IDENTIFYING THE IMPACT OF QUESTIONING IN MATHEMATICS INSTRUCTION

A Dissertation

Presented to

The Faculty of the Education Department

Carson-Newman University

In Partial Fulfillment

of the

Requirements of the Degree

Doctor of Education

By

Rachel E. Hicks

May 2019

CARSON-NEWMAN
UNIVERSITY

Dissertation Approval

Student Name: **Rachel E. Hicks**

Dissertation Title: ***Identifying the Impact of Questioning in Mathematics Instruction***

This dissertation has been approved and accepted by the faculty of the Education Department, Carson-Newman University, in partial fulfillment of the requirements for the degree, Doctor of Education.

Dissertation Committee:

Signatures: (Print and Sign)

Tammy Barnes Ed.D.
Tammy L. Barnes, Ed.D., Dissertation Chair

P. Mark Taylor, Ph.D., Methodologist Member

Patricia Murphree Ed.D.
Patricia Murphree, Ed.D., Content Member

Approved by the Dissertation Committee Date: March 28, 2019

Abstract

Better academic performance is exhibited when a student is actively engaged in their learning. Educators often seek to provide classroom instruction which is based upon best practices and quality student engagement. Student engagement carries with it a myriad of definitions. This research evaluated the instructional strategy of questioning. It is one of the easiest and most prevalent instructional strategies employed. This quantitative study sought to identify a correlation between the number of questions asked by the teacher during classroom instruction and student performance on a math benchmark assessment. The research also sought to identify a correlation between how students chose to answer the questions posed by the teacher and their performance on the assessment. The data were collected in 7th grade math classrooms. Math was chosen as the focus area due to the continued rise in expectations for math teachers and students. This research indicated that the amount of questions is not the main component to be considered when evaluating student engagement.

DEDICATION

To my dear tribe of friends, it makes all the difference in the world to know that people are cheering you on. You have provided constant encouragement and support through this entire process and it has been invaluable.

To my mom and my two sisters, undeniably the three greatest women I have ever known. You serve as the greatest examples of perseverance, dedication, grit, and love through all of life's adventures.

To my husband, thank you for being a steadfast and loving husband and father. All that is good in my life is because of you.

To my children, everything that I do is for you. I love you more than words can say.

ACKNOWLEDGEMENTS

I would like to acknowledge my dissertation committee members Dr. Tammy Barnes, Dr. P. Mark Taylor, and Dr. Patricia Murphree. Their guidance, wisdom, and encouragement were invaluable to me.

None of this would have been possible without the kindness of the math teachers who let me come into their classrooms on multiple occasions. The students are in good hands when they are with you. Your commitment to excellence and your passion for education has not gone unnoticed. I cannot say thank you enough for your encouragement and kindness during this research.

Table of Contents

List of Tables and Figures

Tables

Figures

CHAPTER I: INTRODUCTION AND BACKGROUND OF THE STUDY

Best Practices

All educators seek to find the best methods to use when planning instruction. Many have a standard approach to delivering instruction only to realize that to be a successful classroom instructor they must have a wide assortment of instructional strategies. Thus, the pursuit to find and utilize best practices begins.

As the pursuit to increase student achievement on assessments, both benchmark assessments and state assessments, has heightened teachers have increasingly sought to expand their knowledge and classroom instructional practices. This has led to some successes and many frustrations for teachers. Every year teachers are presented with professional development opportunities, trainings, consortiums, conferences and a host of other options which are provided in an attempt to support and train educators. Along with these trainings' schools hope to see a rise in student achievement as evidenced on a school-wide assessment. While professional development often yields positive outcomes, much useless information is also presented. It is problematic for educators to identify what works and what does not work. An educator may prefer one strategy over another; however, if it is not relevant to the state assessment then it is of no value to the educator. The ability to identify the relevance and feel secure in that decision is of great significance to the classroom teacher.

Throughout an educator's career, there will be an endless amount of educational strategies that will be presented as best practices. Many of these strategies require active student engagement, such as flipped classrooms, discourse, feedback, backwards planning, differentiation, questioning, the Socratic method, cooperative learning, scaffolding, and project-based learning. There are numerous other strategies and no teacher can manage them all well.

Instead, many teachers find one strategy which works for them and use it regularly. Minimal emphasis has been placed on teachers correlating their instructional practices to achievement levels on assessments. Teachers believe if they taught or covered the standards, then the students should have learned what was needed.

Active Student Engagement

Students learn best by doing. Educators have been inundated with instructional approaches which focus on Problem-based learning, real world experiences, experiential learning, hands-on activities, and many other ideas which focus on students being actively involved in the learning process. However, the frequency and the consistency with which these are utilized ranges from non-existent to daily. On a more day-to-day schedule, the simple types of responses which a teacher may utilize are much more manageable and can lend themselves to a reasonable type of classroom instruction in which all learners are involved in the activity. The ability of a teacher to identify the correct student engagement activity is crucial.

Achievement

Achievement is the central focus of all schools, more specifically, achievement on school-wide assessments. Since the adoption of No Child Left Behind, expectations have changed. A change in expectations prompts a change in teaching and learning. The goal is no longer to not only graduate students that will be productive members of society, but now students must achieve and excel. The pressure has not been welcome. A school calendar now has 1-2 weeks of state testing at the end of a school year, preceded by three testing windows throughout the school year in which school-wide benchmark assessments are given.

The preparation and conversation concerning achievement tests permeates all professional learning communities (PLC's), faculty meetings, staff development days, in-service

days, team meetings, parent-teacher conferences, and all conversations in the classroom between teacher and students. Activities such as charting data both by the teacher and student occur at regular intervals. Discussion regarding the validity of the test occurs. Tested standards are analyzed, question types are evaluated, and testing conditions are measured. Every variable of an achievement test is weighed.

What does an achievement test provide for an educator? Some say a snapshot, some say a road map. It provides a way for teachers to evaluate their instruction. Did they teach a standard in such a way that a student was able to gain mastery? If a teacher has identified that he/she are weak in understanding of a specific tested standard, was this evidenced in student achievement scores. As data from benchmark or state assessments is analyzed, the questioning is an essential element to understanding. The questioning leads to solutions or new approaches which can be used to advance learning.

Statement of the Problem

The idea of active student engagement instruction is not a new idea. It is, however, one which does not have a clear and concise definition. It prompts confusion regarding what active student engagement looks and sounds like. When speaking with a group of teachers, one teacher may define student engagement quite differently than another teacher. One administrator may define it very differently than another and if students were asked about student engagement, their definition may completely shock an educator.

What does student engagement reference? Is student engagement a large or small component of instruction? Does this mean a student is answering a question? Does this mean a student is reading a passage? Are students engaged if he/she is involved in a group discussion? Are they engaged if they are silently working at their desk? Is a student engaged if they are

helping another student? Is the picture of a classroom filled with students moving, talking, and participating in a well-structured lesson the ideal of active student engagement? Is student engagement only defined as problem-based learning, hands on activities, or service learning? Are the students meeting their academic goals as defined by benchmark and state assessments? Accordingly, educators need to know what is effective and what is ineffective. The term "student engagement" can be used in a faculty meeting and there will be a different definition form in every mind of every teacher in the room. Teachers want to do what is right, but this is constantly changing. There is a myriad of ways presented to teachers in hopes that the desired results will occur.

The perception of the teacher is also an element that is necessary to implementing instruction heavily concentrated on student engagement. All teachers agree with student engagement but is it being implemented? Do teachers adequately plan and prep for highly engaging activities? What are the factors which are inhibiting them from executing active student engagement?

Purpose and Significance of the Study

The ability to identify what works and what does not work is invaluable to solving a problem. It is often said that teachers need a large toolbox filled with strategies and activities to use in the classroom. Some strategies are developed by accident, usually a combination of teacher knowledge and experiential learning. Other strategies are learned through peer collaboration among teachers. Some strategies are expectations from district personnel thrust upon the faculty of a school. While some instructional strategies are fun, entertaining, or even easy to implement, they will not be considered valuable if standards are not mastered and

achievement is not satisfactory. The purpose of this study was to scrutinize the questioning strategy which teachers use during classroom instruction.

Questioning is a mode of student engagement which can be quickly implemented and can serve as a formative assessment as the teacher develops a lesson. Questions can range from being asked and answered in a quick and concise manner to requiring a more detailed explanation. The usage of questioning is also a type of student engagement which may not have been informed by meaningful thought when a teacher is planning a lesson. It is reasonable to believe that questioning occurs during instruction. However, in order for this type of instruction to be most effective, the questions need to be pre-planned and well-developed. When discussing best practices and active student engagement, the idea of questioning is one of the first and the easiest models, yet it can also be frequently overlooked during the lesson planning stage.

No teacher wants to have a boring classroom. There has never been a first-year teacher who has stated, "I want my class to be lackluster and dull!" In like manner, there has never been a veteran teacher who has used that sentence either. Teachers use words such as "fun", "exciting", "inspiring", even "challenging" to describe their ideal conditions. How is a fun, exciting, and challenging class accomplished? Humans remember what they experience, they learn by what they were actively involved in doing. While all of life is made up of lessons learned through life experiences this is in no way different than the learning which should take place in a classroom.

Theoretical Foundations

Constructivism

The French Swiss philosopher Jean Piaget developed the learning theory of constructivism through his life's work studying children and their cognitive development. Constructivism has been influential in determining teaching styles and in forming types of

classroom instruction. When applied to the classroom, constructivism sees the learner as responsible for acquiring knowledge and as an active participant in the process (Loyens & Gijbels, 2008). Students should be actively involved in their learning. Piaget also recognized that a student's learning occurs when they relate new information with prior knowledge they may have on a topic or through an experience. When receiving the new information, a student will then attach it to his/her previously developed knowledge of a topic and then arrive at his/her own conclusion or understanding of a concept. The development of knowledge is the result of knowledge construction.

How the knowledge is disseminated and the environment into which it is received, followed by the supporting actions to promote the learning of new information is the job of the teacher. Teachers who choose to take a constructivist approach to classroom learning know the needs of their students. They know the level at which their students are able to learn and they create opportunities to learn through creating activities that capitalize on social interactions and in-depth communication with all individuals in the classroom.

Learner-Centered ideology

The child is the central figure of every school. Learner-Centered educators believe that student learning stems from a student's own personal environment, experiences, and beliefs. Following a social observation, a teacher will analyze artifacts collected from a student. These artifacts are samples of student work, as well as data from assessments, attendance, or discipline. Once a teacher combines the artifacts with the anecdotal observations, a clearer picture of student need is created. Teaching should involve blending the students interests with learning opportunities (Schiro, 2013). The learner-centered curriculum theory has its origin in constructivism. Children are influenced by social interactions, intellectual challenges, artistic

interests, and physical endeavors. Children have a natural born curiosity and possess an inherent desire to participate in the world around them. The learner-centered classroom is one which blends cognitive and social constructivism. Students may have prior knowledge but it is natural that they build upon that knowledge through interaction with peers.

In order for a student to be successful in a learner-centered classroom, the responsibility lies heavily upon the teacher. This learning environment is carefully constructed and orchestrated. Learning opportunities are planned and facilitated by the teacher. The learning opportunities are created based upon the needs of the students which the teacher is fully aware of prior to starting the activity. The teacher observes students in multiple ways. Teachers observe students in natural social settings. How does a student enter the classroom? How do they interact with one another? What topics does a student find interesting? The information gleaned from watching a student's simple interaction with others can provide invaluable when seeking to create a connection to the learner.

The discussion regarding individualism is at the center of being a learner-centered educator. The freedom to determine and participate in deciding his/her own educational pursuits is important to a student in a learner-centered classroom. The ability to successfully blend the expectations which a school has for its students as well as the interests of the teachers is a challenging aspect of a learner-centered curriculum. Educators have standards which must be taught. Educators must give their students an end-of-year assessment which gauges student mastery of the standards. How the teacher presents the standards in a learner-centered classroom is the unique challenge. In traditional classrooms, teachers are traditionally the purveyor of knowledge and the students are the recipients of the knowledge whether or not they are willing or non-willing participants. A learner-centered educator recognizes that the success of the

learning results from how the learning objectives are presented and whether or not they are presented in a learner-centered way. Teachers are considered to be the facilitators of learning as opposed to transmitting knowledge only.

The learner-centered ideology is supported throughout history by several noted philosophers. John Amos Comenius explained that artists learn by creating art, so then also children learn to write by writing, and to sing by singing, and to reason by reasoning. The experience allows the student an opportunity to control his/her learning and the opportunity to reflect on his/her learning. Jean Jacques Rousseau believed that learning should proceed with their natural development, children should have direct sensory experiences with concrete objects, and that a child's growth should be the focus of education. True learning comes from growth, not from achievement. Johann Heinrich Pestalozzi emphasized that children should be free to explore, draw, and have a role in creating their own education. Giving the student the chance to control their own education provides motivation for real learning to occur. Friedrick Froebel created kindergarten in an effort to educate children through their sense and perceptions in a playful and enjoyable environment. Building a sense of collaboration is also an important aspect of student's education. Lastly, John Dewey provided concrete elements to being a learner centered educator such as:

- Children and not content should be the focus of teaching.
- Children learn by doing.
- Children make meaning and construct knowledge through the continuous reconstruction of their existing meanings as a result of new experiences they encounter.

- Learning best takes place when children actively initiate and explore problems arising in their world and solve them themselves because of their own interest and motivation.
- The teacher's job is to prepare experiential environments that engage children and challenge them to learn and make personal meanings.
- School subjects should be integrated through project learning.
- Education should be concerned with children's total (intellectual, social, emotional, physical, and spiritual) growth.
- Social interaction and learning are central to the educational endeavor.

The learner-centered style of education gained popularity during the beginning of the 20th Century and waned throughout that century until it regained its influence in the 1960's. It has once again lost prominence because of such political movements as the No Child Left Behind Act and the Race to the Top initiative. The overall emphasis of achievement and a no-nonsense approach to learning has overcome the idea of students as the center of all learning.

Due to the challenge of ensuring that students are learning and achieving, these theories provide the groundwork for evaluating how instruction is being utilized in the classroom. If the students are not at the center of the conversation then, the efforts will not be successful.

Research Questions, Hypotheses, Null Hypotheses

This study addressed the following questions:

Question 1: Is there a statistically significant relationship between teachers who ask more questions during classroom instruction and student performance on math benchmark assessment?

Question 2: Is there a statistically significant relationship between the number of questions answered by students selected by the teacher and the student performance on the math benchmark assessment?

Question 3: Is there a statistically significant relationship between the number of questions answered by student self-selection and student performance on the math benchmark assessment?

Hypotheses

H_{a1} – There is a statistically significant difference in student performance on math benchmark assessments between teachers who ask more questions during instruction and those who do not.

H_{a2}- There is a statistically significant relationship between the number of questions answered by students selected by the teacher and the student performance on the math benchmark assessment.

H_{a3}- There is a statistically significant relationship between the number of questions answered by student self-selection and student performance on the math benchmark assessment.

Null Hypotheses

H_{a1} – There is not a statistically significant difference in student performance on math benchmark assessments between teachers who ask more questions during instruction and those who do not ask more questions.

H_{a2}- There is not a statistically significant relationship between the number of questions answered by students selected by the teacher and the student performance on the math benchmark assessment.

H_{a3}- There is not a statistically significant relationship between the number of questions answered by student self-selection and student performance on the math benchmark assessment.

Limitations

- The sample used for this study is one middle school in Tennessee.

- The student population comes from one middle school in one school district in East Tennessee.
- None of the teachers in this study have taught longer than five years.
- The data for this study are from one benchmark assessment during one school year.
- Testing conditions are not considered when evaluating these data.

Delimitations

- This study is limited to four teachers.
- The population for this study is 7th graders in the 2018-2019 school year.
- The student population is comprised of varying educational levels.
- These data come from one benchmark assessment which reviews four standards.

Definition of Terms

Benchmark assessments- This term is defined as a formative assessment, usually with two or more equivalent forms. This assessment is administered to the same children at multiple times through the course of a school year. These assessments allow educators to monitor the progress of students regarding state standards and to predict performance on state exams ("The importance of validity testing," 2007).

Best Practices- This term is defined as suggesting there is a single best way to do something (Patton, 2001).

Student engagement- This term is defined by cognitive, voluntary and emotional participation in learning and social activities which helps to promote acquisition of knowledge (Caranfil & Robu, 2017).

CHAPTER II: REVIEW OF LITERATURE

Introduction

Not being engaged in school, lack of support, and a lack of connecting school to real life learning are all indicators of students who are at a great risk of dropping out (Bridgeland, DiIulio, & Morison, 2006). Teachers who believe that there is a constant lack of student engagement experience burnout more quickly (Hastings & Bham, 2003). The two most significant people groups in a school are the teachers and the students. If the students are not engaged, then after a time, teachers may grow complacent and this will directly affect the type of learning which will occur in a classroom. A constant feeling of lack of accomplishment adds to the percentage of teachers who choose to leave the profession altogether.

This study is significant because it considers these two crucial groups when examining classroom instruction. While student engagement in academics has always been a source of stress for all teachers, recent studies regarding the progress of American schools has prompted added scrutiny. In 1983, during the Ronald Reagan administration, the "A Nation at Risk" report was released. This report stipulated that compared to other countries, the education system in the United States was failing. The report triggered reactions from the U.S. government regarding the current education system. The in-depth, seemingly all-encompassing current evaluation of all U.S. public schools was initiated. This evaluation fostered the conversation regarding what are teachers doing in the classroom, what students are doing in the classroom, and what factors may be affecting students outside of the classroom. Thus, a myriad of issues, were created that educators were forced to address.

Related Literature

Definition of Student Engagement

The study of student engagement is a multi-dimensional topic. One definition of student engagement focuses on academics and what is occurring in the classroom. Academic engagement is identified by looking at the time spent doing learning activities as opposed to overall general behavioral engagement, which is not related to academics (Barkaoui et al., 2015).

Student engagement is also defined by the overall level of engagement the student has in the pursuit of knowledge and in his/her behaviors at school. Research proves that students who find school valuable will have better academic performance and will be less likely to drop out (Orthner, Jones-Sanpei, Akos, & Rose, 2013).

Caranfil (2017) identified the following definitions of student engagement:

- The level at which a student participates in curricular and extracurricular activities identifies with, and values school defines student engagement (Audas & Willms, 2001).
- Engagement is measured by the involvement of students exhibiting a positive attitude while participating in learning activities (Skinner & Belmont, 1993).
- Student engagement is defined by the extent to which students are motivated to learn and achieve (Libbey, 2004).
- The attention, interest, investment, and effort which students devote to learning activities define student engagement (Marks, 2000).
- The active participation and over all feeling of belonging to a school defines student engagement (Finn & Rock, 1997).

In order to understand the multi-layered definition of student engagement, it should be evaluated from three perspectives. The way a child engages with school and learning can be measured by looking at his/her behavioral engagement, emotional engagement, and cognitive engagement. All three elements have significance when evaluating student success and achievement. While all three types of student engagement are malleable, some are more difficult and challenging to change than others.

Behavioral engagement consists of student actions, whether they be academic or social (Lester, 2018). The behaviors of children are measured by how they act in the classroom and their responses to classroom procedures and their responses to classroom instruction. This type of engagement is easiest to identify and one which teachers can most easily quantify. Positive behaviors are observed when a student follows classroom or school expectations and negative behaviors are exhibited when a student is being disruptive in the classroom or disobeying an administrator (Nguyen, Cannata, & Miller, 2018). The positive behaviors are indicators of higher student engagement and the negative behaviors are indicators of lower engagement or disengagement.

There has been an increased interest in emotional intelligence and its effect on all people with regard to work, relationships, and school. A student with an emotional engagement to a school will enhance his/her desire to work (Lester, 2018). Emotional engagement produces negative or positive feelings toward a school. The significance of positive teacher student relationships is evident through a child's emotional engagement with school. When a teacher is perceived to be "likeable" or "friendly" by a student, this increases the chance that a student will be engaged (McConne, 2018). What a teacher says, does, or even unknowingly transmits through unsaid words or actions affects the emotional attachment which a student has to a

teacher and the school. When defining emotional intelligence and relationships, Goleman (1995) explained that being a good listener, question-asker, being assertive instead of passive or angry, controlling personal reactions and judgments, learning the art of cooperation, negation and conflict resolution are all significant factors in creating solid relationships. In order for one to have positive feelings toward a person or institution, there are specific actions that must be considered.

Cognitive engagement deals with the learning process itself. Self-regulated learning, metacognition, application of learning strategies, and "being strategic" in thinking and studying are all elements of cognitive engagement (Lester, 2018). Cognitive engagement refers to the effort which students exhibit in classroom learning activities, as well as strategies and practices they apply when completing different activities for different subjects (Caranfil & Robu, 2017). Students exhibit higher traits of cognitive engagement when they engage in higher-order thinking and learning activities and when they interact with tasks of a more challenging nature.

One singular definition of student engagement does not exist. The idea of engagement is multi-dimensional. It is also a concept that is not always easily observed. When a student is engaged mentally it is not always evidenced by outside behaviors. At other times a student may be engaged in behavior only and not really learning relative to teacher expectations. The combination of these three types of engagement work collectively to create the learning experience which all students need.

Importance of Student Engagement

Yang (2018) found that, "Empirical studies have demonstrated that student engagement is related to a number of important outcomes, including greater academic participation, achievement, school completion, greater effort in learning activities, a stronger sense of liking

toward and connectedness with school, and more positive personal well-being". The outcomes which are tied to student engagement are vital to the overall success of schools. Traditional teaching methods such as direct instruction, memorization, textbooks, and passive learning are adapting toward learning activities that are collaborative, interactive, interdisciplinary, global and real-world project-based (Kaiser & Wisniewski, 2012). Students cannot participate in cooperative activities without being engaged. Education is no longer a singular event. It is one which requires collaboration and innovation. While many schools and educators focus on student achievement and state assessments, the task is also clearly outlined that schools must produce citizens that will successfully interact in an ever-increasing interdependent world. Actively engaged students work with greater independence, as well as work well in group settings; they also consider the work to be both pleasurable and successful (Beasley, Gist, & Imbeau, 2014). In order to be successful in the modern workforce, a person must have interpersonal skills and problem-solving skills to complete many of the tasks given.

Definition of Student Motivation

As a student grows in knowledge, it provides more motivation to continue learning. However, identifying the motivation level of a student is one of the first challenges which a teacher often faces. Before engagement in learning can occur, motivation must occur first. Motivation can be organized into three types: students with a lack of motivation, those who are extrinsically motivated, and students who are intrinsically motivated (Nayir, 2017). Students with a lack of motivation see no connection between their actions and the task given to them. Extrinsic motivation occurs when there is an outside influence affecting the decisions and intrinsic motivation occurs when individual acts because of enjoyment or interest or his/her own need to succeed.

Connection Between Student Motivation and Student Engagement

Student engagement and motivation are closely linked to student behaviors and how students perceive school. Students exhibit greater motivation and learning when he/she perceive his/her learning has been personalized through individualized instruction and personal interests (Cordova & Lepper, 1996). When attaching the motivation types with levels of engagement students with intrinsic motivation demonstrate authentic engagement in learning and the learning process. Students who are extrinsically motivated demonstrate ritual engagement and passive compliance with no real attachment to the knowledge or the school itself. Students lacking in motivation demonstrate engagement at the rebellion level. Increased student engagement means an increase in student success thus making the findings regarding student motivation important.

Specific Literature Related to the Current Study

Teacher Perceptions of Student Engagement

Active student engagement only comes after the teacher initiates that type of instruction. Because of the importance of teacher effect on students' learning and engagement in the classroom, it is important to examine how teachers define student engagement, the factors they think influence student engagement, and the strategies they use to facilitate student engagement in the classroom.

In a phenomenological investigation, Harris (2008) identified six ways that secondary school teachers understand student engagement.

- Behaving, such as participating in classroom activities and following school rules

When students are behaving, they are following the approved rules given by the teacher. They appear interested in the learning and seem to enjoy learning. They are not disruptive to other

students and their actions tend to indicate that they are engaged. Teachers often do not worry about whether or not the activity is educationally appropriate as long as the student is meeting the behavioral criteria. Student learning is directed by the teacher in this type of engagement.

- Being interested in and enjoying participation in what happens at school

In order for a student to enjoy a lesson they must have an interest in what is occurring. Students must find the topic useful or purposeful. This places greater responsibility on the teacher to produce an entertaining and pleasing lesson. It must be recognized, however, that just because a lesson is engaging or interesting does not automatically mean that authentic learning is taking place. There are many times that students are engaged but they are engaged with meaningless tasks or topics. Teachers believed that as long as students appeared to be enjoying and interacting in the classroom then they were considered to be engaged and learning.

- Being motivated and confident in participation in what happens at school

While behaviors tend to be the key element teachers address when discussing engagement, the types of motivation are also recognized as important to understanding learning. Extrinsic rewards are typically considered to be the key ingredient to producing motivation to learn among students. Teachers believed that students become disengaged in learning because there is no reward given, such as a paycheck. The role of self-efficacy is addressed when dealing with motivation of students. If students feel successful and confident at school and when working on a task they will then continue to attempt new tasks and feel secure in their interactions at school.

- Being involved by thinking

Thinking represents a much larger perception of defining student engagement. A teacher does not see a student thinking. Yet it is expected that a student will be thinking when he/she is engaged in a lesson. The evidence of student thinking is seen when acknowledgement or

understanding of a fact or concept is exhibited. Whether a task is easy or challenging if a student is mentally stimulated the mind is occupied and he/she is considered to be engaged.

- Purposefully learning to reach life goals

If the learning is not connected to higher goals then students will not be engaged. When tasks have a clear purpose, it is easier to establish a connection to learning. Current educational trends have placed increased pressure on schools and educators to promote activities in which students in middle and high school are tasked with indicating an interest in potential careers following graduation. Because the research shows that school engagement declines from the middle school years on, this connection is of significant importance (Orthner et al., 2013). Middle school students are not ready to make life-long career choices; however, they are aware of the careers of their parents or family members and are expected to understand the choices in their middle and high school careers can impact their future.

- Owning and valuing learning

Students who are intrinsically motivated and engaged exhibit more control of their learning (Harris, 2008). Students who own their learning will have a higher quality of engagement with a topic. As students take ownership of their learning, they develop a relationship with learning and become life-long learners. Although not visible in the same manner as behaviors, it is a significant component to being engaged in school.

Teacher perceptions of student engagement are important to recognize because they often guide the instructional decisions which are made. Behaviors exhibiting student engagement are easy to assess. Thinking about learning and valuing learning are not visible to a classroom teacher. Teachers recognize the need for student engagement and also have set definitions regarding what they believe student engagement looks and sounds like, yet many feel inadequate

when utilizing techniques to keep students engaged or may feel reticent in putting forth the time and effort into planning a highly engaging activity.

Teacher Perception of Student Engagement in Mathematics

Student engagement is important in all content areas. All teachers struggle with the task of keeping students engaged. However, mathematics is a main focus area in education. 21st century learning, current job trends, and technological advancements have made it extremely clear that math is the foundation of all major advancements. There is not one part of society which is not touched by mathematics (Bobis, Way, Anderson, & Martin, 2016).

The importance of evaluating teacher perception toward student engagement in math is significant because there is a declining interest in math as students' progress through school. This decline leads to lower participation rates in higher level math in high school courses, as well as in post-secondary studies. Because of the waning interest, the National Council of Teachers of Mathematics (NCTM) has advocated the necessity to build student engagement in mathematics. NCTM seeks to promote greater engagement in order to increase achievement and create a far-reaching and long-lasting participation in mathematical endeavors (Martin, Anderson, Bobis, Way, & Vellar, 2012). In a broader context, lower participation in math will have a great effect on society in general and on potential advancements. In all facets of society, business, medical, national security, research, development, and innovation mathematics serves as the foundation. If mathematics education underachieves or experiences a lack in participation there will be national and international repercussions.

The role of a math teacher is highly regarded, but is also highly scrutinized. While engagement, motivation, and relationships to learning can be discussed in an overall manner with regard to all subjects, research has shown that math has particularly different constructs to

evaluate and address. How math teachers feel about their own ability to utilize engagement-enhancing strategies in math and their perceptions regarding student engagement affects the strategies which are implemented in the classroom during math instruction. How teachers perceive their own learning of math and whether their students are high or low level learners or whether their students will be actively engaged significantly influences the strategies which are implemented (Bobis et al., 2016). The greatest impact on student engagement and achievement is decided by what a teacher does (Hill & Rowe, 1996). Teacher perceptions about why a student is engaged influences the strategies used for the whole class, as well as the strategies used to intervene with individual students who appear to be disengaged (Bobis et al., 2016).

Student Self-Efficacy in Math

Self-efficacy represents the belief a student has within themselves in the ability to complete an academic task (Perry & Steck, 2015). Students with high self-efficacy will not be deterred by a difficult task; they will show more interest in the task and will also recover quickly if not initially successful when solving a task (Myeong-Hee, 2018). Higher levels of confidence and the ability to make informed decisions come with higher student self-efficacy. Students with high self-efficacy will attain higher achievement as well as be more highly engaged in learning. Conversely, students with low self-efficacy will not be engaged in learning and will have lower achievement. If students believe they are more competent in solving a task, their interest and expectations will be greater in mathematics (Perry & Steck, 2015).

Teacher Self-Efficacy

Teacher self-efficacy applies to the understanding that teachers' belief in themselves will be greater if they can execute a course of action and successfully accomplish a teaching task within a specific and defined area (Rubie-Davies, Flint, & McDonald, 2012). Teachers' belief in

their own ability has significant influence on student outcomes (Rubie-Davies et al., 2012). Teachers will only be as successful as they believe. If teachers believe that they cannot change or influence student learning, then they will not have confidence in the strategies or the effort they exert in the classroom.

Highly self-efficacious teachers have the ability to provide learning experiences needed to promote positive student outcomes (Shoulders & Krei, 2015). In order to feel successful in the classroom, teachers must believe that they can deliver a solid lesson which addresses all learning styles and engages all learners. Teachers' sense of self-efficacy is often found in their ability to have high levels of student engagement in learning, the appropriate use of instructional strategies, and in their ability to properly manage a classroom. Success in the classroom is defined as the ability to create and maintain high expectations for all, engage all students with varied activities, maintain active student involvement, and promote enthusiasm for learning (Taylor & Parsons, 2011). While these are all important goals, they are often difficult for teachers to create and sustain. The aspects of learning which keep students engaged are well-known but are not always put into practice.

Innovative instructional practices are more readily accepted if teachers have greater confidence in their abilities and greater satisfaction with their practice (Rubie-Davies et al., 2012). Instructional strategies are the tools which teachers develop and refine as the years progress. If teachers are not successful in the beginning of implementing strategies, their enthusiasm and willingness to improve will wane.

Classroom management is one of the most important elements when measuring the self-efficacy of a teacher. Teachers with greater self-efficacy also have greater motivation to ensure that effective classroom management procedures are in place (Shoulders & Krei, 2015).

Learning does not occur when a classroom is in chaos. The goal of every school is to provide solid instruction and learning and when that goal seems highly unattainable due to poor classroom management, then the self-efficacy levels of a teacher are affected.

Two variables seem to have a direct correlation to teacher self-efficacy. Female teachers tend to have higher self-efficacy. When preparing for the profession females take the pre-service preparation more seriously consequently creating a greater sense of self-efficacy (Berkant & Baysal, 2018). Secondly, years of teaching experience leads to more efficacious teachers (Shoulders & Krei, 2015). The comparison between new and veteran teachers is easily observed. The atmosphere is decidedly different when students walk into the classroom of a veteran teacher as opposed to when they walk into the classroom of a beginning teacher. Success in the beginning years of teaching leads to greater confidence thus, leading to greater self-efficacy.

Instructional Practices Requiring Student Engagement

There is a long and varied list of instructional practices which would fall under the category of student engagement instructional practices. These activities require active student engagement in the classroom. The frequency, quality, and alignment of these strategies with instruction and student needs vary in effectiveness (Lekwa, Reddy, & Shernoff, 2018). As the list develops, it can be divided into those highly concentrated upon behavioral engagement and those concentrated upon cognitive engagement. In some cases, the two categories can overlap and share multiple purposes.

Classroom Management

Classroom management is defined by behavior management strategies that a teacher uses to promote students' compliance with tasks and instructions. These strategies can sometimes be employed before an action occurs or they may be implemented as a consequence of unwanted

student behavior (Lekwa et al., 2018). The first job of a teacher is to have classroom management strategies in place. The teaching and learning environment should be organized, positive, and free from distraction (Skiba, Ormiston, Martinez, & Cummings, 2016). These strategies guide such practices as how to hand in papers, when to sharpen a pencil, as well as how to complete assignments while in class. Wong (2009) defined classroom management as "…all of the things a teacher does to organize students, space, time, and materials so student learning can take place." The learning environment and procedures must be clearly outlined for students to understand how to engage in the classroom.

Note-Taking

As a student progresses through school, the task of note-taking becomes the predominant approach to acquiring information. While the act of note-taking itself conjures images of students being actively engaged, it does not mean that active learning is actually occurring. Teachers seek to use other types of note-taking strategies to ensure that real learning is occurring. One such approach is that of structured note-taking. This type of note-taking provides students with a graphic organizer for note-taking while they interact with a text (Robinson, 2018). Teachers provide guidance regarding important words, concepts, or definitions, and students actively work with those elements to organize and synthesize the information. Cornell notes is another strategy which students can use to divide notes into two categories. One category addresses key topics and the second category paraphrases ideas and discussions held during class. Cornell note-taking works to develop higher order thinking skills.

Dialogue and Discourse

Dialogue and discourse involve more than talk. They are guided interaction between teacher, students, and these individual to allow for a sharing of individual perspectives

manifested through verbal communication (Smart & Marshall, 2013). To engage in discourse and dialogue, students must be actively involved in the learning. This type of learning shapes the environment and guides the students through the types of language and talk which is most conducive to student learning. Students have to interact with concepts and ideas through discussion that they may have never interacted with before.

Opportunities to Respond

There is a growing amount of research which supports that a student's opportunities to respond (OTR) during classroom instruction leads to an increase in integral knowledge (MacSuga-Gage & Simonsen, 2015). An opportunity to respond means that a student is given the chance to respond to instruction and is then provided immediate feedback to his/her response. The OTR can be teacher-directed, through peer-to-peer conversations, through cooperative learning or through technology. Sutherland and Wehby (2001) completed multiple studies in teacher directed opportunities to respond (TD-OTR) and their findings indicated positive effects on academic and behavioral outcomes, including increased task engagement, decreased disruptive behavior, and increased efficiency in the use of class time (MacSuga-Gage & Simonsen, 2015).

Feedback

The importance of teacher feedback cannot be understated. Feedback is a crucial element of the learning process as well as an integral part of the relationship formed between teacher and student (Conroy, Sutherland, Snyder, Al-Hendawi, & Vo, 2009; Sprouls, Mathur, & Upreti, 2015). Feedback is valuable because it engages the learner in evaluation of understanding. Feedback also helps the teacher in scaffolding information to encourage greater synthesis of information. Learning through mistakes is a valuable exercise to enhance learning and only

helps reinforce academic success and reinforce appropriate behavior. Feedback generated by a teacher, which helps a student work through mistakes and serves as an extension of learning.

Technology

When addressing student engagement and how to implement it into classroom instruction, there is no greater tool than that of technology. The role of technology in everyday life is overwhelming; therefore, it should also be built into everyday classroom use. Technology addresses a number of issues when discussing the pitfalls of active student engagement. Technology allows for complex problem solving, collaboration with peers, project-based learning opportunities, interest-based learning, and an increase in self-efficacy in the classroom (Alexander, 2014; Kaiser & Wisniewski, 2012; McConne, 2018; Molyneux & Godinho, 2012; Myeong-Hee, 2018). Along with its prevalence, it should not be considered a difficult tool to implement in instruction. Students are quite adept at using technology because it is a part of their natural upbringing. Teachers must recognize the prevalence and significance of technology in education and strive to continue developing those skills in their students (Kaiser & Wisniewski, 2012; McConne, 2018).

Project-Based Learning

The goal of learning is to keep the students actively engaged throughout the learning process. There are several indicators which define learning. Indicators such as development of knowledge, problem-solving, questioning, and discourse are all factors which teachers can observe in students and can evaluate if good learning is occurring. In striving to create an environment that develops those characteristics, teachers must utilize tasks to create the opportunities for that type of learning. Because of its connection to many of those indicators, as well as its connection to real world applications and self-efficacy, project-based learning in

education has been an important tool to develop. Project-based learning seeks to help students develop an interest in a topic, helps promote synthesis of information, promotes cooperation, helps students learn by doing, helps them develop a hypothesis, and attempts to find a solution to the problem (Myeong-Hee, 2018; Siswono, Hartono, & Kohar, 2018; Wurdinger, 2018).

Whole Group Response

While it is not the preferred method of instruction, whole class instruction is by far the predominant teaching style in most secondary classrooms. Since this type of instruction is the most utilized, it is imperative that teachers use different types of strategies to promote engagement, participation, and allow for quick formative assessment to occur (Nagro, Hooks, Fraser, & Cornelius, 2018). There are several options for promoting active student engagement which do not require a lot of instruction or preparation prior to the beginning of a lesson. The use of hand signals can signal comprehension as well as encourage student engagement (Nagro et al., 2018). Response cards are another tool which provide teachers with an assessment tool to gauge learning. In unison choral responses are quick, but they do not always provide teachers with the information that they need to gauge student understanding. Written responses can also be used in a whole group setting. Written responses can be found in the form of exit tickets, open-ended questions, surveys, and include the use of dry-erase boards. Exit tickets, questioning, and surveys offer an opportunity for reflection. Reflective learning is an often overlooked but key element to the learning process (McConne, 2018). Whole group responses can be varied, but students must also be given time and an opportunity to respond in these settings. Using different types of whole group response systems creates the occasion to do so.

Movement

No one can sit for long periods of time. Thus, why are students expected to sit still and be quiet? There is no shortage of literature which explains and details the importance of movement in schools. The term "active student engagement" means that the students are doing something. To do something means to be moving. Physical movement in school has been associated with higher academic achievement, better cognitive functioning, and improve time on task in classrooms (Pellicer-Chenoll et al., 2015; Thompson, Kolbo, Gilkey, Lei, & Pritchard, 2017). There is no greater way to signify active engagement than to allow students the opportunity to move. Movement can be as simple as hand gestures or as complex as physical athletic activities working in conjunction with a lesson.

Think-Pair-Share

The activity known as Think-Pair-Share is one which is used or mentioned in every professional development seminar or lecture. It is prevalent and understood by all educators. This teaching method was developed in the 1980's by Frank Lyman, a professor at the University of Maryland. (Kaddoura, 2013). Think-Pair-Share involves the following succinct steps. First, the teacher provides the opportunity for students to think by asking a question, posing a prompt, or offering an observation. Secondly, the students find a partner and pair up to discuss or talk about the answers they came up with in response. The pair will write down their thoughts and compare which answers are the best or most helpful. Finally, after the students work together as a pair, they will share their answers with the rest of the class. Think-Pair-Share is a form of student engagement which utilizes reflection, cooperation, synthesis, and verbal responses.

Mathematics Teaching Practices

The aforementioned types of student engagement apply to all content areas. When seeking to identify which practices work best for different subject areas, the literature becomes more specific regarding that specific subject. In order to promote deep learning of mathematics, the National Council of Teachers of Mathematics established Eight Effective Mathematics Teaching Practices (*Taking Action: Implementing Effective Mathematics Teaching Practices*, 2017). These principles provide a framework for what teaching should look like in a math classroom. These principles also set the guidelines for how to incorporate student engagement into math instruction.

- Teachers must establish mathematics goals to focus learning. The goals must be clearly communicated and appropriately aligned with student learning and the learning progression. Goals help the teacher identify the anticipated learning outcome. The ability of the students to master or not master the goals will determine further instructional decisions.
- Tasks must be implemented that promote reasoning and problem solving. Teachers must create opportunities for students to discuss and problem solve through the use of mathematical reasoning. Students must also be allowed to solve problems through varied strategies using multiple entry points. Tasks should be sequenced so that they full develop student understanding.
- Effective math teachers will use and connect mathematical representations. Mathematical representations will help deepen understanding of math concepts and procedures. These representations offer another tool for students to use in problem solving. Instructional time should be given to students so that they have the

opportunity to decide which representation is the best to use in the context of the problem.

- Teachers must facilitate meaningful mathematical discourse. Discourse among students and with teachers creates a shared understanding of mathematical idea. The ability to discuss creates opportunities to analyze and compare student approaches to problem solving. Discourse is not an act which occurs haphazardly. It is strategically planned and monitored. Teachers anticipate student responses and plan how to properly connect the solutions.
- Effective math instruction requires the ability to pose purposeful questions. Questioning can be used to assess learning. It is also used to advance learning and understanding. Questioning leads to students making sense of mathematical relationships. The questions should go beyond surface learning; they should seek to allow students to explain and justify their reasoning.
- Teachers must build procedural fluency from conceptual understanding. Students need to understand the foundation of mathematics then apply that knowledge to procedures. The foundational understanding leads to greater flexibility when choosing which procedure to use when solving contextual and mathematical problems. If students possess only procedural understanding, they are at greater risk to misapply the correct mathematical procedure.
- Effective mathematics teaching supports the productive struggle in learning mathematics. The productive struggle provides students with opportunities both individually and collectively to grapple with mathematical ideas and relationships. Teachers create the occasions for productive struggle and also provide the support for

the students as analysis and connections are made. The productive struggle is essential for developing conceptual understanding.

- Teachers should elicit and use evidence of student thinking. Student thinking is used to provide evidence of progress. Student thinking is also used to assess the needs regarding how to adjust instruction. Teachers must know how to support and extend learning for all students. When students are asked to explain a concept, either orally or in writing, this leads to promoting student thinking.

These mathematical practices provide a foundation for creating opportunities for students to be actively engaged in their learning. Education has separated itself from rote memorization of facts and numbers. The ability to problem solves is the most important skill which a student can develop.

Questioning

A teacher's ability to successfully utilize questioning and create a positive learning environment in the classroom is crucial to student success. Questioning is very important because it creates a classroom climate in which students verbalize their ideas, thereby providing opportunities for more in-depth learning to occur (Smart & Marshall, 2013). While questioning is informative, in order for it to adequately address student learning, it must be done with inquiry in mind. The result of teacher questioning will differ if it is done in a non-inquiry setting.

Appropriately planned questioning strategies can also minimize classroom management problems. The need for lessons to be fast-paced and interactive leads to teachers using a lot of questions while instructing. Bond (2007) referenced the 1992 research from Borich, which found that in some cases, questions account for 80% of classroom talk, and some teachers asked more than 100 questions per hour. All teachers seek to engage their students in effective

classroom instruction, thus the need for planning when engaging in questioning in the classroom. Teachers should plan all questions. This leads to furthering learning by presenting opportunities for high-quality thinking. The questions should be scaffolded in a logical manner and appropriate for the student's ability.

Following the appropriate planning of questions, the teacher should establish expectations and procedures for answering. Ground rules should be established to help reduce confusion. This helps to ensure that everyone knows the appropriate way to answer and the appropriate time. In some cases, hand raising is best. In other instances, a whole group choral response will be best; teachers may want students to discuss first with a partner before answering, and there a variety of ways in which a teacher may choose to receive student responses.

Listening is also an important skill when students are engaged in question and answer sessions. Students must be instructed on how to listen and when it is best to respond or add to the discussion.

Another important aspect of questioning is allowing time for the students to ask the teacher content-related questions. This allows for the student to synthesize information given to them, allows for the opportunity to provide clarification, or allows for the student to ask questions which may bring about a deeper level of understanding. Questioning allows teachers to do quick-checks for understanding, create interest, define concepts, redirect attention, and to enhance overall learning.

Teacher Questioning in Mathematics Education

The use of questioning in the mathematics classroom has evolved and continues to evolve as teachers become more experienced and more familiar with the instructional goals of the

lesson. The first type, and most familiar type, is that of recitation. This type of questioning relies heavily on recall of factual knowledge. When students are asked to recite answers, this indicates lower order cognitive levels. Recitation will ensure success for those students who have memorized multiplication facts but are unaccustomed to higher order conceptual questions. The norm for recitation is students giving predetermined responses, as opposed to the synthesis of information which must occur to answer higher order questions (Gall, 1970).

A second type of questioning is that of discussion. In order to facilitate discussion, teachers must have developed higher order questions meant to draw out and emphasize critical thinking skills. Higher-order questions should scaffold and build upon prior knowledge, as well as allow students to justify, connect, and expand understanding. Discussion allows for multiple perspectives to be presented. Each discussion should be productive. In order to reach this goal, a teacher must sequence questioning and seek to draw out student ideas (Dillon, 1988).

Lastly, constructivist questioning allows for a teacher to focus on student understanding of conceptual knowledge. This type of questioning is a balance of lower level questions as well as higher level questions (Chin, 2007).

Effective teaching will contain a balance of types of questions during a lesson. Eddy (2018) explained the different types of questions which can be used.

1. Gathering Information- These questions lead students through a procedure. Examples of these types of questions would be drill and practice questions.
2. Probing Thinking- This allows students opportunities to explain their approach. Explanations by the student allows for multiple pathways to understanding to be explored.

3. Making the Mathematics Visible- Making math visible allows students to connect conceptual and structural knowledge.
4. Encouraging Reflection and Justification- Students use reflection to contribute to classroom discussion and justify their thinking in multiple types of context.
5. Mathematical Routines- Knowing how and when to use the appropriate mathematical routines for problem solving requires students to utilize more complex thinking and establishes a premise for greater mathematical discourse.
6. Sociomathematical Norms- This type of norm in a math classroom allows the students to go beyond trying to find the right answer just to please the teacher. It allows for student voices to be heard and leads to in-depth investigation for problem solving.

As mathematics instruction has changed over time, the types of instructional strategies have also adapted. The norms of mathematics instruction change from simple question-answer sessions where the students attempt to make sure they are saying what the teacher wants to hear. Instead, the challenging and rigorous work of discovery is the focus and students process and define what needs to happen in order to solve a problem. This leads to greater understanding and greater achievement.

Analysis of Theories

The theories behind student engagement in the classroom started the beginning of educational research and have evolved over time with researchers developing upon the initial observations of previous researchers. Jean Piaget believed in discovery learning. Students learn best by working with manipulatives and applying the hands-on learning they receive to prior knowledge, thus making connections to the concepts being taught (Fogarty, 1999). Lev Vygotsky, as cited by Fogarty (1999), explained how social interactions helped progress

learning. A teacher's ability to successfully utilize questioning and create a positive learning environment in the classroom is crucial to student success. Reuven Feuerstein provided insight into how a teacher can guide a student to deeper understanding and reflective transfer of knowledge. Howard Gardner provides the explanation of multiple intelligences and how it affects the way students learn. Marian Diamond is a neurobiologist who explained dendrites, how they grow, and how their growth or lack of growth affects student learning. All of these theories combined provide the basis for understanding why active student engagement is important.

Constructivist Learning Theory

The roots of student engagement pedagogy are found in constructivism. Piaget's constructivist learning theory focuses on how learning occurs. ("Piaget's Theory on Constructivism,") As explained by Loyens "…the essence of constructivism is that students actively construct knowledge." (Loyens & Gijbels, 2008). The action of constructing knowledge is what makes the learning concrete. Much of Piaget's research centered on young children and their development of numerical knowledge; however, his findings indicated that children are continually learning and constantly constructing new knowledge. (Siegler & Ellis, 1996) Piaget's development of constructivism also highlighted that the construction of knowledge is formed when there is a connection between new information and prior knowledge. When those two interact, then new knowledge is created. This explanation establishes how learning occurs in a classroom.

In order for a child to gain a clear understanding, the new knowledge must be contextually appropriate and the learner must be given time to work with or grapple with the new information. The best approach to allowing a student to tackle with new concepts is to teach in a

way that allows for his/her to be actively engaged in the learning process. Yoders (2014) explained constructivism as follows:

- Learning is characterized by cognitively active learners.
- Learning should happen in context and be structured around related themes or primary concepts.
- New knowledge constructs are built upon prior knowledge.
- New knowledge should be applied and feedback provided.
- Learner self-reflection on the learning process is a key learning activity.

In order for schools to meet the expectations placed upon them by the government and society in general, there is a distinct need for constructivist schooling. The book *In Search of Understanding: The Case for Constructivist Classrooms* (Brooks, Brooks, & Association for Supervision and Curriculum Development, 1993) Brooks outlined five guiding principles to remember when creating a constructivist classroom.

- Principle 1- Pose problems of emerging relevance to students.
- Principle 2- Structure learning around primary concepts.
- Principle 3- Seek and value students' point of view.
- Principle 4- Adapt curriculum to address student's suppositions.
- Principle 5- Assess student learning in the context of teaching.

A constructivist teacher has definitive characteristics which are exhibited in his/her classroom. Constructivist teachers encourage, accept, and develop and accept student independence and creativity. They use data and primary sources, along with manipulative, collaborative, and physical materials. The directions given by constructivist teachers include terms such as "classify," "analyze," "predict," and "create." Student responses and interests

assist the teacher in creating lesson, determining instructional strategies, and adjusting content. A teacher should evaluate their students' understandings of concepts before sharing their own understandings of those concepts. True learning will occur when student knowledge of the world around them grows and when he/she seeks to deepen their understanding through inquiry and discovery.

Following Piaget's initial research regarding constructivism and learning Lev Vygotsky pioneered research in the field of social constructivism. Vygotsky criticized Piaget's theories where children learn through interaction with environment only (Kozulin & Presseisen, 1995). Vygotsky recognized the role of social interactions on learning and how it enhanced the learning process. Social constructivism explores the social interactions which a student engages in combined with the learning process which occurs in the classroom (Powell & Kalina, 2009a). Vygotsky introduced the ideas of zone of proximal development (ZPD), scaffolding, and cooperative learning.

Powell and Kalina (2009) defined ZPD "as a zone where learning occurs when a child is helped in learning a concept in the classroom" (Powell & Kalina, 2009b). If a child is given information that is beyond his/her initial understanding then learning will not occur. For example, in a school library all books are tagged with a label indicating the reading level of that book. Reading levels have been identified to ensure that a student is reading at a level that would increase reading skills. To give a child a book that is beyond his/her reading level creates confusion and frustration. This would not be helpful to the learning process. Some benchmark assessments used in language arts classes will produce reports indicating a student's ZPD after a student takes the initial benchmark test. The ZPD can provide the teacher with information to

ensure that he/she is accurately meeting the needs of a student. Once a child has acquired knowledge within a zone, then his/her zone grows and more learning occurs.

Scaffolding is a second element of Vygotsky's research. Scaffolding offers a student the opportunity to learn new ideas with the aid of a support system (Powell & Kalina, 2009a). A student may be struggling with identifying numbers alone. The teacher would then offer support by working with students using different interactive techniques until students are then able to count and identify the numbers on their own. In a secondary classroom, students may be struggling with reading and understanding a certain passage. The teacher would first read the passage with the students and assist them when new words or new vocabulary are introduced. The teacher would walk the students through how to best identify and learn a new word as well as the best method in finding the meaning of a new vocabulary word. Students would initially do these tasks with a teacher; following that interaction students would then complete that activity with a peer, until finally the students are able to work through a reading passage on their own. Scaffolding identifies that students learn better when there are people that can support them through the learning process.

In connection with ZPD and scaffolding, Vygotsky recognized the significance of cooperative learning within the classroom. Based upon Vygotsky's theory, learning is inherently social and embedded in culture. The key to cooperative learning is communication. How communication is utilized in the classroom is essential to successful academic learning. Communication between teacher and student, as well as communication between students, are key components. Vygotsky combined constructivism and social engagement to add further understanding to how students learn.

Another alternative approach to Piaget's theory was that of the psychologist Reuven Feuerstein. Feuerstein investigated the idea of mediated learning. In a mediated learning setting an adult interacts between the child and its environment (Kozulin & Presseisen, 1995). The adult guides the learning process and determines which types of objects or processes the child will use through the process. The role of the teacher is crucial in understanding mediated learning. Teachers must know the child's ZPD, they must make the learning relevant, and they must help the students grasp the important principles, followed by helping the student apply the learned principles appropriately. The mediated learning environment seeks to create an environment where learning is stretched and deepened upon the addition of new ideas and thoughts. Vygotsky's and Feuerstein's theories together further the understanding that first teachers must recognize the constructive and cognitive functions which are expected of students. Secondly, teachers must recognize that cognitive development will not occur unless students can problem solve and rationalize independently. Additionally, teacher preparation is of utmost importance. Teachers must be trained to recognize ZPD and learning potential of all students instead of just focusing on the curriculum which needs to be covered.

Piaget was the initial developmental psychologist to study intelligences. From his work, other theories and understandings have developed, one of those being Howard Gardner's research on multiple intelligences. Gardner's research (1993) identified eight types of intelligences. These intelligences work in conjunction with one another within an individual's mind. Some are more dominant than others, but all are employed throughout the learning process. The eight intelligences are; musical, bodily-kinesthetic, linguistic, logical-mathematical, spatial, interpersonal, intrapersonal intelligences, and naturalist. The importance of understanding these intelligences is noted (Gardner, 1993, p. 9).

> In my view, the purpose of school should be to develop intelligences and to help people reach vocational and avocational goals that are appropriate to their particular spectrum of intelligences. People who are helped to do so, I believe, feel more engaged and competent, and therefore more inclined to serve the society in a constructive way.

In order for teachers to be successful in educating all students Gardner asserts that teachers must become "assessment specialists" in identifying the types of intelligences which their students possess. The ability to identify these intelligences helps in creating learning opportunities which will help meet the needs of all students.

Musical intelligence was not typically considered to be a form of intelligence but Gardner's research identified music as having specific connections to certain parts of the brain. Early language development is often grouped with musical activities. Many great mathematical minds and scientists are shown to have a deep connection to music and its effects on the human mind ("Gardner's Theory of Multiple Intelligences: Musical Intelligence," 2010). Through recognizing the connections music has to other types of intelligences Gardner recognizes its importance and potential it has on the learning experience of a child.

Bodily-Kinesthetic intelligence activates the motor cortex of the brain (Gardner, 1993) . Body movement develops as children develop, thus solidifying that the development of movement creates a development of knowledge. In order for any movement to occur from the body, the brain must first be activated and send signals to all appropriate muscles and nerves. Students who display high levels of bodily-kinesthetic intelligence like to touch objects, move while learning, and never remain in one place (Manić & Ranđelović, 2017).

Logical-Mathematical intelligence utilizes numbers and reasoning. This intelligence uses induction, deduction, understands the complex relationship between abstract concepts and ideas

or seeks to apply understanding to similar aspects (Pekdemir & Akyol, 2015). The logical-mathematical intelligence is the basis for IQ tests (Gardner, 1993). The ability to solve a problem in a concise manner is the standard by which all intelligences are judged. Often, individuals who exhibit great skill in logical-mathematical intelligences arrive at a solution before it is articulated, the "aha!" moment happens quickly and surprisingly. It is only after the individual stops and shares the revelation does the transference of knowledge occur. Because of the logical-mathematical learners' unique ability to develop a hypothesis and then accept or reject the reasoning, this type of intelligence is still not properly understood. There are many cases in which students may be delayed in other developmental areas yet exhibit characteristics of math prodigies.

Linguistic intelligence is also recognized in traditional psychology, along with logical-mathematical, as the basis of standard knowledge and is measured on IQ tests. Linguistic intelligence applies to the ability to use words efficiently to convey meaning and understanding (Manić & Ranđelović, 2017). Students with strong linguistic intelligence are good speakers, enjoy reading and writing, learn best while listening and note-taking, and have a rich vocabulary.

Spatial intelligence relates to visual types of learning. This learning is seen through drawing, mapmaking, navigation, and architecture. Learners can visualize the meanings of words, create mental images, and interact with color and visual cues. Blind persons utilize spatial intelligences when identifying the shapes of objects (Gardner, 1993). By running their hands along the shape of an object, they are creating a mental image of the length and space of that object, thus giving them the information that they need in order to identify the shape of the object. Students with strong spatial intelligence think in pictures (Manić & Ranđelović, 2017).

Interpersonal intelligence pertains to the ability to recognize the feelings of others, categorize the behaviors of others, lead a group, and communicate effectively (Azid & Yaacob, 2016). Those with strong interpersonal skills are good communicators and are usually placed into a leadership role. Students with strong interpersonal skills will interact well within groups and add to the overall positive classroom cultures. Teachers with strong interpersonal skills are able to actively evaluate a student's mood and personality. They will use that knowledge to create a trusting environment and use it to further mastery learning.

The hardest to assess and possibly the hardest to collect evidence for is that of intrapersonal intelligence. This evidence means that a person understands their own feelings and emotions and understands how to use them for guiding their own behavior (Gardner, 1993). Autistic children serve as an example those with limited intrapersonal intelligence (Gardner, 1993). While autistic children may have exceptional spatial or mathematical reasoning abilities they are unable to label or gauge their own emotions. Intrapersonal intelligence is important because it teaches students how to manage their own emotions in relation to their interactions to another person.

The newest intelligence as denoted by Gardner is that of the naturalist. This pertains to the human ability to discriminate among living things such as plants and animals and also pertains to the sensitivity to features such as clouds and rocks (Checkley, 1997). This type of intelligence was important for understanding the past roles of hunters, gatherers, and farmers.

The development of these multiple intelligences occurs over a child's development years. What is important in the elementary years is not always important in the secondary years of schooling. As Gardner (1993) explained instruction must be evaluated through the developmental lens of the intelligences. Students benefit from explicit instruction only if the

information fits into their specific developmental progression. The responsibility to know when to apply certain types of instruction rests solely on the shoulders of the teachers. Knowing when to apply certain instructional strategies only occurs after a thorough assessment of intelligences occurs.

Diamond's research on the brain in the 1970's and 1980's has fostered increased understanding regarding how students learn. Diamond found that the brain had more connections through interaction with an enriched environment than those brains who lived in an impoverished environment ("The brains behind the brain," 1998). While the brain's optimal time for growing and learning is the first 8-10 years of life this does not mean that the brain ceases to grow and develop after that time. Diamond's research points to the need for classrooms and teachers to create enriched learning environments for students. Every newly learned piece of information forms a connection to previous information within the brain. This creates the formation of dendrites. Dendrites then grow within the brain, creating new connections. Language development is one of the most significant factors of brain development. If students can talk and interact with one another, they share knowledge and understanding. The ability to teach another student a concept is the most significant way to identify that a student truly has gained mastery of the concept.

The work of all previously mentioned developmental psychologists and scientists lead to the understanding that the student is at the center of all that occurs in the classroom and the most important facilitator is the teacher. To engage the idea of being a learner-centered teacher, educators must be primarily focused on what the student is learning, how the student is learning, the environment under which he/she are learning, and whether the student is retaining and applying the learning (Weimer, 2002). There are five key changes which must occur for

teaching to be more focused on the learner. First, there must be a shift in the balance of power in the classroom. The teacher is no longer the authority on all things in the classroom. The student has an active role in the teaching and learning that occurs. This is significant because this power given to students creates a different type of motivation to learn. When a student feels empowered in the learning process it will only add to the development of intrinsic motivation. Next, the function of the content the students are learning must be evaluated and prescribed in a way so that it fits a student's learning needs. Teachers are burdened with the task of "covering" all of the curriculum or standards assigned to a particular class. This creates a format for rote memorization and quick explanation of what needs to be covered. When teachers create a way for students to interact on a deeper level, it serves the purpose of the content. The ability to read, ask questions, develop theories, and test ideas develops deeper learning. Students who are given the opportunity to work with and develop information given to them by their teacher are employing the ideas of constructivist type of learning. Those students are "constructing" new knowledge because they are associating new information with prior knowledge. The role of the teacher is also significant. This is the most challenging and difficult to change when addressing with teachers. The role is divided into two specific categories; one is referred to as "knowledge transmission" and the other is "learning facilitation". Students do not experience meaningful learning when the teacher serves only as a transmitter of knowledge. Teachers who seek to be facilitators lecture less, move around the room with greater frequency, and seek to promote activities that promote student learning. The idea that students must have all of the knowledge before proceeding to deeper, more meaningful tasks is not relevant in a learner-centered style of teaching. It is recognized that working with existing knowledge and then adding to it while being guided by the teacher only serves to deepen understanding. The responsibility for learning

is the fourth relevant characteristic of a learner-centered theory. Traditional teaching has focused on the teacher directing the learning. In order for students to be life-long learners, which they will in one capacity or another, there must be a shift in developing the skills of students so that they can self-direct their learning throughout their life. Organizational skills, reading, comprehension, note-taking skills, listening skills, conversation skills are all relevant skills which will add to the lifelong learning process which all individuals experience. Evaluation and assessments are the final components to address in a learner-centered theory. What is being learned and how do teachers know that it has been learned? Students learn what is going to be tested. Thus, it is imperative that what is being evaluated is relevant and necessary to the mastery of content knowledge. Assessments are the most basic and the easiest way for a teacher to gauge understanding. However, the assessments may not address the sought after depth of understanding. Assessments may only evaluate surface knowledge. Students know when they understand a concept. The goal of an assessment should be for students to show what they have learned and then the teacher can use that assessment data to plan for further instruction, whether it is remedial instruction or enrichment activities.

Criticism of Constructivism

In recent years, the most exhaustive study to be published regarding education and schools is that of John Hattie's book *Visible Learning* (2009). This book comprises 20 years of research combined with an extensive amount of empirical research. Hattie has synthesized 800 meta-analyses based on 50,000 studies using millions of students. Hattie's work evaluated the effects of six factors on achievement; the child, the home, the school, the curricula, the teacher, and the approaches to teaching. Hattie sought to evaluate each area that is commonly discussed in education circles as affecting student achievement. He subsequently shared the findings of

quantitative studies to reinforce or to dispel those notions. For the purpose of this literature review, attention will be given to Hattie's finding regarding teachers and his research regarding constructivism.

Hattie's work emphasizes the premise that teachers matter. It cannot be overstated. While all teachers know this and teacher education programs focus on this aspect, excellent teachers are still not found in every classroom. Many teachers are average at best. Teachers can teach extensively but real learning may not occur. Before students have even entered the school they have constructed their own understanding of school and what they intend to learn. They even already know much of what is being taught to them (Nuthall, 2005). Students already knew 40-50% of what teachers intended to teach them. A third of what is learned is unique to that student and the rest that is learned is only learned by no more than four students.

What should teachers be doing if the students already know what is being taught? Teachers must learn to teach through the eyes of a student. Students learn how to "play the game" of school. They learn that to gain positive attention and good grades, then they must show good behavior in class and give the appearance of being engaged. Teachers must move beyond surface level observations and develop a deeper assessment of real learning.

Hattie (2009) found that teachers who use particular teaching methods have high expectations for all students, and teachers who have positive student-teacher relationships are the most successful. Strategies employed by teachers need to provide multiple opportunities and alternatives to develop beyond surface learning into deep levels of learning and understanding.

Undeniably, teachers walk into classrooms with preconceived notions regarding students and expectations. These preconceived notions are very powerful regarding how teachers will teach and their expectations for students. Teachers must have a strong understanding of

appropriate grade level tasks and assessments when seeking to set expectations for students. The act of sharing pertinent student achievement information along with conversations with a student's teacher from a previous year can help provide important information before the student enters the room. Knowing this information before the school year begins can help save time in the beginning while teachers are initially learning about their students' needs and abilities.

The importance of positive student-teacher relationships is also noted. The two aforementioned tasks cannot be mastered without a strong connection between teacher and student. Teachers will not know when to implement the best strategies to engage the student if the teacher is not aware of the learning needs of the child. The best way to learn the needs of the child is to interact with him/her. Many students are aware of which teachers like them and which teachers do not. Students will not learn from a teacher if the student believes the teacher does not have their best interest in mind. Teachers which foster a sense of belonging, encouragement, attention, and warmth promote student engagement and motivation (Vollet, Kindermann, & Skinner, 2017).

Hattie breaks with current educational trends when he addresses constructivism. In his book he stated that, "…constructivism is not a theory of teaching, but a theory of knowing and knowledge…" (Hattie, 2009) Students come to school with knowledge already accrued. It is now the job of the teachers to deepen that knowledge. Accordingly, teaching and learning is achieved when ideas, thinking, and constructing all work together. "Direct Instruction" garnered the most success when evaluating academic achievement. The phrase "direct instruction" is usually the phrase which most educators attempt to avoid. This term brings to mind the image of the teacher standing at the front of the room talking aimlessly with no regard of student engagement or understanding. Historical models of direct instruction give guidance to

the tasks of the teacher such as; emphasizing seatwork, directing instruction, controlling pace, supervising students, and working with students in small groups (Ryder, Burton, & Silberg, 2006).

The model for Hattie's Direct Instruction involves seven major steps: (Hattie, 2009)

1. Before the lesson begins the teacher has a clear idea of the learning goals. What does the student need to be able to do and understand?
2. The teacher needs to know what will be the indicator of success for this lesson. What will the students be held accountable for? The teacher also needs to communicate this expectation with the student.
3. The teacher needs to grab the student's attention for the lesson. Interest in the lesson should be created so that the student stays engaged.
4. Teacher must follow specific guides such as input, modeling, and checks for understanding.
5. Guided practice is provided by the teacher. Through this activity, students are given the opportunity to share their learning while the teacher actively monitors and provides feedback and remediation as needed.
6. Closure is provided by the teacher so that students have an opportunity to make sense of what they have just been taught.
7. Independent practice opportunities are given to the students. This is the crucial step because it gives students an occasion to apply what they have learned.

The model for Hattie's Direct Instruction has worked for learners of all types. While there is much discussion regarding learning needs for special education populations as well as high-level learners, direct instruction addresses all.

Teachers are primarily responsible for student learning. The idea that a teacher can use constructivism to develop their teaching style is criticized because it provides a surface level look at strategies and engagement. Hattie asserts that the way teachers look at students and learning must change so that more attention is paid to the lens by which students see school. Hattie does assert that the profession has excellent teachers who,

> …possess pedagogical content knowledge that is more flexibly and innovatively employed in instruction; they are more able to improvise and to alter instruction in response to contextual features of the classroom situation; they understand at a deeper level the reasons for individual student success and failure on any given academic task; their understanding of students is such that they are more able to provide developmentally appropriate learning tasks that engage, challenge, and even intrigue students, without boring or overwhelming them; they are more able to anticipate and plan for difficulties students are likely to encounter with new concepts; they can more easily improvise when things do not run smoothly; they are more able to generate accurate hypotheses about the causes of student success and failure; and they bring a distinct passion to their work. (Hattie, 2009)

Hattie's work outlines the huge task which teachers are given. His research serves to remove some pre-conceived ideas which all teachers enter a classroom with. The task is then identifying what teachers can do to teach beyond some of the limitations which are unduly placed on students.

Unresolved Issues

The discussion regarding student engagement and active instruction facilitates the need to address two issues. The first concerns teacher perception of student engagement. Many

teachers believe that their classrooms are ones filled with student engagement. The teachers would articulate that they seek to create a classroom environment that promotes and facilitates highly engaging activities. They would also agree that highly engaged students will perform better on all assessments. However, a conundrum exists because the teacher definitions of student engagement are often not congruent with what is practiced in the classroom.

The second concern lies with defining which instructional strategies are the best for student engagement. Some teachers define a highly engaged classroom as one that is loud and one in which the students are moving around and talking. Another teacher would define student engagement as a quiet classroom where the students sit quietly and are seemingly engaged in a productive struggle with the task in front of them. Teachers want to do what is right and want students to succeed. However, they often lose focus because every strategy is presented to them as the solution or the fix. The growing pressure of achievement tests leads to frustration and misunderstanding concerning what are best practices for student engagement.

Study

This study focused upon 7th grade mathematics instruction. The attention and money provided to promoting mathematics education is increasing. As society and technology continue to grow and develop so will the focus on math. Assessments, both state assessments and benchmark assessments, are the predominant factor used to measure achievement. Benchmark assessments are given throughout the year and the reports are returned to the teachers shortly after the students complete the testing, thus giving the opportunity for teachers to adjust instruction for the current students. The benchmark assessment reports contain specific information related to domains and standards.

Much of the research in this literature review references achievement, but the type of achievement is not defined. Achievement can relate to graduation rates, ACT scores, post-secondary enrollment, reading scores, math scores, or classroom grades. Because the measure by which all teachers are being evaluated is being standardized with the use of achievement tests then it is necessary to scrutinize connection between student engagement and benchmark assessments. Benchmark assessments can provide crucial information for teachers because the data is returned to the teachers while they are currently teaching the same students, in contrast to state assessments when the data is received after the students have moved on to another grade.

After recording the number of times which a teacher posed content-related questions during instruction the results of the benchmark assessment were collected and analyzed. This study only addressed questioning and the subsequent answers received. The answers were divided into two categories; those that were answered by a student selected by the teacher and those that were answered because the student elected to answer on their own accord, known as student self-selection. This study sought to identify if there is a connection between achievement on the benchmark assessment and the number of questions asked during a class period. This study also identified if there was a correlation between achievement and the types of answers given, whether they be student self-selected or students chosen at random by the teacher. Every year, teachers have access to thousands of different types of instructional strategies. How do teachers know which ones are the best and which ones are the most appropriate to use in their classrooms. If assessment results do not show an increase in learning then why do teachers continue to utilize the same practices each year.

Summary

Student engagement is dual defined concept. It relates to a student's feelings about school and to a student's performance and behavior in the classroom. Students will invariably feel better about school if they enjoy the learning that is occurring. But how do educators get students to enjoy learning if they are not given opportunities to actively learn and grow?

The central focus of student engagement is the student. The idea of student engagement derived from the early idea of constructivism and how a student constructs knowledge. As education and research has advanced, the connections between what students do and what they know have grown increasingly. The need for teachers and schools both to provide opportunities to promote active student engagement are at the forefront of professional development. Questioning, in a sense, is the most primitive type of student engagement. It provides real time interaction between a teacher and student and provides a real-life opportunity for a student to be engaged with information and learning. The development of what a student already knows is a sign of true learning when current ideas are stretched and adapted to promote understanding.

CHAPTER III: METHODOLOGY

Introduction

This chapter discusses how the data regarding questioning were collected and analyzed, and it also details the participant and sampling information. An observation measurement was created by the researcher. When developing the research plan, no measurements were found which matched the criterion needed for data collection. The researcher created the Questioning Observation Checklist (QOC) as a measurement. By using this measurement, the researcher organized the data based upon the data collected from the checklist. The reliability and validity of the observation measurement is discussed in this chapter. The timeline of data collection and organization of procedures is explained, as is the description of data analysis and statistical analysis.

Student engagement covers a vast array of activities. For the purpose of this study, the instructional strategy utilized is the use of questioning which is identified based upon the findings of the literature review. Questioning pertains to a direct content-related question, which the teacher poses to the students. The students may answer individually as directed by the teacher or individually based upon their own willingness to answer, referred to as self-selection. The questioning strategy was selected because this is a common instructional practice which all teachers seek to implement regardless of class size, technology access, or training. This is a basic practice which all teachers should know and understand and does not require a significant amount of planning and preparation.

Research Questions

Question 1: Is there a statistically significant relationship between teachers who ask more questions during classroom instruction and student performance on math benchmark assessment?

Question 2: Is there a statistically significant relationship between the number of questions answered by students selected by the teacher and the student performance on the math benchmark assessment?

Question 3: Is there a statistically significant relationship between the number of questions answered by student self-selection and student performance on the math benchmark assessment?

Hypotheses

H_{a1} – There is a statistically significant difference in student performance on math benchmark assessments between teachers who ask more questions during instruction and those who do not.

H_{a2}- There is a statistically significant relationship between the number of questions answered by students selected by the teacher and the student performance on the math benchmark assessment.

H_{a3}- There is a statistically significant relationship between the number of questions answered by student self-selection and student performance on the math benchmark assessment.

Null Hypotheses

H_{a1} – There is not a statistically significant difference in student performance on math benchmark assessments between teachers who ask more questions during instruction and those who do not ask more questions.

H_{a2}- There is not a statistically significant relationship between the number of questions answered by students selected by the teacher and the student performance on the math benchmark assessment.

H_{a3}- There is not a statistically significant relationship between the number of questions answered by student self-selection and student performance on the math benchmark assessment.

Population and Sample

The target populations for this research were math students in the 7th grade from a middle school in Tennessee with approximately 1,100 students. There are four 7th grade math teachers in the research school. The sample consisted of 320 7th grade math students and four classroom teachers. Three of the math teachers have taught five years and one is in his/her second year of teaching. The sample size and selection consisted of regular education classrooms with a selection of students with varied educational abilities and needs. According to Table 3.1, the demographics for this research school in 2017-18 was a population of 87.6% white, 4.5% Black or African-American, and 7.2% Hispanic. The economically disadvantaged population is 47.6% and there are 11.1% students with disabilities. The student population is 54.1% male and 45.9% female.

Table 3.1
2017-2018 School Demographic Information

	Grades Served	Population	Demographics	Economically Disadvantaged	Students with Disabilities
School	6th-8th	1,077	87.6% White 4.5% Black 7.2% Hispanic	47.60%	11.10%

Description of Instruments

For the purpose of this study, no measurements were found which allowed for the calculation of questions asked during a teacher's instruction. A Question Observation Checklist (QOC) was created to allow for data to be collected. This checklist was pilot tested by the researcher and another highly qualified educator. This instrument was used on three occasions to conduct observations of each of the four-math teachers over a period of one month.

Pilot Test

The data for this research was collected by using a QOC created by the researcher. Prior to the collection of data, a pilot test of the observation tool was conducted. The researcher and another field expert conducted three observations in three different math classes. Both observers used the QOC to complete a 20-minute observation. Following the observation, the two observers compared their findings to ensure that the data points matched. Any questions which resulted during the observation were answered and clarified. If changes needed to be made, the checklist was adapted until reliability was established. Once the pilot test was conducted and reliability was determined the researcher began the collection of data for the study.

Question Observation Checklist (QOC)

The QOC allowed the researcher to tally the number of content related questions which a teacher asked during a typical day of classroom instruction. Questioning was identified in the literature review as being a significant type of student engagement which teachers should seek to use. During the class period, the researcher tallied the amount of times which a teacher asked a question. The researcher also tallied the number of student answers given. Answers were categorized into those answered by students who were selected by the teacher to provide the answer and those questions answered by students who volunteered to answer. Following the observation, the number of questions asked were tallied and the number and type of answers given by the student were recorded.

Benchmark Assessment

The benchmark assessment being utilized is the Standards Mastery online benchmark assessment, which is a component of Curriculum Associates. Standards Mastery is a Computer based assessment geared to gauge a student's understanding of a mathematical standard.

Standards Mastery is not timed and no calculators are allowed to be used on this assessment. This benchmark assessment is given to every student at the conclusion of a unit. The assessment tested four mathematical standards from the Tennessee State Standards which were adopted in April 2016 and implemented in the 2017-2018 school year. Those standards were as follows:

- 7.EE.A.1: Apply properties of operations as strategies to add, subtract, factor, and expand linear expressions with rational coefficients.
- 7.EE.B.3: Solve multi-step real-world and mathematical problems posed with positive and negative rational numbers presented in any form (whole numbers, fractions, and decimals).
- 7.EE.B.4.a-1: Solve contextual problems leading to equations of the form $px + q = r$ and $p(x + q) = r$, where p, q, and r are specific rational numbers. Solve equations of these forms fluently. Compare an algebraic solution to an arithmetic solution, identifying the sequence of the operations used in each approach
- 7.EE.B.4.b: Solve contextual problems leading to inequalities of the form $px + q > r$ or $px + q < r$, where p, q, and r are specific rational numbers. Graph the solution set of the inequality on a number line and interpret it in the context of the problem.

This assessment was comprised of 18 questions for the students to answer. Each student completes approximately seven Standards Mastery assessments during the school year. For the purpose of this research, the results from Standards Mastery were used from the assessment created to determine mastery of the unit taught while the observations were conducted.

Research Procedures and Time Period of the Study

This study was conducted in January 2019 and concluded in February 2019. The pilot test for the QOC was conducted first. The researcher worked with one other field expert to

conduct observations to ensure that the same conclusions were drawn. Following the pilot test, the QOC was used to conduct all observations.

The observer used the QOC to observe four classroom teachers three times each. The teachers taught approximately 300 students in the 7th grade. The researcher conducted the observations in person. The observations were ten minutes in duration. During that time the researcher recorded and tallied the amount of questions asked by the teacher.

Standards Mastery was administered in February 2019 at the conclusion of the lesson. The researcher identified the mastery percentile which each class attained and compared the findings to the amount of questions which were asked during classroom instruction. The researcher also compared the mastery percentile to the number of questions answered by students selected by the teacher and those answered by students who volunteered.

Data Analysis

Research Questions

Question 1: Is there a statistically significant relationship between teachers who ask more questions during classroom instruction and student performance on math benchmark assessment?

Question 2: Is there a statistically significant relationship between the number of questions answered by students selected by the teacher and the student performance on the math benchmark assessment?

Question 3: Is there a statistically significant relationship between the number of questions answered by student self-selection and student performance on the math benchmark assessment?

The research data were analyzed using a Pearson ***r*** correlation. The Pearson correlation measures the strength of the relationship between questioning and achievement on the assessment (Ary, Jacobs, Sorenson, & Walker, 2014). The strength of the relationship is indicated by the correlation coefficient: ***r***. The significance of the relationship is expressed in

probability levels: ***p***. The smaller the p-level, the more significant the relationship. The larger the correlation, then a stronger relationship exists between the variables.

Conclusion

The need for proven data is present as the quest for effective instructional practices continue. Questioning is an easy and efficient teaching practice. The correlation between questions and achievement is significant because it identified the effectiveness and the level in which questioning should be implemented in a routine instructional day.

CHAPTER IV: FINDINGS

Introduction

The purpose of this quantitative study was to examine the correlation between the instructional strategy of questioning and student performance on a benchmark assessment. Student engagement is an integral part of classroom instruction and questioning is one of the easiest and fastest way in which a teacher and a student may engage. The origin of student engagement and questioning derived from evaluating the literature which discussed constructivism. Constructivism explained that all students will construct their own knowledge when given new information. The construction of student knowledge builds upon such elements as a student's prior knowledge, previous experiences, and beliefs. As a student learns or constructs knowledge, there should be indicators of student engagement. Student engagement is the easiest to recognize when observing behavior in a classroom. Questioning is an obvious behavior which is easily recognizable; both the teacher and the student have defined behaviors. This quantitative study chose to evaluate questioning based upon both the teacher actions and the student actions.

This study also found its origin when applying the eight Mathematics Teaching Practices established by the National Council of Teachers of Mathematics (Raith, Smith, & Steele, 2017). As mentioned in previous chapters those practices are:

1. Establish mathematics goals to focus learning.
2. Implement tasks that promote reasoning and problem solving.
3. Use and connect mathematical representations.
4. Facilitate meaningful mathematical discourse.
5. Pose purposeful questions.
6. Build procedural fluency.

7. Support productive struggle in learning mathematics.
8. Elicit and use evidence of student thinking.

The fifth mathematical practice regarding purposeful questions is the most relevant and the one which prompted the data analysis for this research.

To answer the first research question, data were collected regarding how many content-related questions were asked by the teacher during a 10-minute time of instruction. The data were collected during 10 minutes of direct instruction to the whole class. There were four teachers who were observed three times each. The questions came from a current unit being taught, which covered four mathematical standards. At the conclusion of the unit, the benchmark assessment was given to the students. The benchmark assessment contained a total of 18 questions, and sought to provide data to the teachers regarding student mastery of the standards taught. The data sought to find the correlation between the number of questions asked by the teacher and the student mastery percentile on the benchmark assessment.

The second and third research questions were answered by collecting data based upon how students were selected to answer the questions posed by the teacher. The second research question was answered by collecting data of how many questions were answered by students selected by the teacher to provide the answer. This number was correlated to the student mastery percentile on the benchmark assessment.

The third research question focused upon the data showing how many questions were answered by students who chose to answer on their own accord. These students were not selected by the teacher to answer the questions but they raised their hands and offered the answer without any prompting from the classroom teacher. All three research questions were analyzed using a Pearson Product Moment Correlation test.

Question 1: Is there a statistically significant relationship between teachers who ask more questions during classroom instruction and student performance on math benchmark assessment?

This question was answered by collecting data through observations and recording the number of content-related questions asked by the teacher on the Question Observation Checklist (QOC) created by the researcher. As displayed below in Table 4.1, the student performance on the math benchmark assessment was compared to the number of questions asked by the teacher.

Table 4.1
Correlation Chart for Questions Asked

	Questions Asked (x)	Percentile Grade on Benchmark Assessment (y)
Teacher A	55	46%
Teacher B	113	43%
Teacher C	36	49%
Teacher D	29	30%

Figure 4.1
Scatterplot for Correlation Test for Questions Asked

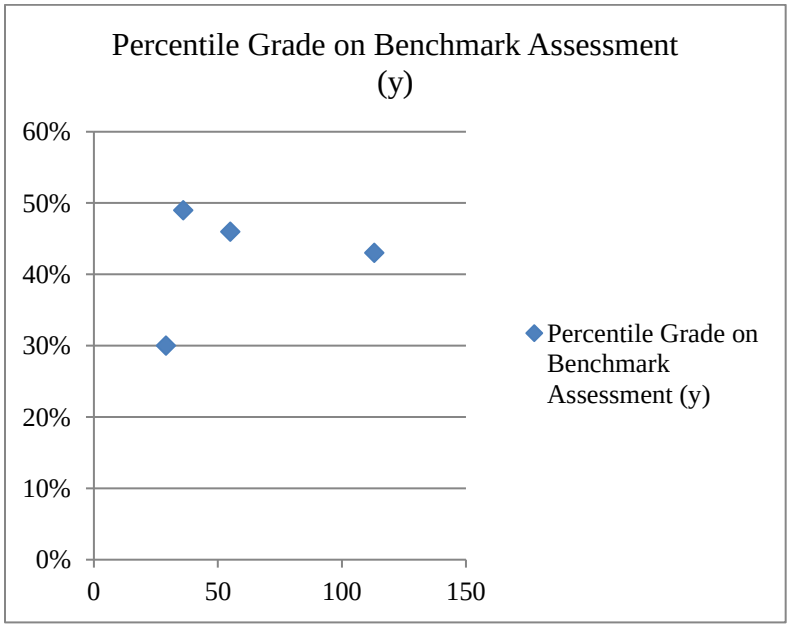

Figure 4.1 Exhibits the frequency of questions asked by the teachers.

As shown above in Figure 4.1, the points on the scatterplot move in the same linear direction. The numbers on the x-axis represent the number of questions asked by the teacher. The numbers on the y-axis represent the percentile score on the benchmark assessment.

To further understand the correlation coefficient, the researcher evaluated the p-value. This value represented the probability that there is a relationship between the two variables. The probability that they have no relationship is low, thus the strong correlations will have low p-values. For this research, the correlation was deemed statistically significant if the p-value is lower than 0.05. This is the alpha level by which the p-value is considered statistically significant or not. The p-value for the data set related to the first question was p= .752. This p-value is high which indicated that there is not statistical significance between questions asked and performance on the benchmark assessment. The hypothesis for question one was rejected and the null hypothesis was accepted.

Null Hypothesis

H_{a1} – There is not a statistically significant difference in student performance on math benchmark assessments between teachers who ask more questions during instruction and those who do not ask more questions.

Question 2: Is there a statistically significant relationship between the number of questions answered by students selected by the teacher and the student performance on the math benchmark assessment?

This question was answered when the researcher collected data through classroom observations. The researcher collected data regarding how many times students were randomly selected by the teacher to answer a question. This data was recorded on the QOC. These answers were compared to performance on the benchmark assessment, as shown in Table 4.2.

Table 4.2
Correlation Chart for Answers Prompted by Teacher Selection

	Teacher Selected Response (x)	Percentile Grade on Benchmark Assessment (y)
Teacher A	34	46%
Teacher B	68	43%
Teacher C	26	49%
Teacher D	38	30%

Figure 4.2
Scatterplot for Correlation Test for Answers Prompted by Teacher Selection

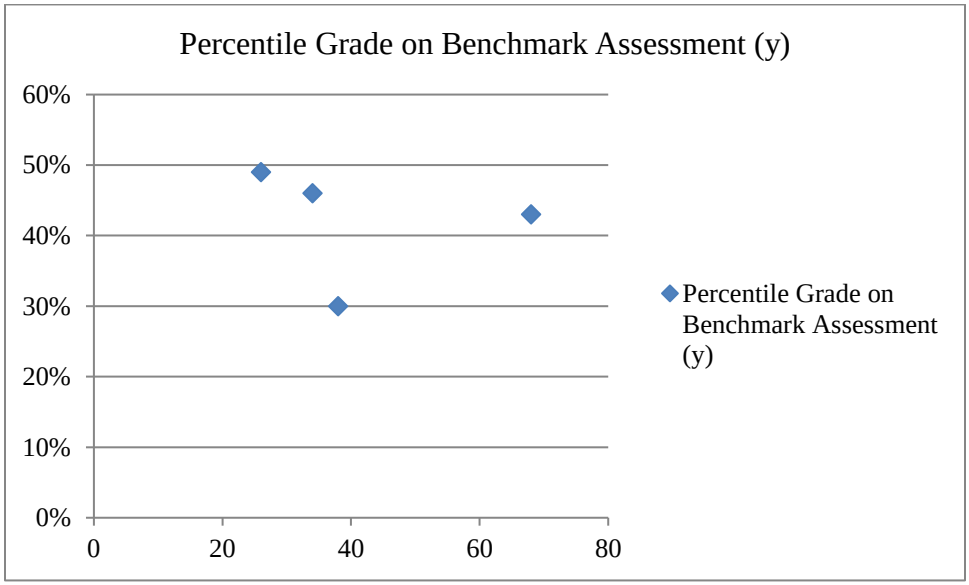

Figure 4.2 Exhibits the questions answered by students selected by the teacher.

As shown in Figure 4.2, the points in the scatterplot move in an opposite direction. The x-axis indicates the number of questions answered by the students selected by the teacher to answer and the y-axis indicates the percentile on the benchmark assessment.

The probability that there is a relationship between the two variables as indicated by the p-value was very low. The p-value was .848, which is very high and does not show a strong relationship between the two variables. This high p-value prompted the researcher to accept the

null hypothesis. This indicates that there is not statistical significance between the questions answered by students selected by the teacher and the performance on the benchmark assessment.

Null Hypothesis

H_{a2}- There is not a statistically significant relationship between the number of questions answered by students selected by the teacher and the student performance on the math benchmark assessment.

Question 3: Is there a statistically significant relationship between the number of questions answered by student self-selection and student performance on the math benchmark assessment?

This question was answered by the researcher through observations noting the number of times students self-selected to answer questions. Questions were posed by the teacher, and the students raised their hands and willingly answered. This data was compared to the performance on the mathematics benchmark assessment, as shown on Table 4.3.

Table 4.3

Correlation Chart for Answers Given by Student Self-Selection

	Student Self Selected Responses (x)	Percentile Grade on Benchmark Assessment (y)
Teacher A	9	46%
Teacher B	29	43%
Teacher C	11	49%
Teacher D	3	30%

Figure 4.3
Scatterplot for Correlation Test for Student Self-Selected Answers

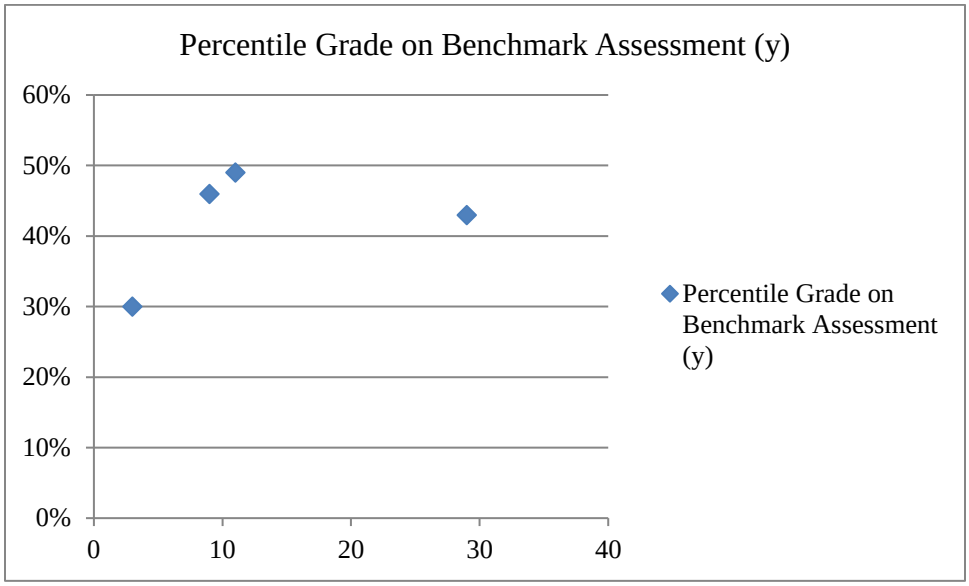

Figure 4.3 Exhibits the frequency of questions answered by self-selection.

As shown on Figure 4.3, the two variables are moving in the same linear direction. The x-axis indicates the number of questions answered by the students on their own accord and the y-axis indicates the percentile grade on the benchmark assessment.

The p-value was high for the data set related to the third question at .622. This indicated that the null hypothesis is accepted.

Null Hypotheses

H_{a3}- There is not a statistically significant relationship between the number of questions answered by student self-selection and student performance on the math benchmark assessment.

Relevant Findings

Based upon the quantitative analysis in this research, there is not a strong correlation between the number of questions asked by a teacher and performance on a benchmark

assessment. According to this data, the teacher which asked the most questions (Teacher B) did not have the highest score on the benchmark assessment, with 43% mastery. The teacher which asked the fewest questions (Teacher D) had the lowest scores on the benchmark assessment, with 30% mastery. However, Teacher C asked only 7 questions more than Teacher D and his/her student mastery was higher by 19% (see Table 4.1). The data identified there were numerous questions asked during typical classroom instruction; however, that did not correlate to outstanding performance on an assessment. This data indicates that the number of questions a teacher asks is not a strong indicator of student performance on an assessment.

Students are considered as having mastered the standard if they achieved 67% or higher on the assessment. There were four teachers with a combined total of 12 different classes which took the assessment; only one of those classes achieved above 67% on this assessment. All 7th grade students combine achieved a score of 42% on the benchmark assessment. The data identified there were several questions asked during typical classroom instruction; however, that did not translate to outstanding performance on an assessment.

This quantitative research also did not show a strong correlation between students who were selected to answer questions by the teacher or students who self-selected to answer questions and performance on an assessment. There was a combined total of 233 questions asked during the observations; 50 of those were unanswered, indicating there were 79% of the questions which were answered. Although the majority of the questions were answered in some capacity, it did not convert to mastery on the benchmark assessment.

Summary

In this study, the null hypotheses of the three research questions were not rejected. Questioning will always be a part of instruction; however, this quantitative study leads the researcher to note that further attention needs to be paid to other aspects of questioning instead of

just quantity of questions asked. The number of questions asked is a small element to be considered when identifying the impact of questioning on instruction. The types of questions asked, the plan for questioning, and the productive struggle which results from deep-level questioning are of greater significance than just the numbers of questions asked.

CHAPTER V: CONCLUSIONS, IMPLICATIONS, AND RECOMMENDATIONS

Introduction

Teaching training and experience places a great amount of emphasis on questioning in the classroom (Bond, 2007). Questioning seeks to promote cognitive processes at different levels and complexities (Ong, Hart, & Chen, 2016). Teachers use questioning as a means to monitor, understand, and evaluate student understanding. Bloom's Taxonomy (1956) outlined six levels of questioning for the classroom; recalling, understanding, applying, analyzing, synthesizing, and evaluating. Those six levels are divided into lower-order and higher-order thinking. As the pedagogical and teaching experience among teachers increase, the understanding of where instructional questions fall in those six levels is essential to providing a well-balanced education. All six levels carry with them a varied degree of synthesis when utilized by the student. In some instances teachers will ask over 100 questions in an hour (Bond, 2007). Accordingly, it is vital for an educator to be cognizant of the questions used and how they are answered.

This quantitative study sought to identify if there was a correlation between the number of questions asked by a teacher and student performance on a benchmark assessment. This study also sought to identify if there was a correlation between the number of students who self-selected to answer mathematical questions and performance on the benchmark assessment. Additionally, the researcher sought to determine if there was a correlation between the number of students who answered based upon the teacher's selection and the performance on the benchmark assessment.

Summary of Conclusions

Question 1: Is there a statistically significant relationship between teachers who ask more questions during classroom instruction and student performance on math benchmark assessment?

This question was tested using a Pearson Product Moment Correlation test. The two variables in question one was; questions asked and percentile performance on the assessment. The p-value was .752 which indicated that there is not a statistically significant relationship between the two variables and the null hypothesis is not rejected.

H_{a1} – There is not a statistically significant difference in student performance on math benchmark assessments between teachers who ask more questions during instruction and those who do not ask more questions.

Question 2: Is there a statistically significant relationship between the number of questions answered by students selected by the teacher and the student performance on the benchmark assessment?

The null hypothesis for the second question was not rejected because the p-value for question two was .848. The two variables for question two were; students selected by the teacher to answer and student performance on the benchmark assessment.

H_{a2}- There is not a statistically significant relationship between the number of questions answered by students selected by the teacher and the student performance on the math benchmark assessment.

Question 3: Is there a statistically significant relationship between the number of questions answered by student self-selection and student performance on the math benchmark assessment?

Additionally, the data showed that the null hypothesis was not rejected for the third question based upon the p-value of .622. Which measured the two variables for the third

question; student answers provided by self-selection and student performance on the benchmark assessment.

H_{a3}- There is not a statistically significant relationship between the number of questions answered by student self-selection and student performance on the math benchmark assessment.

Implications

Upon review of the findings, the data indicated that just the act of questioning alone is not a sufficient strategy to ensure student mastery of mathematical standards. While the act of asking and answering questions indicates student engagement, it is student engagement in one of its most basic forms. The data allowed the researcher to understand that the use of only one mathematical practice is not sufficient to ensure that quality learning and understanding is occurring. The eight mathematical practices build upon one another. While it is not expected that they serve as a checklist, it provides a model for how to scaffold learning and understanding when teaching mathematical standards. Accordingly, questioning is the fifth strategy employed. The use of questioning comes after foundations have been established. If the mathematics teaching practices are implemented in an orderly fashion, the fifth step of questioning would arise after the students have a solid understanding of the concept being taught. This would subsequently allow for the opportunity questioning to be more "purposeful" and meaningful, thus signifying greater student engagement, which results in authentic learning.

Based upon the evidence provided by the data, there is no strong correlation between the mere number of questions asked and answered. Upon conclusion of this research, four implications exist relevant to the research regarding questioning. The quality of classroom instruction is now judged based upon student performance on assessments. Thus, the use of benchmark assessments should be succinctly defined before they are used. The true value in a

benchmark assessment is to help a teacher's understanding of his/her student's learning. Assessments were meant to be used in a formative manner so that they can help a teacher adjust instruction so that it meets the needs of his/her students (Popham, 2009). Assessments were not intended to be an indicator of how well a teacher performed in a classroom, although the connection was made that if assessments were used correctly it would also indicate successful classroom instruction. When examining assessment results, the undefined factors must be weighed considerably before using assessment data to evaluate a teacher's instruction.

The second implication addresses the number of standards expected to be covered in a mathematics classroom during the course of a school year. In mathematics, one math word problem does not only cover one standard. Mathematical standards build upon one another and are interconnected. The knowledge which is gained from math is not in isolation, instead, this knowledge encompasses a vast understanding of all mathematical concepts which begin at the kindergarten level. When students can articulate their mathematical reasoning through mathematical argumentation, the benefits are considerable (Yuling Zhuang & Conner, 2018). However, in order to successfully instruct the student on developing mathematical reasoning, considerable time and effort are necessary. This understanding is hampered by a time constraint during a typical school year.

The third implication from this research regarded the types of questions being asked. When studying Bloom's taxonomy, the varying degree of difficulty for questions is evident. The six levels; recall, understanding, apply, analyzing, synthesizing, and evaluating, require a scaffolded understanding and indicate an acquisition of knowledge of varying levels. The first two types of questions; recalling and understanding, are most prevalent. Teachers who do not plan in-depth discussion questions ahead of time will default to quick recall questions

(Brookhart, 2010). The goal of education is for students to be able to share their knowledge and continue in the learning process throughout life. When an individual has enough command of the knowledge, then the process of transferring information will be seamless. In order to share knowledge, a student must have employed all six levels of Bloom's taxonomy.

The final implication is evaluating student engagement and its authenticity when questioning is being used during instruction. As students appear to answer questions, they seem engaged; however, data from this research suggest that simply asking questions and having them answered does not ensure learning. Behavioral engagement does not automatically signify learning. There was a slight increase in the correlation data for those students who elected to answer questions on their own accord, thus indicating those students are more engaged. One could ascertain that those students had greater confidence and motivation and knew the answer, thus they felt more comfortable in answering the question. This would justify the slightly higher correlation between that variable and performance on the benchmark assessment.

Recommendations for Further Study

While conducting this quantitative analysis, it became apparent that further study should be given to the preparation regarding questioning, the equity of questions being answered by the students, the procedures in place to ensure there is true student engagement when questioning, and the relationship between the teacher and the student.

Through the course of the observations, the researcher noted that the questions asked by the teachers were not pre-planned. The questions were developed throughout the course of instruction. The teacher would first display the math problem on the board. As the students would begin to solve the math problem, the teachers would decide which furthering questions to ask. Most were quickly answered by the students and there was no indication these questions

were rigorous enough to deepen students' mathematical knowledge. Questions should be concentrated so that it narrows the focus to what the student most needs to learn (Tofade, Elsner, & Haines, 2013). This is problematic because this style of teaching relies heavily on the strength of teacher content knowledge and teacher self-efficacy. Beginning teachers will often have difficulty leading in-depth mathematical discourse based upon limited teaching experience, emerging understanding of mathematical pedagogical concepts, as well as beginning experience with classroom management and instructional styles (Averill, Drake, Anderson, & Anthony, 2016). The questions used for instruction must be well-developed and scaffolded so that the instruction addresses all of the mathematical concepts identified.

The researcher also observed the lack of equity concerning questions answered by students. When students self-selected to respond to questions, the same few students chose to respond repeatedly. This does not allow for a teacher to receive a true indication regarding student understanding of the concept. Teachers must be aware of avoiding the same-line of questioning. When teachers lose focus they are not considering the size of the class, the ability levels, nor the language of the questions (Cecil & Pfeifer, 2011). There must be procedures in place to avoid losing students through the question and answer process. Some teachers may use the random "popsicle stick" method of selecting students to answer. Each child's name is written on a popsicle stick and the teacher selects at random the child to answer the question. Other teachers make notes concerning who has answered and who has not by considering if students in various locations around the room have answered, if students from the varied ability groups have answered, and if gender equities have been considered.

Only one of the four teachers had a plan to ensure that all students were engaged with question answering. This teacher had a layered approach to allow students to answer questions.

By providing multiple ways for the student to answer a mathematical question, it provides the student with the opportunity to enhance his/her learning. Students have time to reflect upon the information, clarify understanding, and retain and act upon what they have processed (Sejnost, 2009). After initially posing the question, the teacher would allow the students to think about the answer, followed by a brief time to allow the students to talk with a partner, and finally the student would share the answer with the teacher and the whole class. This method is time consuming and requires a significant amount of training for the students by the teacher. It is worth noting that while the teacher who utilized this technique had the highest score on the benchmark assessment it was not significantly higher than the other three assessment scores. Thus, it can be concluded that a more in-depth study of the types of questions being asked is worthy of evaluation.

The final observation noted by the researcher related to the relationship between the teacher and the students. The students that appeared to have a positive relationship with the teacher performed best on the benchmark assessment. The teacher with the best classroom atmosphere was the teacher with the best classroom management. The students understood the procedures and understood what was expected of them during classroom instruction. They also exhibited significant trust in their teacher and in the task the teacher attempted to accomplish. The process of questioning can quickly become out of control in a classroom that is not well-disciplined or well-managed. While a teacher may seek to offer many questions, before definitive learning can occur, the classroom environment must be considered. Teachers can seek to achieve clarity regarding student behavior by evaluating the cause for concern, when the situation for concern arises or does not occur, what happens before and after the event occurs,

and what views do the students have themselves and others during the learning process (Hue & Li, 2008).

References

Alexander, C. (2014). Student-created digital media and engagement in middle school history. *Computers in the Schools, 31*(3), 154-172.

Appleton, J. J., & Lawrenz, F. (2011). Student and teacher perspectives across mathematics and science classrooms: The importance of engaging contexts. *School Science & Mathematics, 111*(4), 143-155.

Armstrong, P. (n.d) *Bloom's Taxonomy*. Retrieved from https://cft.vanderbilt.edu/guides-sub-pages/blooms-taxonomy/

Ary, D., Jacobs, L. C., Sorenson, C., & Walker, D. (2014). *Introduction to Research in Education* (9th ed.). Belmont, CA: Wadsworth: Cengage Learning.

Audas, R., & Willms, J. D. (2001). *Engagement and dropping out of school: a life-course perspective*.

Averill, R., Drake, M., Anderson, D., & Anthony, G. (2016). The use of questions within in-the-moment coaching in initial mathematics teacher education: enhancing participation, reflection, and co-construction in rehearsals of practice. *Asia-Pacific Journal of Teacher Education, 44*(5), 486-503. doi:10.1080/1359866X.2016.1169503

Azid, N. H., & Yaacob, A. (2016). Enriching orphans' potentials through interpersonal and intrapersonal intelligence enrichment activities. *Yetimlerin Potansiyellerini İçsel ve Sosyal Zeka Geliştirme Etkinlikleriyle Ortaya Çıkarma., 9*(1), 17-32. doi:10.12973/iji.2016.913a

Bandura, A. (1977). Self-efficacy: Toward a unifying theory of behavioral change. *Psychological Review*, 84(2), 191-215. doi.org/10.1037/0033-295X.84.2.191

Barkaoui, K., Barrett, S. E., Samaroo, J., Dahya, N., Alidina, S., & James, C. E. (2015). Teachers' conceptions of student engagement in learning: The case of three urban schools. *Alberta Journal of Educational Research, 61*(1), 80-99.

Beasley, J., Gist, C., & Imbeau, M. (2014). (De)constructing student engagement for pre-service teacher learning. *Issues in Teacher Education, 23*(2), 175-188.

Berkant, H., & Baysal, S. (2018). An analysis of the changes in pre-service teachers' perceptions towards teacher self-efficacy and academic self-efficacy and their relations with several variables. *International Online Journal of Educational Sciences, 10*(4), 164-182. doi:10.15345/iojes.2018.04.009

Bobis, J., Way, J., Anderson, J., & Martin, A. (2016). Challenging teacher beliefs about student engagement in mathematics. *Journal of Mathematics Teacher Education, 19*(1), 33-55. doi:10.1007/s10857-015-9300-4

Bridgeland, J. M., Dilulio, J. J., Jr., & Balfanz, R. (2009). The high school dropout problem: Perspectives of teachers and principals. *Education Digest, 75*(3), 20-26.

Brookhart, S. M. (2010). *How to Assess Higher-Order Thinking Skills in Your Classroom*. Alexandria, Va: ASCD.

Brooks, J. G., Brooks, M. G., & Association for Supervision and Curriculum Development, A. V. A. (1993). *In Search of Understanding: The Case for Constructivist Classrooms*.

Brooks, M. G. (1986). Curriculum development from a constructivist perspective. *Educational Leadership, 44*, 63-67.

Callison, D., & Baker, K. (2014). Elements of information inquiry, evolution of models & measured reflection. *Knowledge Quest, 43*(2), 18-24.

Caranfil, N., & Robu, V. (2017). Student engagement with school: Conceptual and applicative dimensions. *Romanian Journal of School Psychology, 10*(20), 92-114.

Carpenter, S. (2003). Constructivism. *Australian Primary Mathematics Classroom, 8*(1), 29.

Cecil, N. L., & Pfeifer, J. (2011). *The Art of Inquiry: Questioning Strategies for K-6 Classrooms* (Vol. 2nd ed). Winnipeg: Portage & Main Press.

Checkley, K. (1997). The first seven . . . and the eighth: a conversation with Howard Gardner. (Vol. 55, pp. 8-13).

Chen, R. (2014). *Cognitive Development: Theories, Stages and Processes and Challenges*. Hauppauge, New York: Nova Science Publishers, Inc.

Chin, C. (2007). Teacher questioning in science classrooms: Approaches that stimulate productive thinking. *Journal of Research in Science Teaching, 44*(6), 815-843. doi:10.1002/tea.20171

Cordova, D. I., & Lepper, M. R. (1996). Intrinsic motivation and the process of learning: Beneficial effects of contextualization, personalization, and choice. *Journal of Educational Psychology*, *88*(4), 715-730. doi:10.1037/0022-0663.88.4.715

Dillon, J. T. (1988). *Questioning and Teaching: A Manual of Practice*. New York: Teachers College Press.

Engels, M., Colpin, H., Leeuwen, K., Bijttebier, P., Den Noortgate, W., Claes, S.,Verschueren, K. (2016). Behavioral engagement, peer status, and teacher-student relationships in adolescence: A longitudinal study on reciprocal influences. *Journal of Youth & Adolescence, 45*(6), 1192-1207. doi:10.1007/s10964-016-0414-5

Ernest, P. (1998). *Social Constructivism As a Philosophy of Mathematics*. Albany: State University of New York Press.

Finn, J. D., & Rock, D. A. (1997). Academic success among students at risk for school failure. *Journal of Applied Psychology, 82*(2), 221-234. doi:10.1037/0021-9010.82.2.221

Fogarty, R. (1999). Architects of the intellect. *Educational Leadership, 57*(3), 76-78.

Gall, M. D. (1970). Use of questions in teaching. *Review of Educational Research, 40*, 707-721.

Gardner, H. (1993). *Multiple Intelligences: The Theory in Practice*. New York: Basic Books.

Gardner's theory of multiple intelligences: Musical intelligence. (2010). *Journal of Singing, 66*(3), 325-330.

Globus, A., Rosenzweig, M. R., Bennett, E. L., & Diamond, M. C. (1973). Effects of differential experience on dendritic spine counts in rat cerebral cortex. *Journal of Comparative and Physiological Psychology, 82*(2), 175-181. doi:10.1037/h0033910

Goldberg, M. F. (1991). Portrait of Reuven Feuerstein. *Educational Leadership*, 49, 37-40.

Goleman, D. (1995). *Emotional Intelligence*. New York: Bantam Books.

Harris, L. R. (2008). A phenomenographic investigation of teacher conceptions of student engagement in learning. *Australian Educational Researcher (Australian Association for Research in Education), 35*(1), 57-79.

Hastings, R. P., & Bham, M. S. (2003). The relationship between student behaviour patterns and teacher burnout. *School Psychology International, 24*(1), 115.

Hattie, J. (2009). *Visible Learning: A Synthesis of Over 800 Meta-Analyses Relating to Achievement*. London and New York: Routledge.

Hill, P. W., & Rowe, K. J. (1996). Multilevel modelling in school effectiveness research. *School Effectiveness & School Improvement, 7*(1), 1-34.

Hollo, A., & Hirn, R. G. (2015). Teacher and student behaviors in the contexts of grade-level and instructional grouping. *Preventing School Failure, 59*(1), 30-39. doi:10.1080/1045988X.2014.919140

Hotam, Y., & Hadar, L. L. (2013). Pedagogy in practice: the pedagogy of a learning setting as students experience it. *Oxford Review of Education, 39*(3), 385-399. doi:10.1080/03054985.2013.806249

Hue, M., & Li, W. (2008). *Classroom Management : Creating a Positive Learning Environment*. Hong Kong: Hong Kong University Press.

Imms, W., & Byers, T. (2017). Impact of classroom design on teacher pedagogy and student engagement and performance in mathematics. *Learning Environments Research, 20*(1), 139-152.

Jardine, D. W. (2005). Chapter Two: On the Origins of Constructivism. *Piaget & Education Primer* (pp. 17-35).

Jiang, L., & Elen, J. (2011). Instructional effectiveness of higher-order questions: The devil is in the detail of students' use of questions. *Learning Environments Research, 14*(3), 279-298. doi:10.1007/s10984-011-9095-x

Kaiser, C., & Wisniewski, M. A. (2012). Enhancing student learning and engagement using student response systems. *Social Studies Research & Practice (Board of Trustees of the University of Alabama), 7*(3), 137-149.

Kaufman, A. K., & Blewett, E. (2012). When good enough is no longer good enough: How the high stakes nature of the No Child Left Behind Act supplanted the Rowley definition of a free appropriate public education. *Journal of Law & Education, 41*(1), 5-23.

Kayler, M. A., & Sullivan, L. (2011). Integrating learner-centered theory and technology to create an engaging pedagogy for K-12 students and teachers. *Journal of Technology Integration in the Classroom, 3*(1), 99-103.

Kayler, M. A. (2009). Teacher development and learner-centered theory. *Teacher Development, 13*(1), 57-69. doi:10.1080/13664530902858501

Kaymakamoglu, S. E. (2018). Teachers' beliefs, perceived practice and actual classroom practice in relation to traditional (teacher-centered) and constructivist (learner-centered) teaching (Note 1). *Journal of Education and Learning, 7*(1), 29-37.

Klein, A. (2015). No Child Left Behind: An Overview. Retrieved from http://www.edweek.org/ew/section/multimedia/no-child-left-behind-overview-definition-summary.html

Klette, K., Sahlström, F., Blikstad-Balas, M., Luoto, J., Tanner, M., Tengberg, M., Slotte, A. (2018). Justice through participation: student engagement in Nordic classrooms. *Education Inquiry (Co-Action Publishing), 9*(1), 57-77. doi:10.1080/20004508.2018.1428036

Kozulin, A., & Presseisen, B. Z. (1995). Mediated learning experience and psychological tools: Vygotsky's and Feuerstein's perspectives in. *Educational Psychologist, 30*(2), 67.

Lekwa, A. J., Reddy, L. A., & Shernoff, E. S. (2018). Measuring teacher practices and student academic engagement: A convergent validity study. *School Psychology Quarterly*. doi:10.1037/spq0000268

Lester, D. (2018). A review of the student engagement literature. *National Forum of Applied Educational Research Journal, 31*(1/2/2018), 1-8.

Libbey, H. P. (2004). Measuring student relationships to school: Attachment, bonding, connectedness, and engagement. *Journal of School Health, 74*(7), 274-283.

Loyens, S. M. M., & Gijbels, D. (2008). Understanding the effects of constructivist learning environments: introducing a multi-directional approach. *Instructional Science*, *36*(5/6), 351-357. doi:10.1007/s11251-008-9059-4

MacSuga-Gage, A. S., & Simonsen, B. (2015). Examining the effects of teacher-directed opportunities to respond on student outcomes: A systematic review of the literature. *Education and Treatment of Children, 38*(2), 211-239.

Manić, M., & Ranđelović, D. (2017). Level in which students prefer different types of Gardner's multiple intelligence. *Journal of Educational & Instructional Studies in the World, 7*(2), 55-64.

Marks, H. M. (2000). Student engagement in instructional activity: patterns in the elementary, middle, and high school years. *American Educational Research Journal, 37*(1), 153-184. doi:10.2307/1163475

Martin, A. J., Anderson, J., Bobis, J., Way, J., & Vellar, R. (2012). Switching on and switching off in mathematics: An ecological study of future intent and disengagement among middle school students. *Journal of Educational Psychology, 104*(1), 1-18. doi:10.1037/a0025988

Marzano, R. J., Marzano, J. S., & Pickering, D. (2003). *Classroom Management That Works: Research-based Strategies for Every Teacher*. Alexandria, Va: Assoc. for Supervision and Curriculum Development.

McConne, J. (2018). "Why are we doing this?": Using digital reflection to increase student engagement. *Ubiquitous Learning: An International Journal, 11*(2), 13-22. doi:10.18848/1835-9795/CGP/v11i02/13-22

McTighe, J., & Wiggins, G. (2005). *Understanding by Design* (2nd ed.). Alexandria, VA: ASCD.

Myeong-Hee, S. (2018). Effects of project-based learning on students' motivation and self-efficacy. *English Teaching, 73*(1), 95-114. doi:10.15858/engtea.73.1.201803.95

Nagro, S., Hooks, S. D., Fraser, D. W., & Cornelius, K. E. (2018). Whole-group response strategies to promote student engagement in inclusive classrooms. *Teaching Exceptional Children, 50*(4), 243-249. doi:10.1177/0040059916640749

Nayir, F. (2017). The relationship between student motivation and class engagement levels. *Eurasian Journal of Education.* (71), 59-77. doi:10.14689/ejer.2017.71.4

Nguyen, T. D., Cannata, M., & Miller, J. (2018). Understanding student behavioral engagement: Importance of student interaction with peers and teachers. *Journal of Educational Research, 111*(2), 163-174. doi:10.1080/00220671.2016.1220359

Null, J. W. (2003). Education and knowledge, not “Standards and Accountability”: A critique of reform rhetoric through the ideas of Dewey, Bagley, and Schwab. *Educational Studies, 34*(4), 397-413.

O'Neil, J. (1995). On schools as learning organizations: A conversation with Peter Senge. *Educational Leadership,* 52, 20-23.

Oh, E. G., & Kim, H. S. (2016). Understanding cognitive engagement in online discussion: Use of a scaffolded, audio-based argumentation activity. *International Review of Research in Open and Distributed Learning, 17*(5), 28-48.

Orthner, D., Jones-Sanpei, H., Akos, P., & Rose, R. A. (2013). Improving middle school student engagement through career-relevant instruction in the core curriculum. *Journal of Educational Research, 106*(1), 27-38. doi:10.1080/00220671.2012.658454

Patall, E. A., Steingut, R. R., Vasquez, A. C., Trimble, S. S., Pituch, K. A., & Freeman, J. L. (2018). Daily autonomy supporting or thwarting and students' motivation and engagement in the high school science classroom. *Journal of Educational Psychology, 110*(2), 269-288. doi:10.1037/edu0000214

Patton, M. Q. (2001). Evaluation, knowledge management, best practices, and high-quality lessons learned. *American Journal of Evaluation, 22*(3), 329.

Pekdemir, Z., & Akyol, A. (2015). Examination of the effect of drama education on multiple intelligence domains of children attending to 5th grade. *Education & Science / Egitim ve Bilim, 40*(182), 143-158. doi:10.15390/EB.2015.4823

Perry, D. R., & Steck, A. K. (2015). Increasing student engagement, self-efficacy, and meta-cognitive self-regulation in the high school geometry classroom: Do iPads help? *Computers in the Schools, 32*(2), 122-143. doi:10.1080/07380569.2015.1036650

Piaget's Theory on Constructivism. Retrieved from http://www.teach-nology.com/currenttrends/constructivism/piaget/

Popham, W. J., & Association for Supervision and Curriculum, D. (2009). *Instruction That Measures Up: Successful Teaching in the Age of Accountability*. Alexandria, Va: ASCD.

Powell, K. C., & Kalina, C. J. (2009). Cognitive and social constructivism: Developing tools for an effective classroom. *Education, 130*(2), 241-250.

Ong, K., Hart, C., Chen, P. (2016). Promoting higher-order thinking through teacher questioning: A case study of a Singapore science classroom. *New Waves Educational Research & Development*, 19(1), 1-19.

Quin, D., Hemphill, S. A., & Heerde, J. A. (2017). Associations between teaching quality and secondary students' behavioral, emotional, and cognitive engagement in school. *Social Psychology of Education: An International Journal, 20*(4), 807-829.

Quinn, S. (2015). Collaborative learning design in the middle school: Sculpting 21st century learners. *International Journal of Learning: Annual Review, 22,* 31-51.

Rawle, F. (2017). Practical advice for scaling up student engagement methods from small to large classes. *Transformative Dialogues: Teaching & Learning Journal, 10*(3), 1-14.

Reschly, A. L., Huebner, E. S., Appleton, J. J., & Antaramian, S. (2008). Engagement as flourishing: The contribution of positive, emotions and coping to adolescents' engagement at school and with learning. *Psychology in the Schools, 45*(5), 419-431. doi:10.1002/pits.20306

Riegler, A. & Steffe, L. (2014). "What is the teacher trying to teach students if they are all busy constructing their own private worlds?" *Constructivist Foundations, 9*(3), 297-301.

Robinson, C. (2018). Note-taking strategies in the science classroom. *Science Scope, 41*(6), 22-25.

Ross, A., & Willson, V. (2012). The effects of representations, constructivist approaches, and engagement on middle school students' algebraic procedure and conceptual understanding. *School Science and Mathematics, 112*(2), 117-128.

Rubie-Davies, C. M., Flint, A., & McDonald, L. G. (2012). Teacher beliefs, teacher characteristics, and school contextual factors: What are the relationships? *British Journal of Educational Psychology, 82*(2), 270-288. doi:10.1111/j.2044-8279.2011.02025.x

Ryder, R. J., Burton, J. L., & Silberg, A. (2006). Longitudinal study of direct instruction effects from first through third grades. *Journal of Educational Research, 99*(3), 179-192. doi:10.3200/JOER.99.3.179-192

Schiro, M. S. (2013). *Curriculum Theory: Conflicting Visions and Enduring Concerns* (2 ed.). Los Angeles: SAGE.

Sejnost, R. (2009). *Tools for Teaching in the Block*. Thousand Oaks, Calif: Corwin.

Shapiro, E. S. (2011a). *Academic Skills Problems: Fourth Edition Workbook*. New York: The Guilford Press.

Shapiro, E. S. (2011b). *Academic Skills Problems:Fourth Edition Direct Assessment and Intervention* New York: The Guilford Press.

Shoulders, T. L., & Krei, M. S. (2015). Rural high school teachers' self-efficacy in student engagement, instructional strategies, and classroom management. *American Secondary Education, 44*(1), 50-61.

Skiba, R., Ormiston, H., Martinez, S., & Cummings, J. (2016). Teaching the social curriculum: Classroom management as behavioral instruction. *Theory Into Practice, 55*(2), 120-128. doi:10.1080/00405841.2016.1148990

Skinner, E. A., & Belmont, M. J. (1993). Motivation in the classroom: reciprocal effects of teacher behavior and student engagement across the school year. *Journal of Educational Psychology, 85*, 571-581. doi:10.1037/0022-0663.85.4.571

Smart, J. B., & Marshall, J. C. (2013). Interactions between classroom discourse, teacher questioning, and student cognitive engagement in middle school science. *Journal of Science Teacher Education, 24*(2), 249-267.

Smith, T. (2018). Active learning in the math classroom. *Tech & Learning, 38*(7), 26-28.

Sprouls, K., Mathur, S. R., & Upreti, G. (2015). Is positive feedback a forgotten classroom practice? Findings and implications for at-risk students. *Preventing School Failure, 59*(3), 153-160.

Stiggens, R., & DuFour, R. (2009). Maximizing the power of formative assessments. Phi Delta Kappan, 90(9), 640-644.

Sutherland, K. S., & Wehby, J. H. (2001). Exploring the relationship between increased opportunities to respond to academic requests and the academic behavioral outcomes of students with EBD: A review. *Remedial and Special Education, 22*(2), 113-121. doi:10.1177/074193250102200205

Raith, M. L., Smith, M., & Steele, M. (2017). *Taking Action: Implementing Effective Mathematics Teaching Practices*: National Council for Teaching Mathematics.

Tanner, L. N. (1997). *Dewey's Laboratory School. Lessons for Today*.

Taylor, K., & Walton, S. (2001). Testing pitfalls (and how to help kids avoid them). *Instructor, 111*(3), 26-86.

Taylor, L., & Parsons, J. (2011). Improving student engagement. *Current Issues in Education, 14*(1), 1-32.

The brains behind the brain. (1998). *Educational Leadership, 56*(3), 20-25.

The Glossary of Education Reform. (2014). Retrieved from http://edglossary.org/stakeholder/

The importance of validity testing. (2007). *Predictive Validity of Selected Benchmark Assessments Used in the Mid-Atlantic Region*(17), 1-3.

Tofade, T., Elsner, J., & Haines, S. T. (2013). Best practice strategies for effective use of questions as a teaching tool. *American Journal of Pharmaceutical Education, 77*(7), 1-9. doi:10.5688/ajpe777155

Tschannen-Moran, M., Hoy, A. W., & Hoy, W. K. (1998). Teacher efficacy: its meaning and measure. *Review of Educational Research, 68*(2), 202-248. doi:10.2307/1170754

Turan, Z., & Meral, E. (2018). Game-based versus to non-game-based: The impact of student response systems on students' achievements, engagements and test anxieties. *Informatics in Education, 17*(1), 105-116. doi:10.15388/infedu.2018.07

Vollet, J. W., Kindermann, T. A., & Skinner, E. A. (2017). In peer matters, teachers matter: Peer group influences on students' engagement depend on teacher involvement. *Journal of Educational Psychology, 109*(5), 635-652. doi:10.1037/edu0000172

Weimer, M. (2002). *Learner-Centered Teaching: Five Key Changes to Practice*. San Francisco: Jossey-Bass.

Wheatley, K. F. (2002). The potential benefits of teacher efficacy doubts for educational reform. *Teaching & Teacher Education, 18*(1), 5-22. doi:10.1016/S0742-051X(01)00047-6

Wong, H. K., & Wong, R. T. (2009). *The First Days of School: How to Be an Effective Teacher*. Singapore: Pristone Pte. Ltd.

Yang, C., Bear, G. G., & May, H. (2018). Multilevel associations between school-wide social-emotional learning approach and student engagement across elementary, middle, and high schools. *School Psychology Review, 47*(1), 45-61.

Yoders, S. (2014). Constructivism theory and use from 21st century perspective. *Journal of Applied Learning Technology*, *4*(3), 12-20.

Yuling, Z., & Conner, A. (2018). Analysis of teachers' questioning in supporting mathematical argumentation by integrating Habermas' rationality and Toulmin's model. *Conference Papers -- Psychology of Mathematics & Education of North America*, 1323-1330.

Appendices

Appendix A

District Approval to Use Data

November 29, 2018

To Carson-Newman University:

On behalf of the School District, I am writing to formally indicate our awareness of the research proposed (Identifying the Impact of Questioning in Mathematics Instruction) by Rachel Hicks, an instructional coach at Lake Forest Middle School. We are aware that Rachel intends to conduct her research by observing our teachers and using anonymous data from benchmark assessments. I am responsible for the personnel/teachers and am the Director of Schools for County. I give Rachel Hicks permission to conduct her research in our system.

Sincerely,