration, and various cognitive and metacognitive strategies (NEE, 2015). Some tasks teachers can ask students to do are: require them to determine what makes an argument valid, assess possible solutions, categorize problems, map concepts, or explain a worked example. They can also promote critical thinking through deep-level questions, which should help prompt students to actively process the material and highlight inconsistencies, which in turn creates curiosity. Deep questions can help teachers be more effective at helping students learn complex knowledge (NEE, 2015).

For an observer who is watching for critical thinking in a classroom, he or she might watch for the teacher to use: instructional strategies promoting student involvement, engagement strategies that maintain or increase student thinking, incorporation of learning processes students can use to build prior knowledge into advanced applications, questions leading to deeper thinking and/or problem solving for students, a requirement for students to justify their answers, a requirement of credibility of evidence, development an informed argument, or asking higher-order questions (NEE, 2015).

Because critical thinking and problem solving has been identified as such an important component for students to learn, many frameworks have been developed to help promote these processes. Some of the most familiar and effective frameworks are Bloom's taxonomy (Bloom, 1956), Webb's depth-of-knowledge (Webb, 2007), and rigor and relevance (International Center for Leadership in Education, 2015). Although these do not represent a comprehensive look at critical thinking and problem solving, they are the most widely used in education today (Hess, Jones, Carlock, & Walkup, 2009; International Center for Leadership in Education, 2015; Seaman, 2015; Webb, 2007).

Bloom's taxonomy (Bloom, 1956) was created by a committee, of which the most distinguished figure was Benjamin Bloom, during the 1950s. It was published in 1956 in what is referred to as the Handbook (Seaman, 2011). Bloom's taxonomy is a way to categorize the levels of reasoning skills required of students in classroom setting. In Bloom's taxonomy there are six levels, each requiring a higher level of thought from the students. The idea is for a teacher to move a student up the taxonomy as the student progresses in their knowledge (Bloom, 1956).

The following are the different levels of Bloom's taxonomy with a brief description of what one should expect from each level.

(a) *Knowledge* - in this level of Bloom's Taxonomy, questions are asked solely to test whether a student has gained specific information from the lesson. Knowledge questions use words like tell, list, label, name, etc.

(b) *Comprehension* - in this level of Bloom's Taxonomy students go past simply recalling facts and instead has them understanding the information. Comprehension questions use words like describe, contrast, discuss, predict, etc.

(c) *Application* - In application questions, students have to actually apply, or use, the knowledge they have learned. Application questions use words like complete, solve, examine, illustrate, show, etc.

(d) *Analysis* - In the analysis level, students are required to go beyond knowledge and application and actually see patterns they can use to analyze a problem. Analysis questions use words like analyze, explain, investigate, infer, etc.

(e) *Synthesis* - With synthesis, students are required to use the given facts to create new theories or make predictions. Synthesis questions use words like invent, imagine, create, compose, etc.

(f) *Evaluation* - The top level of Bloom's taxonomy is evaluation. Here students are expected to assess information and come to a conclusion such as its value or the bias behind it. Evaluation questions use words like select, judge, debate, recommend, etc (Bloom, 1956, p. 1-2).

Within 15 years of its publication, Bloom's taxonomy (the *Handbook*) was considered to be one of the major works in the field of curriculum (Seaman, 2015). A resent search for Bloom's taxonomy brought back on Google 521,000 results, Google Scholar brought 42,400 results, and ERIC brought up 846 results. In addition, over a million copies of the *Handbook* were printed since 1956 (Seaman, 2015). The ability of an educational concept to last nearly 60 years under extreme scrutiny should suggest it as a valuable tool when looking at improving problem solving and critical thinking for students.

A more recent addition to the field of education in regard to problem solving and critical thinking is Webb's depth-of-knowledge module (Webb, 2007). Webb's depth-of-knowledge (DOK) module grew out of the need to be able to align curriculum standards and assessment (Webb, 2007). Although Bloom's taxonomy is useful in developing a problem solving and critical thinking curriculum, it is hard to create tests (Bloom, 1956; Webb, 2007). This is because Bloom's taxonomy categorized the cognitive skills needed when faced with a new task, which helped describing the type of thinking processes necessary to answer a question (Hess et al., 2009). The DOK model, on the other hand, relates more closely to the depth of content understanding and the scope of a learning activity. These can be more easily observed in the skills required to complete the task (Hess et al., 2009).

Webb's depth-of-knowledge (DOK) module breaks the labeling of assessment questions into four levels.

(a) *DOK Level 1, Recall and Reproduction* - recall of fact, term, principal, or concept; perform a routine procedure.

(b) *DOK Level 2, Basic Application of Skills/Concepts* - use information, conceptual knowledge; perform two or more steps with decision points along the way; solve routine problems; organize or display data; interpret or use simple graphics.

(c) *DOK Level 3, Strategic Thinking* - reason or develop plan to approach a problem; employ some decision-making and justification; solve abstract, complex, or non-routine problems, complex. DOK level 3 problems often allow more than one possible answer.

(d) *DOK Level 4, Extended Thinking* - perform investigations or apply concepts and skills to the real world which requires time to research, problem solve, and process multiple conditions of the problem or task; perform non-routine manipulations across disciplines, content areas, or multiple sources (Hess et al., 2009, p 4).

Generally speaking, DOK Levels 1-3 can be used for both large scale, on demand assessments, and local assessments. DOK Level 4 should be reserved for local assessment (Hess, 2006).

A resent search for Webb's Depth-of-Knowledge brought back on Google 135,000 results, Google Scholar brought 35,000 results, and ERIC brought up 287 results. The wide use and application in most states in the U.S. is cementing the value of Webb's depth-of-knowledge module in helping to assess problem solving and critical thinking (Webb, 2007). Both Bloom's taxonomy and Webb's depth-of-knowledge can serve important functions in education reform at the state and local level in terms of standards development, developing a problem solving/critical thinking curriculum, and assessment alignment (Hess et al., 2009).

Daggett (2008) suggests education exists to meet the needs of the society it is a part of and therefore it must change and adapt to meet society's needs. To help meet the needs of students who will half to live and compete in the 21st century, the International Center for

Leadership in Education developed the Rigor/Relevance Framework (Daggett, 2008). The framework consists of two components, Knowledge Taxonomy (based on Bloom's Taxonomy) and application model. It also has four quadrants – acquisition (quadrant A), application (quadrant B), a simulation (quadrant C), and adaptation (quadrant D). These four quadrants represent knowledge types. On the knowledge continuum (y axis), one moves up and down from basic acquisition of knowledge to complex integration and evaluation of knowledge, just as in Bloom's taxonomy. The second continuum, the Application Model (x axis), moves from knowledge for its own sake at the low end of the continuum to knowledge at the high end of the continuum being used to solve complex real-world problems and to create projects, designs, and other works for use in real-life situations (Daggett, 2008).

Quadrant A represents simple recall and basic understanding of knowledge for its own sake. Quadrant A is the most testable quadrant and is where students gather their foundation knowledge. Quadrant B represents action or high degree of application for knowledge. The highest level of application in this quadrant would be to apply appropriate knowledge to new and unpredictable situations. In high schools, Quadrant B is often represented by career and technical education. Quadrant C represents more complex thinking than Quadrant A but is still knowledge for its own sake. In high schools, quadrant C may represent college prep programs such as dual credit, AP, and International Baccalaureate classes. Quadrant D represents action or a high degree of application. Students have both the competency to think in complex ways and also the ability to apply the knowledge and skills they have acquired. The quadrant leading to the highest level of problem solving and critical thinking, and thus prepare students to be better equipped to meet the challenges of the 21st century, is quadrant D (International Center for Leadership in Education, 2015).

Unfortunately, there has been little research to determine whether teaching critical thinking improves student academic performance (Karbalaei, 2012). However, the few studies conducted have shown a strong correlation between the two. Shukdeb and Sulakshana (2015) conducted a study of a cell biology course at Bethune-Cookman University. Biology seniors are required to take this course for graduation. The study was done from 1997 to 2014 (17 years) with an average class size each year of 18 students. In the class, from the students who received the problem solving/critical thinking instruction 22% more of the students received an A or a B than students in the control group (Shukdeb & Sulakshana, 2015).

Syafii and Yasin (2013) did a similar study except they used high school biology students. They found the experimental group (the group directed towards problem solving and critical thinking) scored, on an average, higher (95.47%) than the control group (25.12%). This could be due to the fact students learn skills and acquire knowledge more readily when they can transfer learning to new or more complex situations. This process is more likely to happen once they have established a deep understanding of content (National Research Council, 2001).

Ensuring a curriculum aligns to standards alone will not be enough to prepare students for the challenges of the 21st-century. Teachers need to provide all students with challenging tasks and demanding goals. They must structure learning so students can reach these high goals and accomplish the challenging tasks that await them as they become a part of this ever-expanding global society (Hattie, 2002).

Indicator 7.4 of the Missouri model teacher and leaders standards addresses formative assessment. Formative assessment is best thought of as assessment for learning and can be contrasted with summative assessments which is assessment of learning (Warner, 2011). Assessment becomes formative in nature only when either the teacher or the student uses the information to inform teaching and/or to influence learning (Atkin, Black, & Coffey, 2001). Buffum et al. (2012) defined formative assessment as “An ongoing process of collectively analyzing targeted evidence to determine the specific learning needs of each child and effectiveness of the instruction the child receives in meeting these needs” (p. 77). Effective monitoring of student learning will focus not just on test scores but on the whole practices leading to the test scores (Reeves, 2011).

Black and Wiliam (1998) explained formative assessment as, “all those activities undertaken by teachers and by their students which provide information to be used as feedback to modify the teaching and learning activities in which they are engaged” (p. 7). Cizek (2010) defined formative assessment as a collaborative process between educators and students to help them understand the student’s learning and conceptual organization, areas of strength and weakness, which can then be used as source of information to help teachers in instructional planning, and students to deepen their understanding and improve their achievement.

The Network for Educator Effectiveness (2015) stated formative assessment has multiple meanings but chose to define it in terms of classroom observations. They suggested teachers who use formative assessment will perform quick checks for understanding as the lesson is progressing. The purpose is to inform modification of teaching and learning activities in real time. Thus, it is information used to guide instruction as part of the instructional process (NEE, 2015).

When the definitions of formative assessment are analyzed, some themes begin to emerge that are important in truly helping educators properly use formative assessments to help improve student achievement. Hattie (2009) stated “the biggest effects on student learning occur when teachers become learners of their own teaching and when students become their own teachers” (p

22). Formative assessment occurs in the here and now of a classroom. It provides feedback to students about the quality of their work and their level of understanding. Teachers also receive feedback about specific student learning needs. This allows both groups the opportunity to receive feedback about their strengths and weaknesses in the learning process and the subsequent chance to revise and improve (DuFour & Marzano, 2011; Hollingworth, 2012). Thus learning is a very personal journey between the teacher and the student in which there are remarkable commonalities for both (Hattie, 2009). In order for formative assessment to be realized, students, teachers, and administrators must undergo a conceptual shift in their approach to assessment. Instead of viewing assessments as an absolute measure of a students' proficiency (summative assessment), each individual assessment must be looked at as a snapshots in time of a students' progress towards the desired goal (DuFour & Marzano, 2011).

Since formative assessment is among the most common features of successful teaching and learning (Black & Wiliam, 1998; Hattie, 2009; Leahy, Lyon, Thompson, & William, 2005; Wiliam, 2011), one of the best ways then to understand feedback is to consider the notion of the gap. The goal of formative assessment is to reduce the gap between where the student is and where he or she is meant to be (Hattie, 2013). To make this happen, the goal of where a student needs to be and where they currently are must be clearly defined.

Assessment is a natural feature of teaching and learning and an ongoing part of classroom life (Black & Wiliam, 1998; DuFour & Marzano, 2011; Hattie, 2012; Leahy et al., 2005; Wiliam, 2011). Most people think of assessment as: written or oral weekly quizzes, end-of-semester examinations, portfolios, and comments and grades on homework assignments. These are usually thought of as summative assessments rather than formative although they can and should be used as both (Atkin et al., 2001). Questioning is the most common form of formative assessment. However, other kinds of formative assessment might include solving problems on a whiteboard or answering spot quizzes with fist-to-five, where students hold up fingers to represent their understanding. One finger might mean very little understanding and five fingers complete understanding. A thumbs up means I am good and a thumbs down means I need more help. Oral presentations and skill demonstrations can give auditory and kinesthetic students a chance to demonstrate they understand. Finally, technology can be used to quickly assess such as clickers, Plickers, and Kahoot (Network for Educator Effectiveness 2015; Buffum et al., 2012). Formative assessment can vary in form and length depending upon the grade level and subject matter. In essence, formative assessments are “any device teachers used together evidence of student learning” (Guskey, 2010, p. 55). All these methods and devices should be used to help gage where students are in comparison with the desired educational goals.

If observing a classroom where a teacher uses formative assessment, one might see the teacher monitoring the learning of the whole class and many individuals using multiple checks for understanding, monitoring learning progress, using assessment to modify teaching, using assessment strategies that are seamless throughout instruction, and using strong, appropriate corrective action is taken to ensure learning of all students (NEE, 2015). Atkin et al. (2001) did a report of formative assessment for the Committee on Classroom Assessment and the National Science Education Standards, Center for Education, National Research Council in which they looked for ways educators could improve formative assessment practices at their schools. Highlights of the findings in this report include the following:

- Research shows regular and high-quality assessment in the classroom can have a positive effect on student achievement.

- Information generated from assessments must be used to inform the teacher and/or the students in deciding the next step in the learning process.
- Student participation is a key component of successful assessment strategies at every step. If students are to participate effectively in the process, they need to be clear about the target and the criteria for good work, to assess their own efforts in light of the criteria, and to share responsibility in taking action in light of the feedback.
- Teachers need time and assistance in developing accurate and dependable assessments. Much of this assistance can be provided by creating settings in which teachers have opportunities to talk with one another about the quality of student work.
- The essential support for teachers (for example, time and opportunities to work with other teachers) can be created at the school level, but sometimes district and state-level resources are necessary.
- It is necessary to align assessment in the classroom with externally developed examinations, if the goals of education are to be consistent and not confuse both teachers and students. (Atkin, Black, & Coffey, 2001, p. 1-2)

Call it monitoring student learning, feedback, convergent assessment, or formative assessment, this teaching practice has been shown to have an exceptionally large effect size on student learning (Atkin et al., 2001; Beckett & Volante, 2011; Black & Wiliam 1998; Buffum et al., 2012; Hattie, 2009; Wiliam, 2011).

Black and Wiliam (1998) helped to bring formative assessment to the forefront of education in the United States with a study in which they analyzed findings from over 250 studies on formative assessment. They concluded:

> Standards are raised only by changes put into direct effect by teachers and students in classrooms. There is a body of firm evidence showing formative assessment is an essential feature of classroom work and development of it can raise standards. We know of no other way of raising standards for which such a strong *prima facie* case can be made on the basis of evidence of such large learning gains. (p. 19)

Continuing this research in 2011, Wiliam estimated formative assessment interventions can produce an average of six to nine months of learning gained per year.

Hattie (2009) discovered similar results in a meta-analysis study. Hattie found when ranked by effect size, six of the top 10 influences on student achievement or contributions come from the teacher. Of these six contributions from the teacher, formative assessment was the highest ranked practice with an average effect size of 0.90.

In a meta-analysis published in 1990, Kulik, Kulik, and Bangert-Drowns found mastery learning programs improve student performance by nearly one half of one standard deviation, especially for low achieving students leading them to conclude:

> Few educational treatments of any sort or consistently associated with achievements effects as large as those produced by mastery learning … in evaluation after evaluation, mastery programs have produced impressive gains. (Kulik et al., 1990, p. 292)

Leahy et al. (2005) found when teachers use formative assessment, students can learn in six to seven months what would normally take an entire school year to learn. Although the studies conducted on formative assessment may vary some on their calculated effect size, it is clear formative assessment works when it comes to improving student achievement. In fact, Reeves (2011) suggested the impact of monitoring on student learning is nearly linear. More monitoring equals more achievement.

Because of the importance research has placed on teachers' ability to engage students in the subject matter, teach a curriculum which requires students to problem solve and critically think, develop strong positive relationships with their students, and monitor the effect on individual and class learning (formative assessment), schools have looked for ways to insure these practices take place. Teacher evaluation systems are one way educators have tried to ensure that teacher create an environment where these activities take place (NEE, 2015). One of the preferred ways that educators have chosen to determine if these systems are being effective is using value-added models.

Value-Added Models

One method that has become a common way to hold teachers responsible is through value-added models (DuFour & Marzano, 2011). Value-added models have become popular when it comes to evaluating the effectiveness of teachers. One definition of value-added models is, "A quasi-experimental statistical model that yields estimates of the contribution of schools, classrooms, teachers, or other educational units to student achievement, controlling for non-school sources of student achievement growth, including prior student achievement, and student and family characteristics" (Hadfield et al., 2012, pp 8). Goe et al. (2008) defined value-added teacher evaluation as utilizing value-added models to determine a teacher's contribution to student test scores and utilizing this information as part of the teacher evaluation process. Almost half the states in the United States require teacher reviews to be based in part on test-score data (Goe et al., 2008).

Not everyone is in favor of using value-added models as a component of teacher evaluations. Most teachers do not consider test-score data a fair measure of what students have learned (Washington, 2011). Complex algorithms that adjust for students' income and race have made test-score assessments more fair but are widely resented, contested, or misunderstood by teachers (Ripley, 2012). Despite the great outcry by many educators against using value-added models as a part of teacher evaluations, evidence continues to support the use of student achievement scores (Christie et al., 2013; Hadfield et al., 2012; Little et al., 2009; Washington, 2011).

Hadfield et al. (2012) suggested there are several aspects effective models should:

(1) Contain utilization of student test scores,

(2) Contain measurement of student growth,

(3) Contain several years of convergent evidence,

(4) Contain valid, fair, and reliable student test scores,

(5) Address missing test scores and missing data points,

(6) Account for, but not adjust for race, socioeconomic status (SES), general ability, and prior achievement,

(7) Randomly group students and randomly allocate teachers, and

(8) Possess calculations sufficiently complex in design or the instrument possesses instructional sensitivity. (p. 59)

When these aspects are contained as a part of value-added models, the results will reflect quality teaching in the classroom. However, such tests are expensive and must be administered for long periods of time (Hadfield et al., 2012).

Value-added models have several advantages they can add to teacher evaluation systems. They measure how teachers contribute to student learning and are highly objective because they do not require evaluators to make subjective judgments (Washington, 2011). They are generally cost-efficient and are nonintrusive (Little et al., 2009). They can reveal variations among teachers when it comes to their contribution to student learning (DuFour & Mattos, 2013).

However, value-added models are fairly new and the scores from them must be interpreted with caution. Little et al. (2009) pointed out three problems associated with value-added models. First, variations in scores among teachers have not been strongly linked to what teachers do in the classroom. Second, there is a lot of uncertainty in the statistical estimates for individual teachers. Third, they also assume student test scores are valid and reliable indicators for student learning, which is not always the case (Little et al., 2009, p. 5).

Department of Elementary and Secondary Education (DESE) and the Network for Educator Effectiveness (NEE)

As a result of the increased pressure to span the achievement gaps among minorities and poor performance on state standardized tests, the State of Missouri found itself in noncompliance with the No Child Left Behind Act (NCLB) (Marshall & Oliva, 2010). In 2012, the Department of Elementary and Secondary Education (DESE) wrote a waiver for exemption to the NCLB laws they would implement. Part of the exemption was the implementation of a state-wide educator evaluation system. The Missouri's Educator Evaluation System was created, field-tested and piloted, and refined by hundreds of educators across the state. The system is founded on general beliefs about the purpose of the evaluation process, which is to improve the quality of teaching in school districts across the state and by so doing increase the achievement levels of students (DESE, 2015).

In order to help school districts meet the requirements put forth by DESE, the University of Missouri Network for Educational Effectiveness (NEE) developed a comprehensive teacher evaluation model. NEE provides school districts with the training, resources, and data systems in the fove major areas of observations, professional development plans, teacher/student artifacts, student evaluations, and value-added models. Currently NEE is the most widely-used model in the state of Missouri (NEE, 2015).

Summary

Teacher evaluation has been played an important role in helping to shape education throughout history. As new ideas and concerns have changed, education teacher evaluation processes have changed as well to meet those needs. The United States current education climate is emphasizing the need to increase students' performance in the area of science to be competitive in today's global society.

To meet this need in science, the State of Missouri has implemented the Missouri Learning Standards (MSL) and developed the Missouri Assessment Program (MAP) to evaluate how well their students are doing in science, as well as other subject areas. In addition, since teachers have been shown to have the largest effect, when it comes to variables schools can control for, on student achievement (Danielson, 2007; Hattie, 2013; Marzano, 2011), the State of Missouri has chosen to adopt a teacher evaluation model to determine the effectiveness of classroom teachers.

The Network for Educator Effectiveness has created a teacher evaluation system based upon the requirements set forth by the state of Missouri to help school districts accomplish this task (University of Missouri College of Education, 2015). The indicators most commonly used by school districts using the NEE system are:

- Indicator 1.2 of the Missouri Model Teacher and Leaders Standards addresses Student Engagement

- Indicator 4.1 of the Missouri Model Teacher and Leaders Standards addresses Problem Solving and Critical Thinking
- Indicator 5.3b of the Missouri Model Teacher and Leaders Standards addresses Secure Teacher Student Relationships
- Indicator 7.4 of the Missouri Model Teacher and Leaders Standards addresses Formative Assessment

Therefore, it stands to reason the ability of indicators 1.2, 4.1, 5.3b, and 7.4 of the NEE model to improve student achievement needs to be studied.

CHAPTER THREE: METHODS

Overview

The purpose of this quantitative correlational study was to examine the relationship between eighth-grade science teachers' observation scores and academic achievement scores of their students on the Missouri Assessment Program eighth grade science test. This chapter will include an explanation of the design of the study, the research question, the null hypothesis, and the participation and settings of the study. An explanation of the instrumentation used in the study and the procedures used will be given, and the chapter will conclude with an explanation of the data analysis method.

Design

A correlational design was used for this study. A correlational design was appropriate because it is used in studies to help us describe mathematically the relationship between two variables through the use of correlational statistics. This basic design involves collecting data on two variables, a predictor variable and a criterion variable, for each individual in a sample and computing a product-moment correlational coefficient (*r*) (Gall, Gall, & Borg, 2007, pp. 342-352). The statistical procedure used to calculate the product-moment correlational coefficient statistic, also known as Pearson *r*, allows the researcher to look at both the magnitude, direction, and statistical significance between a criterion variable and a particular predictor variable (Gall et al., 2007, pp. 342-352). This study was designed to help determine the relationship, if any, between the predictor variables (science teacher observation scores on Indicators 1.2, 4.1, and 7.4) to the criterion variable (eighth grade MAP science scores) thus making a correlation design appropriate for this study.

The predictor variables in this study were eighth grade science teacher observation scores as recorded by the NEE observation instrument for the following four Missouri Model Teacher and Leader Standards:

- Indicator 1.2: Does the teacher cognitively engage students in the subject matter?
- Indicator 4.1: Does the teacher use instructional strategies leading to problem solving and critical thinking?
- Indicator 7.4: Does the teacher monitor the effect of instruction on individual/class learning - formative assessment? (University of Missouri College of Education, 2012).

An overall mean score was determined for each eighth grade science teacher on each of the four indicators. The eighth grade science teachers' observation scores for middle schools in Missouri as archival data and was obtained by request from both the participating school districts and the Assessment Resource Center (ARC) for the University of Missouri.

The criterion variable was the score as measured by the Missouri Assessment Program (MAP) scores on the eighth grade science test. Sixty-two science teachers participated in the study. All student test scores at the participating schools were linked to the science teacher responsible for their eighth grade science instruction and then averaged to come up with one score per teacher. Scores on the Missouri Assessment Program (MAP) test for the 2015-2016 school year was archival data and was obtained by request from the participating school districts who retrieved the data form the Department of Elementary and Secondary Education's Comprehensive Data System (MCDS).

Research Questions

RQ1: Is there a relationship between the criterion variable (the average achievement scores for an eighth grade class on the eighth grade science Missouri Assessment Program test) and the predictor variable (eighth grade science teachers' observation scores for Indicator 1.2, cognitive engagement) for the 2015-2016 school year?

RQ2: Is there a relationship between the criterion variable (the average achievement scores for an eighth grade class on the eighth grade science Missouri Assessment Program test) and the predictor variable (eighth grade science teachers' observation scores for Indicator 1.4, problem solving and critical thinking) for the 2015-2016 school year?

RQ3: Is there a relationship between the criterion variable (the average achievement scores for an eighth grade class on the eighth grade science Missouri Assessment Program test) and the predictor variable (eighth grade science teachers' observation scores for Indicator 7.4, formative assessment) for the 2015-2016 school year?

Null Hypotheses

$H_0$1: There is no significant relationship between the criterion variable (the average achievement scores for an eighth grade class on the 8th grade science Missouri Assessment Program test) and the predictor variable (eighth grade science teachers' observation scores for Indicator 1.2, cognitive engagement) for the 2015-2016 school year.

$H_0$2: There is no significant relationship between the criterion variable (the average achievement scores for an eighth grade class on the eighth grade science Missouri Assessment Program test) and the predictor variable (eighth grade science teachers' observation scores for Indicator 1.4, problem solving and critical thinking) for the 2015-2016 school year.

H_03: There is no significant relationship between the criterion variable (the average achievement scores for an eighth grade class on the eighth grade science Missouri Assessment Program test) and the predictor variable (eighth grade science teachers' observation scores for Indicator 7.4, formative assessment) for the 2015-2016 school year.

Participants and Setting

The population for this study consisted of 183 school districts (Network for Educator Effectiveness, 2015) in the state of Missouri which both utilized the Network for Educator Effectiveness (NEE) model for teacher evaluations for the 2015-2016 school year and evaluated their teachers on Indicators 1.2, 4.1, and 7.4. All schools were invited to participate and out of these school districts, 37 chose to participate. Of the 37 schools that chose to participate, their student population ranged from 51 students to 764. The mean student population of the participating schools was 282 students.

The predictor variables of eighth grade science teachers' observation scores for middle schools in Missouri was archival data and were obtained by request from the Assessment Resource Center (ARC) for the University of Missouri. ARC stores the data obtained by schools who participate in the NEE teacher evaluation program. The criterion variable of eighth grade student science scores on the Missouri Assessment Program (MAP) test for the 2015-2016 school year was also archival data and was obtained from Department of Elementary and Secondary Education's, Missouri Comprehensive Data System (MCDS). This data is open to the public to view. All student test scores at the participating school were averaged together and linked to the science teacher responsible for the students' class instruction by the building principal using an Excel document (see Appendix C).

From the 37 schools that chose to participate, there were a total of 62 teachers who participated in the study. On two of the indicators, Indicator 1.2, cognitive engagement and Indicator 4.1, problem solving and critical thinking, five out of the 62 teachers received no score. Thus five participants were participants were removed for a total sample size of 57. The rule of thumb suggested by Gall et al. (2007) is that a minimum of 66 participants is desirable for a correlation design for a medium effect size with statistical power of .7at the .05 alpha level (p. 145). The sample was just shy of the expected minimum.

Of these 62 teachers, 45 were female and 17 were male. The mean teaching time for these 62 teachers was 8.1 years with a standard deviation of 7.33 years. Thirty-five had a bachelors degree, 27 had a masters degree, and none had a doctorate degree.

Instrumentation

Classroom Observation Instrument

The NEE is a teacher evaluation system which was developed by two separate auxiliary units of the College of Education at the University of Missouri, the Heart of Missouri Regional Professional Development Center (RPDC) and the Assessment Resource Center (ARC). In addition, the program was developed with input of educators from Missouri school districts and faculty from the University of Missouri College of Education (University of Missouri College of Education, 2012). The classroom observation instrument, which is part of the web-based tools developed by NEE, is based upon the Missouri Model Teacher and Leader Standard (MMTLS) approved by the state Board of Education in June 2011. Missouri adopted the Missouri Model Teacher and Leader Standards as a part of the ESEA flexibility waiver, which established a new set of accountability requirements to replace those set forth by No Child Left Behind (NCLB) (U.S. Department of Education, 2012). Thirty-six indicators make up the Missouri Model

Teacher and Leader Standards (University of Missouri College of Education, 2012; Department of Elementary and Secondary Education, 2015b). Additionally, the Missouri Teaching Standards are based upon the National Model for Teaching Standards developed by the Interstate Teacher Assessment and Support Consortium (InTASC) of the Council of Chief State School Officers (Council of Chief State School Officers, 2011).

The classroom observation instrument was developed to be used across all subjects and grade levels. Individual rubrics provide standardized protocols and scoring guides for each of the 36 indicators set forth by the Missouri Model Teacher and Leader Standards (University of Missouri College of Education, 2012). It utilizes a seven-point scale ranging from 0-7. A zero identifies a teacher did not use/demonstrate the particular indicator. A seven identifies a teacher modeled/used the particular indicator to its fullest potential (see Appendix C for rubric). The NEE rubrics have been used and tested with teachers working in grades K-12 and across all content areas (University of Missouri College of Education, 2012).

Only individuals who have completed training and have qualified as an evaluator may login and utilize the NEE teacher evaluation system. Qualification consists of a review of the Missouri Model Teacher and Leader Standards, instruction on how to apply the NEE rubrics, practice scoring classroom observations on video clips, and passing the qualifying exams. This is a three-day process with additional recertification required each year (University of Missouri College of Education, 2012). This instrument has been used in numerous other studies (Evans, 2014; Garnet, 2013). Permission to use the archival data obtained from this observation instrument was obtained from NEE.

Scores on these rubrics were obtained after a principal went into a teacher's classroom and observed a lesson taught to students. Based upon what they observed, the principal determined a score from 0-7 for the teaching indicators they observe.

These scores were entered into an online data recording tool provided by NEE (see Appendix C) at http://nee.missouri.edu/resources.aspx. This data was archived by Assessment Resource Center (ARC) which can be accessed by NEE member schools to evaluate the scores and create reports. These reports can also be obtained at http://nee.missouri.edu/resources.aspx. The predictor variables in this study were the archived data in the ARC data base system.

The indicators used in this study were school-wide eighth grade science teachers' observation scores for Indicators 1.2, 4.1, and 7.4 of the Missouri Model Teacher and Leader Standards. Indicator 1.2 measures if the teacher cognitively engages students in the subject matter (University of Missouri College of Education, 2012). Cognitively engaging students can be defined as a students' active mental involvement in the learning activities or mental effort such as meaningful processing, strategy use, concentration, and metacognition (University of Missouri College of Education, 2015).

Indicator 4.1 measures if the teacher helps students problem solve and critically think (University of Missouri College of Education, 2012). Problem solving and critical thinking can be defined as purposeful, reasoned, and goal oriented. It is the kind of thinking used to problem solve, formulate inferences, calculate likelihoods, and make decisions (Halpern, 1998).

Indicator 7.4 measures if the teacher conducts formative assessments with their students (University of Missouri College of Education, 2012). Formative assessment is defined as an ongoing process of collectively analyzing specific evidence to determine the targeted learning needs of each child and the effectiveness of the instruction the child receives in meeting these needs (Buffum et al., 2012).

Missouri Assessment Program 8th Grade Science Test

The Missouri Assessment Program (MAP) eighth grade science test was developed by the state of Missouri and traces its origins back to the 1993 Outstanding Schools Act. Since then it is been modified several times to meet other legislation such as No Child Left Behind (NCLB) and Race To the Top/Top 20 by 2020 (Department of Elementary and Secondary Education, 2015c). The science test is given in fifth and eighth grade and provides useful information about individual student's performance as well as performance at the classroom, building, and district levels (Department of Elementary and Secondary Education, 2015-2016). MAP assessments were developed by CTB/McGraw-Hill and DESE and were intentionally aligned with specific Show-Me Standards measured at the grade and subject area for the state of Missouri (Department of Elementary and Secondary Education, 2014). For each assessment, content experts determined the norm-referenced items for each grade and subject area matched the designated standards. Then groups of Missouri educators reviewed each item to produce an "item-to-standard" congruence rating to insure each question sufficiently measured the content or process demanded by the standard. In addition, to insure instrument validity, CTB/McGraw-Hill with DESE routinely reviews and analyzes performance.

There re three types of questions on the MAP eighth grade science test. One section is made up of multiple-choice items. A question is given to the students followed by three to five response options. These questions are taken from the Survey edition of TerraNova®, a nationally-normed test developed by CTB/McGraw-Hill. Another type of question is the constructed response. For these questions, students are required to supply (rather than select) an appropriate response. The third type of question is the performance events. On the performance event, students must work through more complicated items. Performance events allow for more than one approach to get the desired or correct answer. This type of assessment gives insight into a student's ability to apply knowledge and understanding in real-life situations (Department of Elementary and Secondary Education [DESE], 2014).

According to the Department of Elementary and Secondary Education,

> The Department uses the information obtained through MAP to monitor the progress of Missouri's students toward meeting the Show-Me Standards/GLE Strands in order to inform the public and the state legislature about student performance and to help make informed decisions about educational issues. (DESE, 2014, p. 1)

The following are the Show-Me Standards/GLEs for science:

(1) Properties and principles of matter and energy.

(2) Properties and principles of force and motion.

(3) Characteristics and interactions of living organisms.

(4) Changes in ecosystems and interactions of organisms with their environments.

(5) Processes (such as plate movement, water cycle, air flow) and interactions of Earth's biosphere, atmosphere, lithosphere and hydrosphere.

(6) Composition and structure of the universe and the motions of the objects within it.

(7) Processes of scientific inquiry (such as formulating and testing hypotheses).

(8) Impact of science, technology and human activity on resources and the environment. (DESE, 2014, p. 2)

The reliability of raw scores on MAP tests is annually evaluated using Cronbach's alpha, which is a "lower-bound estimate of test reliability" (Missouri Department of Elementary and

Secondary Education, 2014). According to DESE, since 2006 all reliability statistics have been over .90 for the eighth grade science MAP tests which indicates acceptable reliability (Missouri Department of Elementary and Secondary Education, 2015c). This data was archival data and in the public domain. This data was obtained through a website located at http://dese.mo.gov. Data can be downloaded by each individual school principal in the state of Missouri and includes a mean scale score for all students who took the eighth grade MAP science test in the school. Student performance on the MAP is reported as a three-digit number ranging from 540 to 895 for the eighth grade science (referred to as a scale score) test. Corresponding levels are assigned on a continuum of proficiency: Below Basic (540-670), Basic (671-702), Proficient (703-734), and Advanced (735-895). These percentages are determined by the Department of Elementary and Secondary Education (DESE) and are based upon the student's scale score (Department of Elementary and Secondary Education, 2015c).

Procedures

IRB approval was obtained before any data collection occurred (see Appendix C). This study examined archival data from both the Network for Educator Effectiveness' database system (Assessment Resource Center) and the website for the Department of Elementary and Secondary Education for the state of Missouri. Only data from school districts who currently use the NEE teacher evaluation model and gave permission to access this data were included in this study.

The superintendents of all the NEE school that met this criteria were contacted by email and provided with a letter describing the purpose of the study, any potential risks or benefits associated with participating in the study, what precautions would be taken to ensure confidentiality, the conditions associated with participating in the study, and the type of data requested (see Appendix C). Once permission was received from the superintendents, principals were asked to tie student scores to the teacher responsible for teaching their eighth grade science class. They were provided the data sheet and given a detailed procedure of how to do this (see Appendix C). This student achievement data on the eighth grade MAP science test was obtained through DESE's Missouri Comprehensive Data System (MCDS). This data was archival data and accessible by the building level principal. The mean scale score on the eighth grade MAP science test for all students assigned to a particular teacher was the number used as the criterion variable. The scores on the eighth grade science tests range from 540 to 895 (DESE, 2014, p. 3). Since this was archival data, no further work was required beyond this tying of student data to the responsible teacher. Since the number used was an average for all the teachers' eighth grade students, all student information and names remained anonymous.

Teacher observation scores for the selected teachers were provided by the Network for Educator Effectiveness Assessment Resource Center. These scores reflected data collected from principal observations during the 2015-2016 school year on Indicators 1.2, 4.1, and 7.4. The standard set by NEE was that each teacher is observed (unannounced) at least six to eight times throughout the school year with the observation lasting approximately 10-20 minutes. In addition, these observations were followed up with feedback within 24 hours by the administrator(s) who did the observation(s) (University of Missouri College of Education, 2012; Marshall, 2009).

The student achievement data was linked to each participating teacher and sent to the Assessment Resource Center (ARC). ARC then linked the student achievement data from the eighth grade science test to each teacher evaluation scores as recorded by the administrator(s) who did the observation(s) for the four indicators examined in this study. ARC then sent back a report with the average student achievement scores on the eighth grade MAP science test (predictor variable) and the teacher evaluation scores on Indicators 1.2, 4.1, and 7.4 (criterion variables). This report tied together criterion and predictor variable data set with an arbitrary number assigned by the ARC. In this way, complete confidentiality was maintained for students, teachers, and schools who participated in the study. Data was then analyzed using correlation statistics by means of IBM SPSS software.

Data Analysis

A linear regression analysis was utilized to test the three null hypotheses and determine the strength and direction of the relationship between each predictor variables of school-wide teacher observation scores for Indicator 1.2, Indicator 4.1, and Indicator 7.4 and the criterion variable of student achievement on the Missouri Assessment Program eighth grade science test.

Data screening was conducted to look for data entry errors and inconsistencies. To verify the assumption of outliers, scatterplots between all pairs of the predictor variables and the criterion variable were plotted. The data was examined for extreme outliers. The assumption of normal distribution was verified by plotting a scatter plot for each pair of predictor variables and the criterion variable. The researcher looked for the classic "cigar shape" (Green & Salkind, 2011; Warner, 2013). The assumption of linearity was verified by creating a scatterplot for each pair of predictor variables and criterion variable. The researcher looked for a linear relationship (Green & Salkind, 2011; Warner, 2013). Finally, each null hypothesis was tested at the 95% confidence level with a Bonferroni correction adjusted to an alpha level of 0.017 (two-tailed) (Gall et al., 2007; Warner, 2013).

CHAPTER FOUR: FINDINGS

Overview

In Chapter Four, the descriptive statistics will be discussed as well as the data screening procedures. The results for the null hypotheses will be presented, including the linear regression analysis and scatterplots for each predictor variable (cognitive engagement, problem solving and critical thinking, and formative assessment) and the criterion variable of average achievement scores for an eighth grade class on the eighth grade science Missouri Assessment Program test.

Research Questions

RQ1: Is there a relationship between the criterion variable (the average achievement scores for an eighth grade class on the eighth grade science Missouri Assessment Program test) and the predictor variable (eighth grade science teachers' observation scores for Indicator 1.2, cognitive engagement) for the 2015-2016 school year?

RQ2: Is there a relationship between the criterion variable (the average achievement scores for an eighth grade class on the eighth grade science Missouri Assessment Program test) and the predictor variable (eighth grade science teachers' observation scores for Indicator 1.4, problem solving and critical thinking) for the 2015-2016 school year?

RQ3: Is there a relationship between the criterion variable (the average achievement scores for an eighth grade class on the eighth grade science Missouri Assessment Program test) and the predictor variable (eighth grade science teachers' observation scores for Indicator 7.4, formative assessment) for the 2015-2016 school year?

Null Hypotheses

$H_0$1: There is no significant relationship between the criterion variable (the average achievement scores for an eighth grade class on the 8th grade science Missouri Assessment

Program test) and the predictor variable (eighth grade science teachers' observation scores for Indicator 1.2, cognitive engagement) for the 2015-2016 school year.

$H_0$2: There is no significant relationship between the criterion variable (the average achievement scores for an eighth grade class on the eighth grade science Missouri Assessment Program test) and the predictor variable (eighth grade science teachers' observation scores for Indicator 1.4, problem solving and critical thinking) for the 2015-2016 school year.

$H_0$3: There is no significant relationship between the criterion variable (the average achievement scores for an eighth grade class on the eighth grade science Missouri Assessment Program test) and the predictor variable (eighth grade science teachers' observation scores for Indicator 7.4, formative assessment) for the 2015-2016 school year.

Descriptive Statistics

The descriptive statistics for the criterion variable (the average achievement scores for an 8th grade class on the 8th grade science Missouri Assessment Program test) and for each of the predictor variables (eighth grade science teachers' observation scores for Indicator 1.2, cognitive engagement, Indicator 1.4, problem solving and critical thinking, and Indicator 7.4, formative assessment) can be found in Table 1.

Table 1

Descriptive Statistics for Predictor and Criterion Variables

Variable	*N*	*M*	*SD*
Eighth Grade Science MAP Test Scores	57	691.59	18.29
Indicator 1.2, Cognitive Engagement	57	5.30	0.88
Indicator 1.4, Problem Solving and Critical Thinking	57	4.74	1.09
Indicator 7.4, Formative Assessment	57	4.98	0.96

Data Screening

Data screening was conducted on the data to look for missing data, outliers, and any inconsistencies in the predictor or criterion variables. Visual checking, scatterplots, and stem-and leaf displays were used to check for outliers, and no outliers were discovered (Gall et al., 2007). Five of the 62 participants (numbers 17, 38, 40, 45, and 52) were missing data and found not to have been evaluated on all three of the predictor variables, and so they were removed from the final data analysis.

Results

Null Hypothesis One

For the first hypothesis, the research examined if there was a relationship between the criterion variable (the average achievement scores for an eighth grade class on the eighth grade science Missouri Assessment Program test) and the predictor variable (eighth grade science teachers' observation scores for Indicator 1.2, cognitive engagement) for the 2015-2016 school year. A linear regression analysis was used to test the null.

To verify the absence of outliers between the predictor variable (Indicator 1.2, cognitive engagement) and the criterion variable (the average eighth grade achievement score on the MAP Science test) a scatter plot was used. The data was examined for extreme outliers. No extreme outliers were found (see Figure 1).

The assumption of normal distribution was verified by plotting a scatterplot between the predictor variable (Indicator 1.2, cognitive engagement) and the criterion variable (the average eighth grade achievement score on the MAP Science test). The researcher looked for the classic cigar shape (Green & Salkind, 2011; Warner, 2013). The researcher found the data to follow the classic cigar shape, verifying the assumption of normal distribution (see Figure 1).

The assumption of linearity was verified by plotting a scatterplot between the predictor variable (Indicator 1.2, cognitive engagement) and the criterion variable (the average eighth grade achievement score on the MAP Science test). The researcher looked for a linear relationship (Green & Salkind, 2011; Warner, 2013). A linear relationship was identified, satisfying this assumption (see Figure 1).

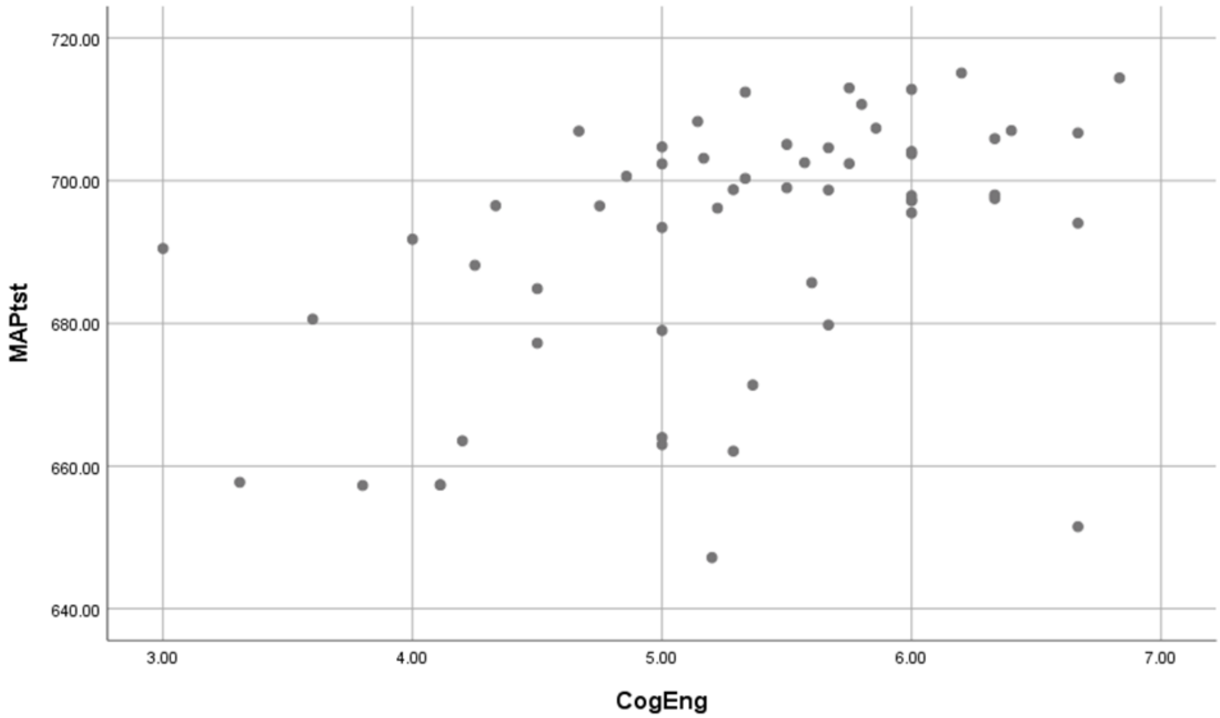

Figure 1. Scatterplot between the average eighth grade achievement score on the MAP Science Test and Indicator 1.2, cognitive engagement.

A linear regression analysis was performed at the 95% confidence level with a Bonferroni correction used to adjusted the alpha level to 0.017 where PCalpha = .05/3. The researcher rejected the null hypothesis where the regression model yielded $F(1, 55) = 15.59$, $p < .001$. The correlation between the two variables was r = 0.47, indicating a large effect size (Warner, 2013, p. 208).

Null Hypothesis Two

For the second null hypothesis, the researcher examined if there was a relationship between the criterion variable (the average achievement scores for an eighth grade class on the eighth grade science Missouri Assessment Program test) and the predictor variable (eighth grade science teachers' observation scores for Indicator 4.1, problem solving and critical thinking) for the 2015-2016 school year. A linear regression analysis was used to test the null hypothesis.

To verify the assumption of outliers, a scatterplot between the predictor variable (Indicator 4.1, problem solving and critical thinking) and the criterion variable (the average eighth grade achievement score on the MAP Science test) was used. The data was examined for extreme outliers. No extreme outliers were found (see Figure 2).

The assumption of normal distribution was verified by plotting a scatterplot for the predictor variable (Indicator 4.1, problem solving and critical thinking) and the criterion variable (the average eighth grade achievement score on the MAP Science test). The researcher looked for the classic cigar shape (Green & Salkind, 2011; Warner, 2013). The researcher found the data to follow the classic cigar shape, verifying the assumption of normal distribution (see Figure 2).

The assumption of linearity was verified by plotting a scatterplot for the predictor variable (Indicator 4.1, problem solving and critical thinking) and the criterion variable (the average eighth grade achievement score on the MAP Science test). The researcher looked for a linear relationship (Green & Salkind, 2011; Warner, 2013). A linear relationship was identified, satisfying the assumption of linearity (see Figure 2).

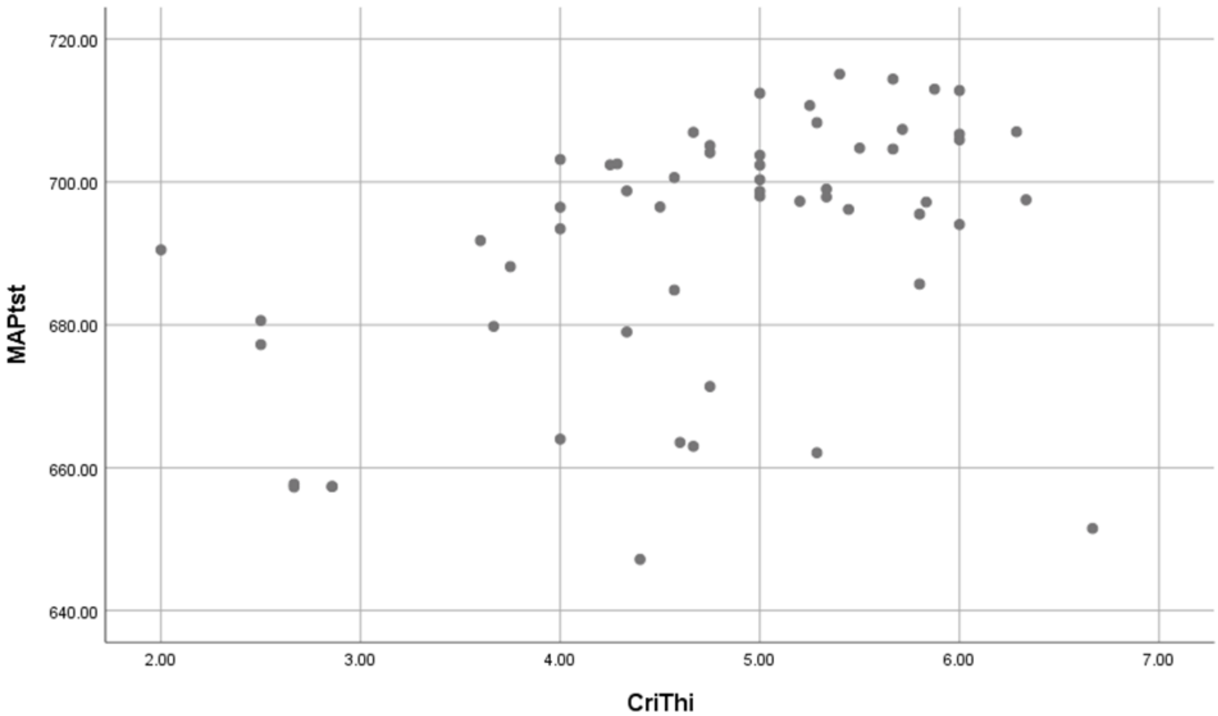

Figure 2. Scatterplot between the average eighth grade achievement score on the MAP Science Test and Indicator 4.1, problem solving and critical thinking.

A linear regression analysis was performed at the 95% confidence level with a Bonferroni correction adjusted to an alpha level of 0.017 where PCalpha = .05/3. The researcher rejected the null hypothesis where the regression model yielded $F(1, 55) = 15.59$, $p < .001$. The correlation between the two variables was $r = 0.47$, indicating a large effect size (Warner, 2013, p. 208).

Null Hypothesis Three

For the third null hypothesis, the researcher examined if there was a relationship between the criterion variable (the average achievement scores for an eighth grade class on the eighth grade science Missouri Assessment Program test) and the predictor variable (eighth grade science teachers' observation scores for Indicator 7.4, formative assessment) for the 2015-2016 school year. A linear regression analysis was used to test the null.

To verify the absence of outliers between the predictor variable (Indicator 7.4, formative assessment) and the criterion variable (the average eighth grade achievement score on the MAP Science test), a scatterplot was used. The data was examined for extreme outliers. No extreme outliers were found (see Figure 3).

The assumption of normal distribution was verified by creating a scatterplot for the predictor variable (Indicator 7.4, formative assessment) and the criterion variable (the average eighth grade achievement score on the MAP Science test). The researcher looked for the classic cigar shape (Green & Salkind, 2011; Warner, 2013). The researcher found the data to follow the classic cigar shape verifying the assumption of normal distribution (see Figure 1).

The assumption of linearity was verified by creating a scatterplot for the predictor variable (Indicator 7.4, formative assessment) and the criterion variable (the average eighth grade achievement score on the MAP Science test). The researcher looked for a linear relationship (Green & Salkind, 2011; Warner, 2013). A linear relationship was identified, satisfying the assumption of linearity (see Figure 3).

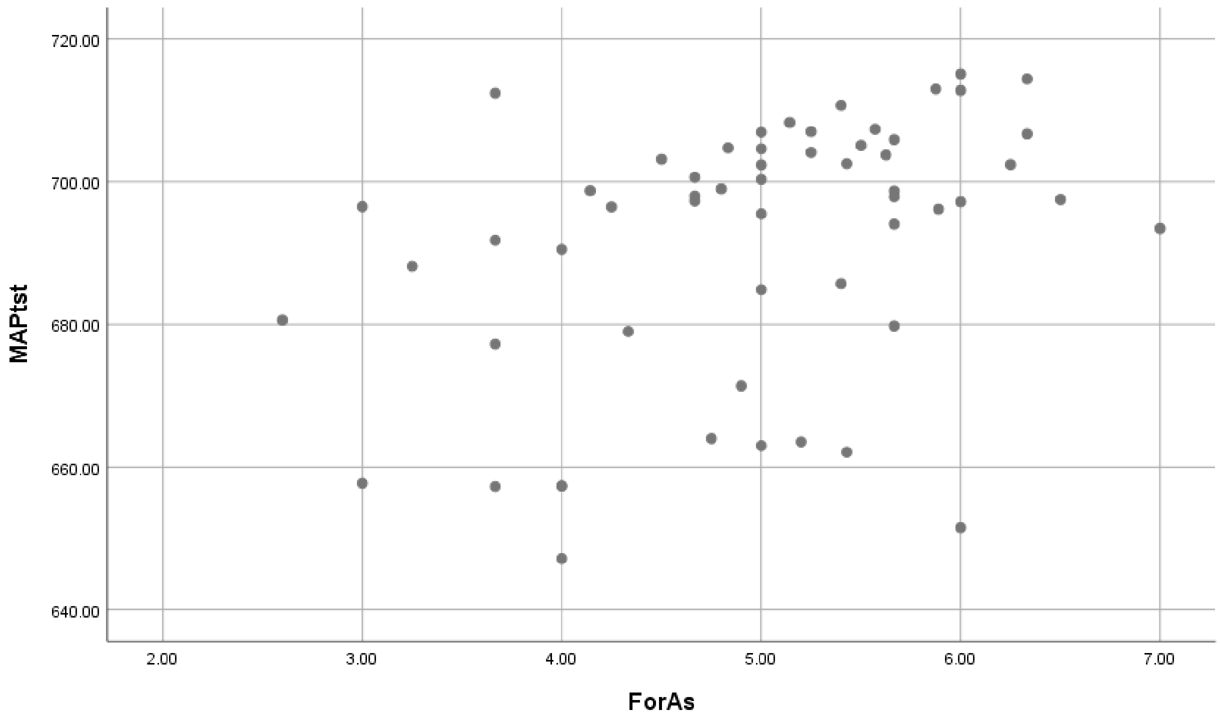

Figure 3. Scatterplot between the average eighth grade achievement score on the MAP Science Test and Indicator 7.4, formative assessment.

Finally, a linear regression analysis was performed at the 95% confidence level with a Bonferroni correction adjusted to an alpha level of where 0.017 PCalpha = .05/3. The researcher rejected the null hypothesis where the regression model yielded $F(1, 55) = 9.63$, $p < .003$. The correlation between the two variables was $r = 0.39$, indicating a large effect size (Warner, 2013, p. 208).

CHAPTER FIVE: CONCLUSIONS

Overview

The researcher utilized a linear regression analysis for this study to test the three null hypotheses to describe the strength and relationship between each predictor variable and the criterion variable. This chapter discusses the relationship between the three predictor variables of cognitive engagement, problem solving and critical thinking, and formative assessment and the criterion variable of students' scores on the eighth grade science test for the state of Missouri. It discusses some conclusions and implications of the study as it relates to the current body of research, some of the limitations associated with it, and suggestions for further research that would help to add to the body of research.

Discussion

Administrators use evaluation instruments to make decisions regarding professional development the retention and promotion of staff, and school goals. Since it has been shown teachers are the single greatest contributing factor to student achievement in schools (Marzano, Frontier, & Livingston, 2011; Hattie, 2013; Coggshall et al., 2012), it is vital to see if teacher observations are effective and what teaching practices tend to have the greatest impact on student achievement. The purpose of this study was to determine if there is a relationship between the scores eighth grade science teachers receive on the Network for Educator Effectiveness observation instrument for the teaching practices of cognitive engagement, problem solving and critical thinking, and formative assessment and how well their eighth grade science students perform on Missouri's state accountability test.

There were two instruments used to gather the data that was evaluated in this study. The Network for Educator Effectiveness (NEE) is a teacher evaluation system which was developed by two separate auxiliary units of the College of Education at the University of Missouri, the Heart of Missouri Regional Professional Development Center (RPDC) and the Assessment Resource Center (ARC). The classroom observation instrument used in this study was developed to be used across all subject and grade levels. Individual rubrics provide standardized protocols and scoring guides for each of the 36 indicators set forth by the Missouri Model Teacher and Leader Standards (University of Missouri College of Education, 2012). This observation instrument utilizes a seven-point scale ranging from 0-7.

The Missouri Assessment Program (MAP) eighth grade science test was developed by the state of Missouri. The science test is given in fifth and eighth grade and provides useful information about individual students' performance as well as performance at the classroom, building, and district levels (Department of Elementary and Secondary Education, 2015c). MAP assessments were developed by CTB/McGraw-Hill and DESE and were intentionally aligned with specific Show-Me Standards measured at the grade and subject area for the state of Missouri (Department of Elementary and Secondary Education, 2014).

The research used the data collected by these two instruments to help evaluate the following research questions:

- Is there a relationship between the criterion variable (the average achievement scores for an eighth grade class on the eighth grade science Missouri Assessment Program test) and the predictor variable (eighth grade science teachers' observation scores for Indicator 1.2, cognitive engagement) for the 2015-2016 school year?
- Is there a relationship between the criterion variable (the average achievement scores for an eighth grade class on the eighth grade science Missouri Assessment

Program test) and the predictor variable (eighth grade science teachers' observation scores for Indicator 4.1, problem solving and critical thinking) for the 2015-2016 school year?

- Is there a relationship between the criterion variable (the average achievement scores for an eighth grade class on the eighth grade science Missouri Assessment Program test) and the predictor variable (eighth grade science teachers' observation scores for Indicator 7.4, formative assessment) for the 2015-2016 school year?

A correlational design was used for this study to help determine the relationship, if any, between the predictor variables (science teacher observation scores on Indicators 1,2, 4.1, and 7.4) to the criterion variable (eighth grade MAP science scores).

Null Hypothesis One

For Null Hypothesis One, the researcher found a significant correlation between scores the eighth grade science teachers received for Indicator 1.2, cognitive engagement as measured by the NEE classroom observation instrument and the average score their students received on the eighth grade Missouri Assessment Program (MAP) science test. These results coincided with previous research done regarding student achievement and student engagement.

Hattie (2009) conducted a ground-breaking study synthesizing over 800 meta-analyses. In this study, Hattie found that cognitive engaging strategies have an effect size of 1.29, putting cognitive engaging strategies in the top five most effective learning strategies out of the 252 ranked learning strategies. Marzano and Pickering (2011) found student engagement to be one of the core elements necessary in quality education. Marzano and Pickering (2011) further suggested that research on how to motivate and engage students is essential in order to understand and solve some of the most vexing challenges educators face when it comes to school reform. Gallup conducted a study in 2009 of 78,106 students in 80 schools across eight states. Researchers in this study found that for every one percentage point increase in a student's score on Gallup's engagement index, a six-point increase in reading achievement and an eight-point increase in math achievement scores occurred (Gallup Poll, 2014; Blad, 2014).

Null Hypothesis Two

For Null Hypothesis Two, the researcher found a significant correlation between scores the eighth grade science teachers received for Indicator 4.2, problem solving and critical thinking as measured by the NEE classroom observation instrument, and the average score their students received on the eighth grade Missouri Assessment Program (MAP) science test. These results coincided with previous research conducted regarding student achievement and problem solving and critical thinking. According to Karbalei (2012), although this is a highly-valued skill in the work force, there has been little research to determine whether teaching critical thinking improves student academic performance. Karbalei went on to say that the few studies conducted have shown a strong correlation between the two.

One of these studies was done by Shukdeb and Sulakshana (2015) in a cell biology course at Bethune-Cookman University. Biology seniors were required to take this course for graduation. The study took place over a 17-year period (from 1997 to 2014). Shukdeb and Sulakshana found that 22 percent more of the students in the class who received the problem solving/critical thinking instruction received an A or a B than students in the control group (Shukdeb & Sulakshana, 2015). Syafii and Yasin (2013) conducted a similar study to Shukdeb and Sulakshana's study except they used high school biology students. They found students directed towards problem solving and critical thinking on an average scored higher than the control group 95.47% of the time. Syafii and Yasin (2013) suggested that this may be due to the fact that students learn skills and acquire knowledge more readily when they can transfer learning to new or more complex situations.

Null Hypothesis Three

For Null Hypothesis Three, the researcher found a significant correlation between scores the eighth grade science teachers received for Indicator 7.4, formative assessment as measured by the NEE classroom observation instrument, and the average score their students received on the eighth grade Missouri Assessment Program (MAP) science test. These results coincided with previous research conducted regarding to student achievement and formative assessment. Formative assessment is among the most common features of successful teaching and learning presented in the current body of classroom teaching practices (Black & William, 1998; Hattie, 2009; Leahy, Lyon, Thompson, & William, 2005).

In Black and William's (1998) study, they analyzed findings from over 250 studies on formative assessment and concluded there is no other way of raising standards for which such a strong *prima facie* case can be made on the basis of evidence of such large learning gains (p. 19). Continuing this research in 2007, William estimated formative assessment interventions can produce an average of six to nine months of learning gained per year. Hattie (2009) discovered similar results in a study of over 800 meta-analyses. Hattie found when ranked by effect size, six of the top 10 influences on student achievement are contributions from the teacher. Of these six contributions from the teacher, formative assessment was the highest ranked practice with an average effect size of 0.90. Leahy et al. (2005) found that when teachers use formative assessment, students can learn in six to seven months what would normally take an entire school year to learn. Although the studies done on formative assessment may vary on their calculated effect size, it is clear formative assessment works when it comes to improving student achievement.

Conclusion

The researcher began this study to determine if there was a correlation between the criterion variable of eighth graders scores on the state of Missouri's standardized test for science and the predictor variables of specific teaching practices: cognitive engagement, problem solving and critical thinking, and formative assessment. After performing a linear regression with a Bonferroni correction, it was fond that all the predictor variables had a moderate to strong correlation with the criterion variable. The findings of this study coincided with what the research had to say regarding these predictor variables.

Many researchers have found that cognitive engagement can improve student achievement (Appleton & Lawrenz, 2011; Conner & Pope, 2013). Kahu, (2013) went as far as to suggest the value and effect of engagement on student achievement is no longer questioned. This study supported this claim, showing a strong correlation between cognitive engagement and how well students performed on the eighth grade Missouri standardized test for science. In addition to academic achievement, other studies have shown that students who were engaged in school also receive better employment ratings and higher socioeconomic status as adults (Appleton & Lawrenz, 2011). This study adds to this body of knowledge and suggests that schools should place student engagement as a high priority on their list of teaching practices to train and support teachers on.

Developing problem solving and critical thinking is a skill that has been sought by employers in their employees for years. Despite this, many employers complain their employees are not equipped with critical thinking skills when they leave school and enter the workforce

(Shukdeb & Sulakshana, 2015). In addition, the explosion in technology has created an ever-changing global economy that the future generation of students will have to adapt to and learn how to think critically through the new problems this creates (Daggett, 2008). Higher educational institutions of learning in the United States today expect their students to be capable of tackling these challenges of the 21st-century (Shukdeb & Sulakshana, 2015).

Even though these issues regarding problem solving and critical thinking are widely known and excepted among educators, there have been few studies that have shown that there is an actual link between problem solving and critical thinking skills and student achievement (Karbalei, 2012). This study suggested that there is a strong correlation between problem solving and critical thinking and student achievement on the eighth grade science scores for the Missouri end-of-year standardized test. Teaching problem solving and critical thinking skills often take more time than doing simpler types of tasks. Due to the pressure put on teachers for their students to do well on standardized assessments and the amount of material they are required to cover (Christie et al., 2013; Hadfield et al., 2012; Little et al., 2009; Washington, 2011), this study may suggest that the time a teacher spends teaching problem solving and critical thinking skills is time well spent in regards to how their students perform on standardized tests.

A teacher's ability to use formative assessment is a natural feature of teaching and learning and an ongoing part of classroom life (Black & Wiliam, 1998; Wiliam, 2011; DuFour & Marzano, 2011; Hattie, 2013; Leahy et al., 2005). Although in this study formative assessment had the weakest correlation of the three, though still significant, this teaching practice has been shown to have an exceptionally large effect size on student learning (Atkin et al., 2001; Beckett, & Volante, 2011; Black & Wiliam, 2011; Buffum et al., 2012; Hattie, 2009; Wiliam, 1998).

Black and William (1998) analyzed findings from over 250 studies on formative assessment and concluded “we know of no other way of raising standards for which such a strong *prima facie* case can be made on the basis of evidence of such large learning gains” (p. 19). This study continues to support the current body of research showing a strong correlation between formative assessment and eighth graders’ scores on the state of Missouri’s standardized test for science. Educators should continue to support and train their teachers on the effective use of this strategy.

One of the areas that was surprising to the researcher and seemed to contradict what the current body of research had to say was on the topic of teacher evaluations. Many researchers concluded that teacher evaluations lack the evidence to support any validity to the process (Aseltine et al., 2006; Danielson & McGreal, 2000; Marshall, 2009). The consensus was that the criteria used in these evaluations is not based in research and the evaluators are typically inadequately trained (Danielson & McGreal, 2000; Haefele, 2003; Jacobson, 2005; Marzano et al., 2011). One of the biggest concerns is incompetent teachers receive ratings that are too lenient and superior ratings are rewarded to average teachers (Jacob & Lefgren, 2006; Marshall, 2009; Stronge et al., 2008). The research in this study suggested that the Network for Educator Effectiveness might be effective at rating teacher efficiency regarding student performance. If administrators using the classroom observation instrument can accurately score a teacher’s ability to implement teaching practices that have been proven to be effective at increasing student performance, then this could significantly contribute to the current body of educational research in the area of teacher evaluation systems.

Evans (2014) conducted a similar study to this one and examined the criterion variables of how well students performed on Missouri’s standardized test for mathematics and English language arts. Evans examined how the criterion variable correlated with observation scores teachers received using the Network for Educator Effectiveness (NEE) observation instrument for specific teaching strategies. Some of these strategies were: the use of academic language, cognitive engagement, motivation, problem solving, teacher student relationships, and formative assessment. Evans found there was not a statistically significant relationship between a teacher's score on these predictor variables, as reported on the NEE observation instrument, and criterion variables of how well students perform on the Missouri's standardized test for mathematics and English language arts. There are a number of factors that could have contributed to the difference in results between Evans' (2014) study and the current researchers. Evans (2014) suggested that one of the weaknesses of the study was the number of school districts involved in the study (six small rural schools participated) where the current researcher had 37 different participating school districts including small rural school districts and larger urban districts. Evans' (2014) study had 25 mathematics teachers and 29 English language arts teachers that participated. The current researcher had 62 teachers who participated in the study. Finally, when Evans (2014) performed his study, the Network for Educator Effectiveness had only been in place for two years (University of Missouri, 2015). Administrators had only had one to two years of training and experience using the system. The current study gave administrators two more years to become familiar with the system and become more adequately trained on how to use it. All these factors may have helped to contribute to the differences in results between Evans' study and this study.

Macroeconomic studies have established a clear link between student achievement on science tests and per capita gross domestic product (GDP) growth (Bisaccio et al., 2014). With this in mind, finding ways to improve science achievement on science tests is crucial. This study helped to show that there is a correlation between teachers use of cognitive engagement, problem solving and critical thinking, and formative assessment and how well they performed on the eighth grade Missouri science test.

Implications

The predictor variables in this study of cognitive engagement, problem solving and critical thinking, and formative assessment are all variables that have been studied before. There are some implications from this study that may help to increase the current body of knowledge. The first is regarding teacher evaluations. Administrators use evaluation instruments to make high-stakes decisions regarding professional development, retention and promotion of staff, and school goals (Coggshall et al., 2012; Hattie, 2013; Marzano et al., 2011). Because of this it is vital to see if teacher observations are effective and what teaching practices tend to have the greatest impact on student achievement. In contrast to this, understanding the current body of research shows a general lack of confidence in the current body of teacher evaluation systems to affect teaching practices or adequately represent what is occurring in the classroom (Aseltine et al., 2006; Danielson & McGreal, 2000; Haefele, 2003; Marshall, 2009; Stoelinga, 2012). This study suggested that the Network for Educator Effectiveness may be able to adequately represent quality teaching in the classroom. Although a correlation of the variables in this study exists, it does not mean causality (Warner, 2013), but it does warrant further research into the Network for Educator Evaluation (NEE) teacher evaluation system.

Although the current body of research shows that cognitive engagement has been accepted as an effective teaching strategy to improve student achievement, the practice of implementing cognitive engagement into schools tends to remain low (Conner & Pope, 2013; Blad, 2014; Yazzie-Mintz, 2010). According to Conner and Pope (2013), 40 to 60 percent of high school students are chronically disengaged. Gallup Poll (2014) found 28 percent of students in schools said they were not engaged and 17 percent said they were actively disengaged, and Yazzie-Mintz (2010) reported 66 percent of high school students reported being bored at least every day in class. This study suggested that professional development and goals emphasizing better engagement in classrooms is a strategy that will help improve student achievement.

Employers and schools of higher education have recognized problem solving and critical thinking as skills needed to be competitive in the 21^{st}-century (Shukdeb & Sulakshana, 2015). However, few studies have been done to evaluate the effect of problem solving and critical thinking on student achievement (Karbalei, 2012). This study suggested that there may be a correlation between problem solving and critical thinking and student achievement. Add to this the fact that problem solving and critical thinking are skills that students will need to acquire to be competitive in higher education and the employment field (Daggett, 2008), and the implementation of this practice into the classroom may be one of the best teaching strategies that schools could incorporate.

Because a clear link between student achievement on science tests and per capita gross domestic product (GDP) growth has been established (Bisaccio et al., 2014) developing more problem solving and critical thinking in students may be crucial. As mentioned earlier, although a correlation of the variables in this study exist, it does not mean causality (Warner, 2013). The score on the test is probably not what is creating the higher (GDP). Rather it may be what these students are doing that creates that correlation. Problem solving and critical thinking could be some of those skills leading to these correlations and deserves further research.

Limitations

One of the limitations of this study was the small sample size of 57 teachers that participated. This did not meet the number suggested by Gall et al. (2007) of a minimum of 66 participants is desirable for a linear regression design (p. 176). Other researchers suggest that showing a strong correlation with a larger sample size is not required (Warner, 2013). Also, the sample size was weighted more strongly towards smaller schools. The researcher found it difficult to get the larger school districts to participate in the study.

Another limitation of the study was the inability to track whether the protocol suggested by the Network for Educator Effectiveness was followed by each administrator. For example, it could be argued that each observation at least 20 minutes and followed up within 24 hours with a face-to-face conversation between the teacher and observer may not have been followed (University of Missouri College of Education, 2012). Results could have been skewed if all protocols were not followed by the observer. The researcher had no way of verifying this since all data collected in this study was archival data.

The inability to determine a direct relationship between the predictor variables and the criterion variables was also a limiting factor of this study (Warner, 2013). The correlation could be the result of many factors such as the student teacher relationships, previous knowledge of students, years of teaching experience, goals and objectives put forward by the school, or motivation strategies put forward by the students. In education, it is hard to tie results such as student achievement to one single predictor variable. However, there is a correlation between the predictor variables of cognitive engagement, problem solving and critical thinking, and formative assessment and the criterion variable of eighth graders scores on the state of Missouri’s standardized test for science.

Recommendations for Future Research

This study suggested that the Network for Educator Effectiveness may be able to adequately represent quality teaching in the classroom. This is a significant addition to the current body of knowledge regarding teacher evaluation systems and their effectiveness in improving teaching practices and predicting student achievement. The current system lacks significant studies in this area (Aseltine et al., 2006; Danielson & McGreal, 2000; Haefele, 2003; Marshall, 2009; Nuthall, 2004; Stoelinga, 2012). More studies would need to be done to determine if the Network for Educator Effectiveness was effective at improving teaching practices and predicting student achievement. Since the Network for Educator Effectiveness is the single most used evaluation system in Missouri, studies in this area are crucial.

Since employers and schools of higher education have expressed that problem solving and critical thinking are skills needed to be competitive in the 21st-century (Shukdeb & Sulakshana, 2015), more studies need to be conducted to help determine what effect problem solving and critical thinking has on student achievement (Karbalei, 2012). With its possibility to be correlated with student achievement, success in higher education and employment (Shukdeb & Sulakshana, 2015) and a possible link to per capita gross domestic product (GDP) (Bisaccio et al., 2014), establishing a stronger correlation between problem solving and critical thinking and student achievement, specifically regarding science tests, would help push forward the body of knowledge in this area.

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Appendix A

Liberty IRB Approval

LIBERTY UNIVERSITY
INSTITUTIONAL REVIEW BOARD

November 4, 2016
Grant Lavoy Stock
IRB Exemption 2663.110416: The Relationship between Teacher Evaluation Scores and 8th Grade Science Achievement Scores in Missouri

Dear Grant Lavoy Stock,
The Liberty University Institutional Review Board has reviewed your application in accordance with the Office for Human Research Protections (OHRP) and Food and Drug Administration (FDA) regulations and finds your study to be exempt from further IRB review. This means you may begin your research with the data safeguarding methods mentioned in your approved application, and no further IRB oversight is required.

Your study falls under exemption category 46.101(b)(4), which identifies specific situations in which human participants research is exempt from the policy set forth in 45 CFR 46:101(b):

> (4) Research involving the collection or study of existing data, documents, records, pathological specimens, or diagnostic specimens, if these sources are publicly available or if the information is recorded by the investigator in such a manner that subjects cannot be identified, directly or through identifiers linked to the subjects.

Please note that this exemption only applies to your current research application, and any changes to your protocol must be reported to the Liberty IRB for verification of continued exemption status. You may report these changes by submitting a change in protocol form or a new application to the IRB and referencing the above IRB Exemption number.

If you have any questions about this exemption or need assistance in determining whether possible changes to your protocol would change your exemption status, please email us at irb@liberty.edu.

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Appendix B

Superintendent and Principal Letters

Permission Electronic Mail

Dear (Superintendents name here)

I am conducting a research project entitled *The Effect of Teacher Evaluation Scores on 8th Grade Science Achievement Scores in Missouri* in partial fulfillment of the requirement for a doctoral degree in educational leadership at Liberty University.

The research gathered should assist in providing insights and perspectives into the relationship between teacher effectiveness and student achievement as well as provide a specific examination of the Network for Educator Effectiveness (NEE) observation instrument. As the NEE model is very closely tied to the new Missouri teacher standards, this study will have implications for educational leaders throughout Missouri.

I will be sending you a letter similar to this email seeking your permission as the superintendent of the (*Name Here)* School District to gather MAP data for the years 2014 and 2015 8th grade science test as part of the data collection and analysis process. This data will be linked with the NEE observation data provided by the Assessment Resource Center. Agreeing to provide the requested information is voluntary. The identity of the teachers and students will be anonymous, and the identity of the school district will remain confidential in this dissertation or any future publications of this study.

What would be needed beyond your permission to use this data would be the help of your building level principal(s) to download the 8th grade science MAP data into an Excel spread sheet with the teacher's NEE ID number that corresponds to the students they taught. This spread sheet will have no student names or student numbers (just scale score numbers) and no teacher names (just the NEE ID). I have created a step by step guide to walk the principals through this and the whole process should not take them more than 5-10 minutes to complete. I have attached copies of the spread sheet and the step by step process so you can look them over.

Please do not hesitate to contact me with any questions or concerns about participation (phone: 417-xxx-xxxx or electronic mail: gstocklds@gmail.com). You may also contact the dissertation advisor for this research study, Dr. Kurt Michael (phone: 143-xxx-xxxx or electronic mail: kmichael9@liberty.edu). If you choose to participate, please sign and return the permission letter in the envelope provided when you receive it in the mail.

Yours truly,

Grant Stock

Superintendent Permission Letter

(DATE)

Dear (Superintendents name here)

I am conducting a research project entitled *The Effect of Teacher Evaluation Scores on 8th Grade Science Achievement Scores in Missouri* in partial fulfillment of the requirement for a doctoral degree in educational leadership at Liberty University. The research gathered should assist in providing insights and perspectives into the relationship between teacher effectiveness and student achievement as well as provide a specific examination of the Network for Educator Effectiveness (NEE) observation instrument. As the NEE model is very closely tied to the new Missouri teacher standards, this study will have implications for educational leaders throughout Missouri.

I am seeking your permission as the superintendent of the (*Name Here)* School District to gather MAP data for the years 2014 and 2015 8th grade science test as part of the data collection and analysis process. This data will be linked with the NEE observation data provided by the Assessment Resource Center. Agreeing to provide the requested information is voluntary. The identity of the teachers and students will be anonymous, and the identity of the school district will remain confidential in this dissertation or any future publications of this study.

Please do not hesitate to contact me with any questions or concerns about participation (phone: 417-xxx-xxxx or electronic mail: gstocklds@gmail.com). You may also contact the dissertation advisor for this research study, Dr. Kurt Michael (phone: 143-xxx-xxxx or electronic mail: kmichael9@liberty.edu). Should you choose to provide the requested information, please sign and return the permission letter in the envelope provided. A copy of this letter and your written consent should be retained by you for future reference.

Yours truly,

Grant Stock

Name of School District ____

Signature of Superintendent ____ Date ________

Principal Request for Help Electronic Mail

Dear (Principal name here)

I am conducting a research project entitled *The Effect of Teacher Evaluation Scores on 8th Grade Science Achievement Scores in Missouri* in partial fulfillment of the requirement for a doctoral degree in educational leadership at Liberty University. The research gathered should assist in providing insights and perspectives into the relationship between teacher effectiveness and student achievement as well as provide a specific examination of the Network for Educator Effectiveness (NEE) observation instrument. As the NEE model is very closely tied to the new Missouri teacher standards, this study will have implications for educational leaders throughout Missouri.

I sent a letter similar to this one seeking permission from your superintendent (*Name Here)* to gather MAP data for the years 2014 and 2015 8th grade science test as part of the data collection and analysis process. (*Name of Superintendent Here*) has given me permission to collect this data, and I have attached a copy of that permission letter. The data I collect will be linked with the NEE observation data provided by the Assessment Resource Center. Although (*Name of Superintendent Here*) has given me permission to collect this data, your help is voluntary, the identity of the teachers will be anonymous and the identity of the school district will remain confidential in this dissertation or any future publications of this study. In addition to your agreement to help me in my study, I would ask for your help in downloading the 8th grade science MAP data into an Excel spread sheet with the teacher's NEE ID number that corresponds to the students they taught. This spread sheet will have no student names or student numbers (just scale score numbers) and no teacher names (just the NEE ID). I have created a step by step guide to walk you through this process. The whole process should not take more than 5-10 minutes to complete. I have attached copies of the spread sheet and the step-by-step process so you can look them over.

Please do not hesitate to contact me with any questions or concerns about participation (phone: 417-xxx-xxxx or electronic mail: gstocklds@gmail.com). You may also contact the dissertation advisor for this research study, Dr. Kurt Michael (phone: 143-xxx-xxxx or electronic mail: kmichael9@liberty.edu). Please send me an email or call my phone and let me know if you are willing to help me out. My study involves such a small population I will need quit a large participation rate, so your help in this study would be very much appreciated.

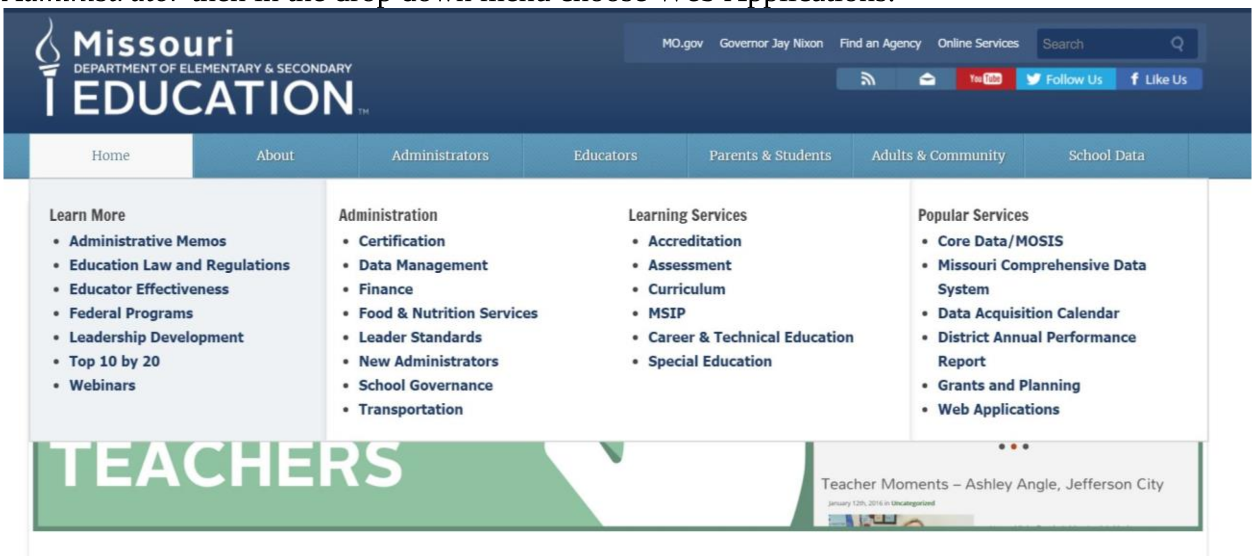
Yours truly,

Grant Stock

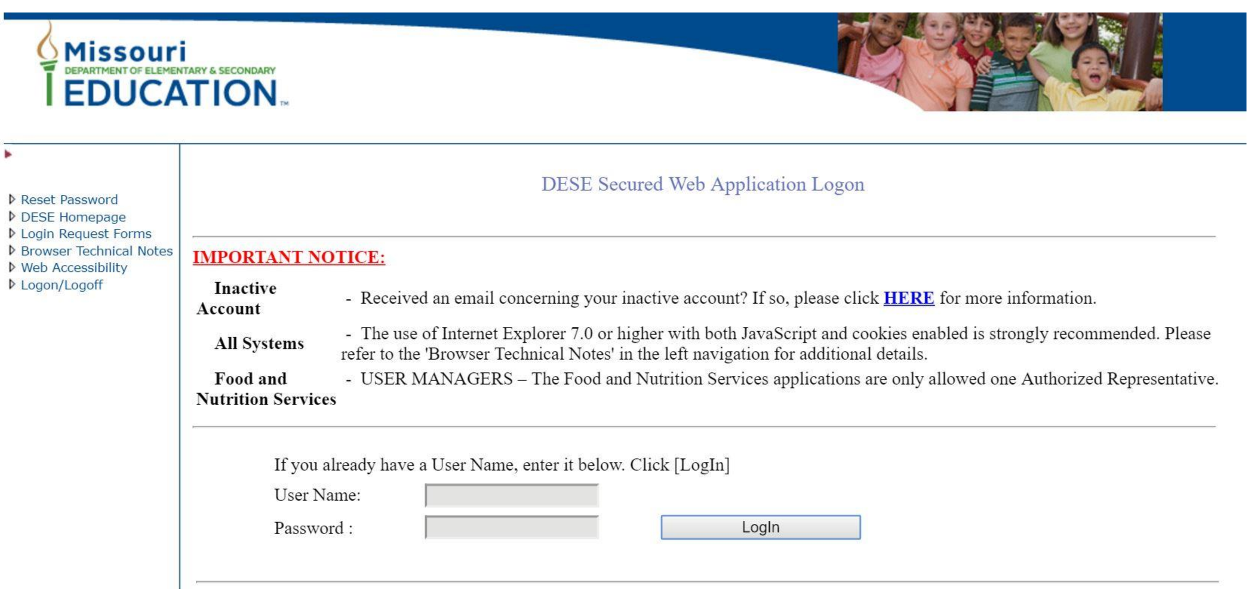
Appendix C

Steps for School Principals to Tie Student Data to Teacher NEE Numbers

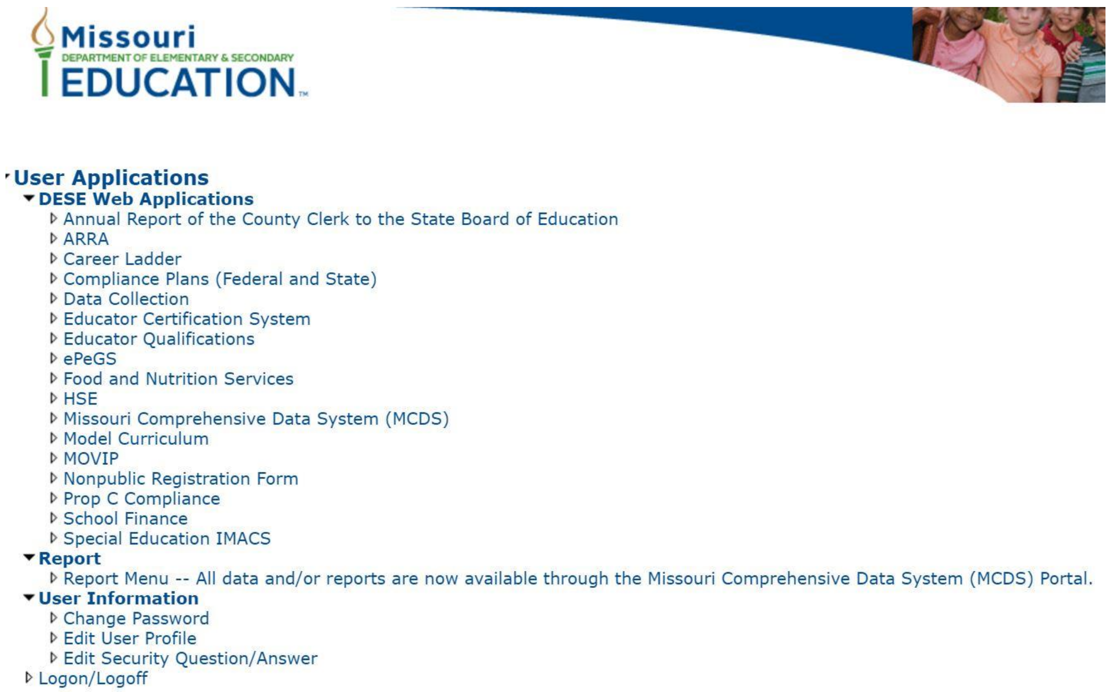
STEP ONE:
Open up your web browser and type in www.dese.mo.gov then from the menu on the top choose *Administrator* then in the drop down menu choose Web Applications.



STEP TWO:
Log in to your DESE Web Applications Account using your principal *User Name* and *Password*.

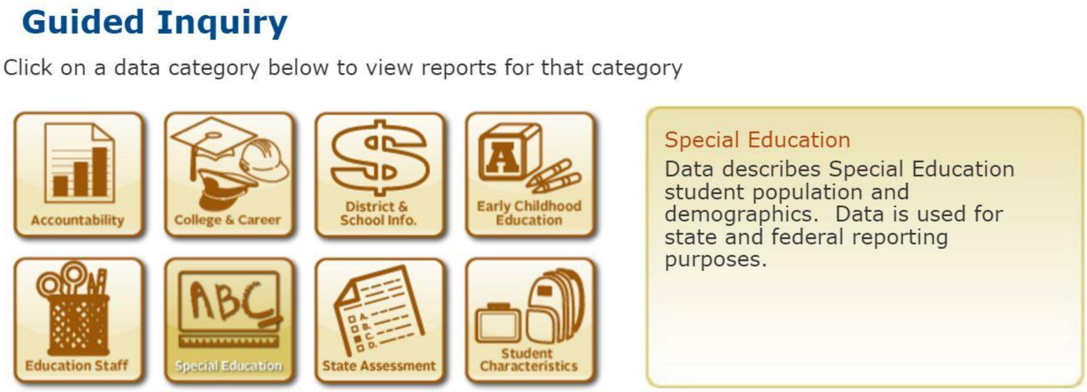


STEP THREE:
From the User applications menu choose *Missouri Comprehensive Data System (MCDS)*.

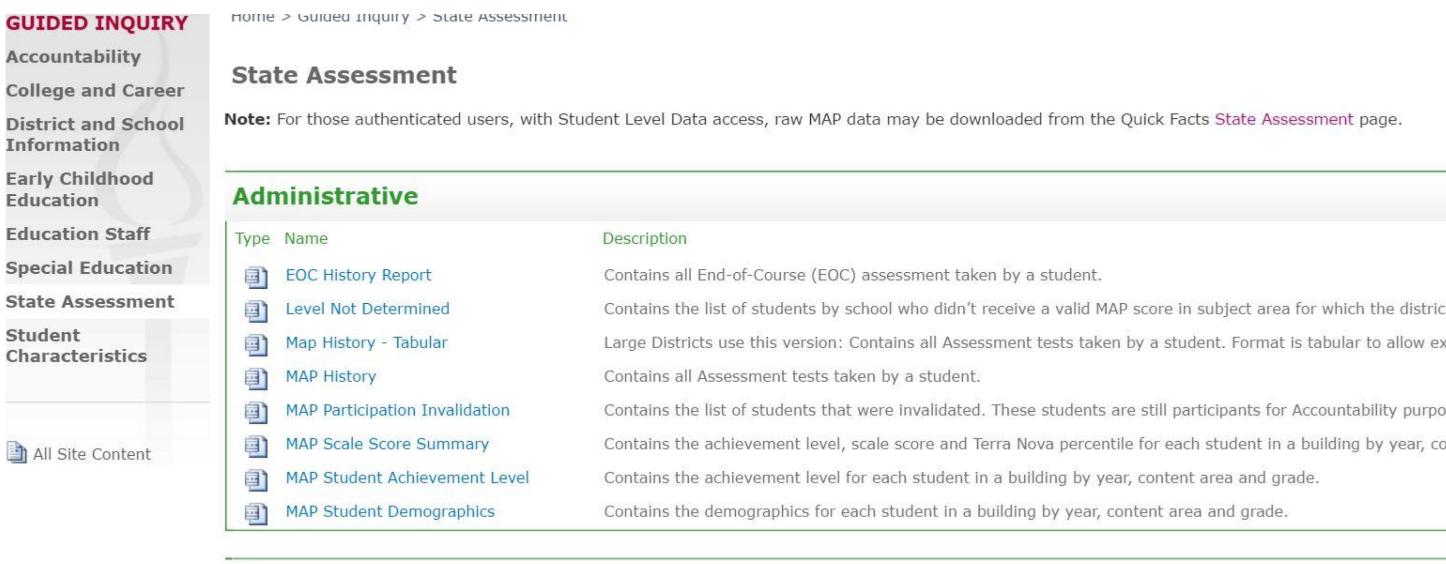


STEP FOUR:
From the home screen select *Guided Inquiry*.

STEP FIVE:
From the boxes click on *State Assessment*.

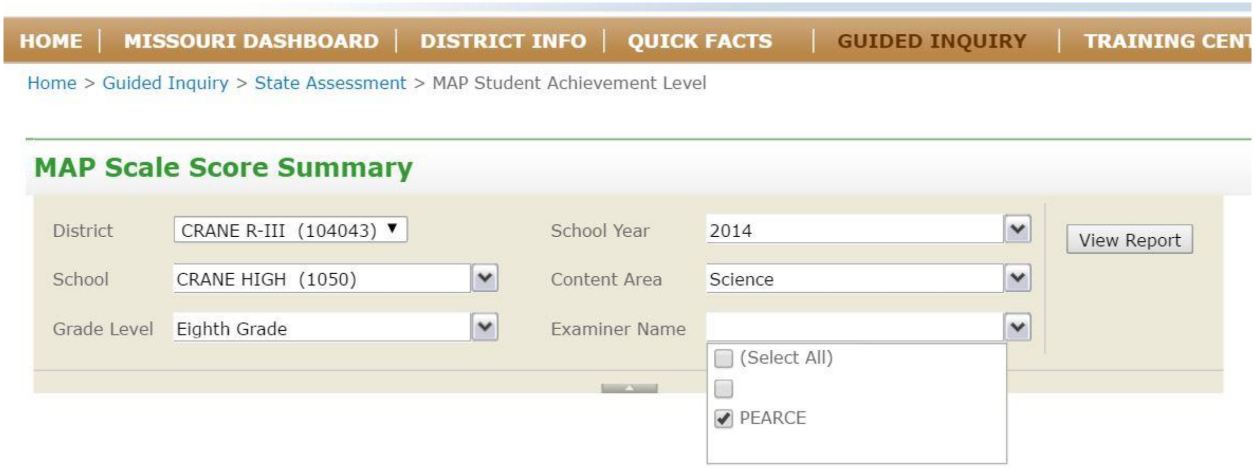


STEP SIX:
Under Administrative choose *MAP Scale Score Summary*.



STEP SEVEN: (If you have more than one teacher you will come back to this step for each one)
Here you will choose the correct information for your school.

1. Choose your District and wait for the page to refresh.
2. Choose the year ***2015*** and wait for the page to refresh.
3. Choose the school where the 8th grade MAP science test is given and wait for the page to refresh.
4. Choose ***Science*** for the content area and wait for the page to refresh.
5. Choose eight grade for the grade level and wait for the page to refresh.
6. Choose your District and wait for the page to refresh
7. Choose the Examiner Name for the teacher who you will be pulling the data for. If you have more than one teacher who administrate the eighth grade MAP science test you will need to come back to this step for each teacher.



8. Click View Report.

STEP EIGHT:
Here you will want to save the data to an Excel file. DO this by clicking on the save icon and choose Excel. This should download an Excel Document to your computer. Open the file.

STEP NINE:
Click on the work book tab that says ***MAP Scale Score Summary*** at the bottom of the Excel Document. NOTE: if you have a newer version of Excel make sure in the yellow strip at the top of the Excel document you click ***Enable Editing*** or you will not be able to do the next step.

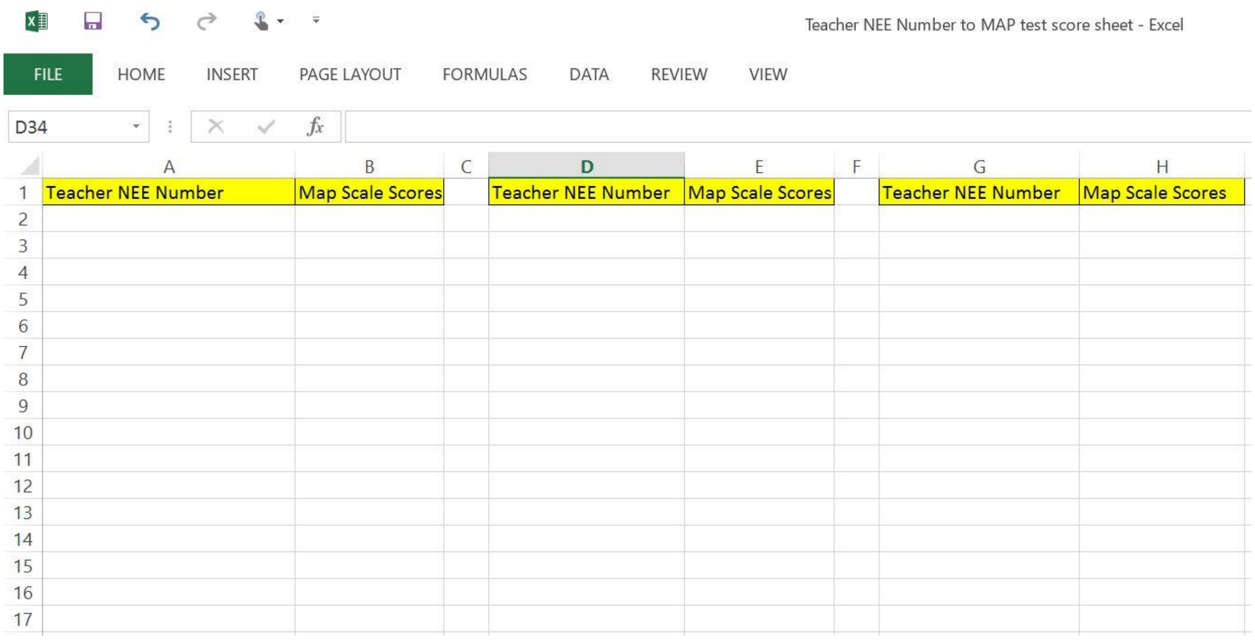
STEP TEN:
Highlight all the MAP Scale Scores in the column labeled ***MAP Scale Score***, then right click and choose copy. Make sure you do not copy any names or identifying data with these numbers. Only give me the MAP Scale Score.

MAP Scale Score
723
689
631
699
672
658
678
705
698
727
718
705
691
708
663
692
720
702
676
701
685
637
703
707
715
639
678
705
693
730

STEP ELEVEN:
Open up the document I sent you named Teacher NEE Number to MAP test score sheet. Past the data you copied in STEP TEN (MAP Scale Score) into the column labeled MAP Scale Score. Then in the column labeled Teacher NEE Number put the teacher's number associated with having taught these students. This number is the number you get from NEE.

Teacher NEE Number	Map Scale Score
	723
	689
	631
	699
	672
	658
	678
	705
	698
	727
	718
	705
	691
	708
	663
	692
	720
	702
	676
	701
	685
	637
	703
	707
	715
	639
	678
	705
	693
	730
	683
	703
	711
	719
	721
	740
	697

STEP TWELVE:
If you have more than one teacher who administers the Eight Grade MAP Science test go back to STEP 7 and repeat through eleven for each teacher. There are columns for each teacher in the Excel document Teacher NEE Number to MAP test score sheet. I created columns for 4 teachers. If you have more than 4 teachers responsible for teaching eight grade science please copy and paste enough columns for each teacher and their corresponding students MAP Scale Scores.



STEP THIRTEEN:
Save this Excel document and email it back to me at gstocklds@gmail.com

If you have any questions please call me or email me. Thank you so much for your help on this doctoral dissertation.

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