An Examination of Pedagogy in Middle School Science Classrooms and Its Effect on Student Achievement

Brittany E. Kiser

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Dissertation Committee:

Dr. Suzanne King, Chair

Dr. James W. Guthrie

Dr. Nancy Kline

ABSTRACT

BRITTANY E. KISER: An Examination of PEDAGOGY in Middle School SCIENCE and Its Effect on STUDENT ACHIEVEMENT

The development of policies ensuring regular examination of American students has been one approach to the mandate of accountability within the United States. While the face of assessment in education and the subsequent policies continue to evolve, the method to which classrooms approach preparing students for these examinations does so as well, though not in concert. Although some research has attempted to connect the two, particularly in the fields of mathematics and reading, a clear link between pedagogy in science classrooms and student achievement on standardized exams has not yet been established. Using qualitative and quantitative data gathered through surveys and mining of historical public domains, the researcher has attempted to determine if an existing correlation between the predominant pedagogy of middle schools in a large, urban district in South Florida and achievement of students on the Florida Grade Eight Statewide Science Assessment can be substantiated. Significant differences were identified with regard to student achievement on this assessment and whole-class teacher demonstrations, students working in collaborative groups, and formative assessment use in the classroom, as well as with respect to the school-wide category of pedagogy and the school's socioeconomic label. The impact of such information could be widespread, allowing for the reformation of pedagogy in science classrooms, professional development for current educators, and educator training provided at the collegiate level as well as policy maintenance and development.

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Thank you. All of you.

DEDICATION

For my hero.

The late nights

The events missed

The weekend move

For my Tony.

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CHAPTER I

INTRODUCTION

Background

Standardized assessments are one approach to the mandate of accountability that the United States has developed. Just how much influence the instructional method holds over student achievement on standardized assessments is a point of contention, although most educational researchers agree that this plays a role at the very least (Turner, 2011). The education of children is an extensive field, comprised of an abundance of strategies, methods and instructional practices—teacher-directed and student-driven, although popular, accounting for a mere two of the plentiful approaches. Traditional teaching methods are most closely associated with teacher-directed, yet other methods, such as Montessori, knowledge-centered, self-contained, community-centered, departmentalized, and assessment-centered, among others, are also common (Wu & Huang, 2007). With the advent of technology, virtual school (such as Florida Virtual Schools, FLVS) has become a reality as well. It is important to note that none of these methods are mutually exclusive; in fact, many would argue that a balance of these practices reflects the ideal learning environment, which in turn may lead to increased achievement. This study explored the relationship(s) between instructional method and student achievement in science.

Significance of the Study

The understanding and application of scientific knowledge compels students to utilize higher-order thinking and skills from varied content areas to synthesize and defend new ideas

(Calado, Neves, & Morais, 2013). In other words, immersion in science at its core necessitates the 21st century skills that global market leaders insist our future workforce master. Given that science is the basis of STEM (Science, Technology, Engineering, Math) and the United States Bureau of Labor Statistics projects that careers in STEM fields will grow exponentially, approximately one million more by the year 2022 than in 2012, today's students require, at the very least, a minimum level of proficiency in the sciences, which may realistically be the baseline of their future career (Vilorio, 2014).

Science education standardized test results indicate that Florida middle school students scoring at or above the accepted proficiency rate reached just 50% and 52% in 2017 and 2018, respectively, on the Statewide Science Assessment (Florida Department of Education, 2018). Similarly, the middle school students of a large, urban school district in South Florida reaching scores on the Statewide Science Assessment which are considered to be proficient were 52% in 2017 and 54% in 2018 (Florida Department of Education, 2018). A clear link between pedagogy in middle school science classrooms and student achievement on the Statewide Science Assessment has not been established. The success or failure of a specific method of instructional delivery in the middle school science classroom, whether student-driven or teacher-centered, should be evident given students' performance on the Grade Eight Statewide Science Assessment. This information could be utilized to reform middle school science education so as to improve student performance on the Statewide Science Assessment. Thus, the goal of this study was to determine if there is a positive correlation between instructional method (specifically student-driven versus teacher-centered) in a large, urban school district's public middle schools and student achievement on the Grade Eight Statewide Science Assessment. This information could be utilized to inform middle school science educators' teaching practice and to affect the knowledge and understanding of best practices for suppliers of professional development and instructors of pre-service teachers.

Rationale for the Study

Middle school students nationwide are demonstrating low achievement in science on standardized assessments. On the PISA 2015 science assessment, the United States ranked at 496, just above the mean international score of 493 (Organization for Economic Cooperation and Development, 2016). On a national level, the 2015 NAEP assessment of grade eight science indicated that 67% of students scored at or above the "Basic" level; this level is considered to be mastery of grade-level content only in part (Institute of Education Sciences, 2016; 2012a). When compared to the 2011 NAEP score of 64%, the difference is significant (Institute of Education Sciences, 2012b). Middle school students in the State of Florida are demonstrating comparably low achievement on the Grade Eight Statewide Science Assessment. In 2017, 50% of students assessed on this exam reached the designated proficiency level on this assessment, while 52% of Florida middle school students were considered to be proficient in 2018 (Florida Department of Education, 2018). In a similar trend, middle school students of a large, urban district in South Florida are also demonstrating low achievement on the Grade Eight Statewide Science Assessment. In 2017, 52% of the students within this district that sat for this test reached the designated proficiency level, while 54% attained the minimum score considered to be proficient in 2018 (Florida Department of Education, 2018). Thus, it logically follows for a study which dives further into instruction and its relationship to student performance in the sciences.

Theoretical Framework. The theoretical framework for this study was established from a dual perspective—philosophical and psychological. From the philosophical standpoint, the study rests upon the contentions of the philosopher and education advocate of the 1820s, John Dewey. Dewey (1938/1997) was the first to propose that education ought to pivot around the learner and the manner in which the learner constructs knowledge, the concept which is now known as student-centered instruction. He contested the traditional teaching method, insisting that the teacher must act as the facilitator of knowledge acquisition, providing carefully-planned experiences for the learner that will interact with the learner's prior knowledge (Dewey, 1938/1997). Only then, Dewey (1938/1997) explains, will the learner be able to assemble meaningful knowledge that is relevant and valuable, allowing him/her to become a productive member of society.

The psychological perspective samples from the theories of several notable psychologists over time, beginning with Lev Vygotsky's *Social Development Theory* of the 1930s. Vygotsky's (1978) theory indicated an inherent connection between child development and learning. Specifically, this study expands upon Vygotsky's Zone of Proximal Development for learning, which indicates that specific boundaries exist between a student's current [actual] and prospective [potential] abilities in terms of development (Vygotsky, 1978). Like Dewey, Vygotsky's (1978) Zone emphasizes the need for the teacher to act as a guide, helping the student to reach metacognitive levels that he/she would not have been able to do so independently, thus allowing for a student to optimally perform in the classroom. Closely aligned in frame is Jean Piaget's *Theory of Cognitive Development*, also of the 1930s. Piaget (1952/1965) believed that children progressed through varied stages of mental maturation, in which the process of a student's thinking trumps the product. In the Piagetian classroom, students are grouped by ability and enhance cognition through appropriately planned experiences to build understanding, rather than to be receivers of knowledge (Piaget, 1952/1965). Two specific aspects of Piaget's theory, schema and adaptation, served as a basis for Jerome Bruner's development of the *Constructivist Theory*. Bruner's (1960) *Constructivist Theory*, developed in the 1960s, centered on four aspects for best structuring knowledge so that students may learn to manipulate the information and make connections. Similar to his contemporaries, Bruner (1960) emphasized the importance of learners as active, not passive, in the development and organization of knowledge. Once again, this theory indicates that the teacher act as a facilitator in helping students to build transferable problem-solving skills (Bruner, 1960). The work of these educational pioneers led to the development of modern constructivism, which has since been packaged and re-packaged by more recent educational theorists to become what is currently acknowledged as student-driven instruction.

Conceptual Design. The conceptual design for this study revolves around the work of current educational researcher, Robert Marzano, of Learning Sciences International. Marzano's (2007) research has led to his evidence-based claim that instructional methods—inclusive of before, during, and after classroom interactions—effect student achievement. This work has indicated that specified instructional practices on the part of the teacher affect a student's ability to perform in the classroom (Marzano, 2007). This body of research has been distilled into the Marzano Art and Science of Teaching Learning Map, a graphic organizer comprised of 60 segments, known as elements of effective instruction (Marzano, 2007). Though none are specifically delineated as teacher-directed or student-driven, the elements are reminiscent of explicit pedagogies which have been shown to increase student achievement. Thus, in this study, the Learning Map serves as a guideline for classroom indicators which result in higher student performance.

Context of the Study. This study took place within a large, urban school district located in southeast Florida, comprised of the entire county. This district is the fifth-largest district in Florida and the eleventh-largest district in the United States (SDPBC, 2016a). The District is comprised of 180 schools, grades Pre-Kindergarten through grade 12, and services over 193,000 students

(SDPBC, 2016a). The study focused upon the 35 public middle schools, which house students in grades six through eight, and those educators that teach science courses within these schools.

Purpose of the Study

The primary purpose of this study was to establish if there is a positive correlation between instructional method (specifically the degree to which a school practices student-driven methods versus teacher-centered) in the public middle schools of a large, urban school district and student achievement on the Grade Eight Statewide Science Assessment. This information is of value as, for the years 2013-2015 and 2017-2018, the school district in question has out-scored both the State mean and those of the other Urban Seven districts (Florida Department of Education, 2016; 2018). On the 2016 Grade Eight Statewide Science Assessment, the public middle schools of this district again out-stripped the State and five of the Urban Seven districts, having scored equally to one other county (Florida Department of Education, 2016). The secondary aim of this study was to determine what, if any, characteristics of a school act as an influential factor on the predominant pedagogy of the school's science department. A by-product of this study was additionally to fill an existing gap in the current literature that is available on this topic.

Research Questions

The following questions will guide this study:

1. In a large, urban school district, is one predominant modality of grades six through eight science teachers, mixed pedagogies versus student-driven pedagogy, correlated with higher student achievement than the other?

2. What school characteristics (i.e. demographics, average years of teacher experience, etcetera) are associated with a predominance of student-driven pedagogy or mixed pedagogies?

Assumptions

This study was predicated upon several assumptions. First, it was presumed that there is in fact a difference in student achievement between the pedagogies of student-driven and teacher-centered instruction and that middle school educators in this district's schools practice these methods of instructional delivery with fidelity. Similarly, it was assumed that student achievement on the Statewide Science Assessment is, in fact, influenced by the type of instruction a student experiences in the classroom. In addition, it was taken for granted that teacher participants will answer the survey questions both honestly and accurately. Finally, it was assumed that science teachers in this large, urban district's middle schools are teaching the curriculum as intended and indicated on the state-provided course description and addressing content per the state Item Specifications document as the curriculum will be assessed on the Statewide Science Assessment across all grades six through eight.

Limitations and Delimitations

As with any study, limitations must be considered. First, the sample size of teacher participants and school data may be problematic, dependent upon how many and which middle school principals allow their teachers to participate. Should an insufficient number of participants be utilized in this study, it may seriously skew the data. Alongside this possible issue that may have an effect on the validity of the data, confounding variables that affect the data must also be considered. Dependent on the location of the school site and the home life of the individual student, extraneous variables such as parental involvement, student cognition and motivation may affect student scores on Grade Eight Statewide Science Assessment. Similarly, teacher efficacy of the expected content knowledge as well as the teacher's desire to instruct middle school science may also act as confounding variables. Furthermore, as the State of Florida has, thus far, maintained the Next Generation Sunshine State Standards for Science and refused to adopt the Next Generation Science Standards, a national movement towards normalizing science standards, the ability to generalize this study's findings beyond Florida's Urban Seven to outside schools and districts may be limited. A final consideration of limitations is the survey instrument itself, as it has not been previously piloted for reliability. This study does not have any qualified delimitations.

Definition of Terms

The following terms are utilized throughout the execution of this study in the stated capacity:

- **Accountability:** metric for determining effectiveness of schools, educators and districts based upon student achievement on standardized assessments (see also *school-based accountability*)
- **Achievement:** concerns the quantitative measurement of student's mastery of a specific content, generally within the context of a summative, often standardized, norm-referenced or criterion-referenced, assessment (see also *performance*)
- **Complexity:** the level of cognitive demand required of the student to perform a task or meet an objective (Webb, 2007)

- **Difficulty:** indicates the effort involved to complete a goal where tasks and objectives are concerned or the percentage of students correctly responding to an item when in reference to an assessment (Tan & Othman, 2013)
- **Grade Eight Statewide Science Assessment:** science assessment for the state of Florida, assessing standards from grades 6-8 and administered at the end of grade eight, formerly known as the Florida Comprehensive Achievement Test 2.0 Science
- **NAEP:** National Assessment of Educational Progress
- **Pedagogy:** the art of instructional delivery in the classroom
- **Performance:** concerns the quantitative measurement of student's mastery of a specific content, generally within the context of a summative, often standardized, norm-referenced or criterion-referenced, assessment (see also *achievement*)
- **PISA:** Program for International Student Assessment
- **School-based Accountability:** metric for determining effectiveness of schools, educators and districts based upon student achievement on standardized assessments (see also *accountability*)
- **Student-driven Instruction:** refers to a classroom environment which focuses on the learner in designing activities, making connections and similar classroom practices, and is synonymous with learner-centered instruction, student-led pedagogy and student-centered methods, all of which allow for interchanges among these terms (Turner, 2011)
- **Teacher-centered Instruction:** includes such actions as lecture, with the teacher as the main focus in the classroom, and is synonymous with teacher-centered methods and teacher-led instructional practices, which again can be transposed (Wu & Huang, 2007)
- **TIMSS:** Trends in International Mathematics and Science Study

- **Urban Seven:** the seven largest districts in the State of Florida which share similar demographics and characteristics (Broward County, Duval County, Hillsborough County, Miami-Dade County, Orange County, Palm Beach County, Pinellas County)

Organization of the Remainder of the Study

Chapter two explores the literature and available data as it relates to this study. The literature review presents the current research regarding student achievement in science, the opposing pedagogies of teacher-centered versus student-driven instruction, and an overview of studies connecting instructional methods to student achievement. Following the literature review, chapter three of this text presents the intended research design and methodology. This section includes a review of the research questions and hypotheses as well as the specified plan for data collection and data analysis. Chapter four presents the data collected and results identified from the study, while chapter five delves into analyzation of the data as it relates to the current literature and future implications for practice.

CHAPTER II

LITERATURE REVIEW

Introduction

Educators, researchers, parents and politicians alike have shown interest in the success of students in public, private and charter schools in the United States and abroad. In most cases, this success is judged by student performance on assessments, a result of this era of accountability. Current literature surrounding student performance, determined by scores on a standardized test or similar assessment, are plentiful as are studies on the instructional practices which are believed to lead to higher achievement on said assessments. However, the available literature is predominantly concerned with the subjects of mathematics, reading and writing, with very little reference to the sciences—both conceptual and social.

As discussed within the current literature, student-driven instruction refers to a classroom environment which focuses on the learner in designing activities, making connections and similar classroom practices, and is synonymous with learner-centered instruction, student-led pedagogy and student-centered methods, all of which allow for interchanges among these terms (Turner, 2011). In short, any manifestation of instructional delivery which places the student as the driver of the learning can be considered to be within the realm of this mode of teaching. Conversely, teacher-driven pedagogy includes such actions as lecture, with the teacher as the main focus in the classroom, and is synonymous with teacher-centered methods and teacher-led instructional practices, which again can be transposed (Wu & Huang, 2007). This category of instructional delivery relies upon the teacher as the giver of information and the student as the passive receiver. The manner in which instructional methods are referred to in the literature incorporates the act of teaching in the classroom; that is, the given procedure in which the educator presents the material to the student. Similarly, student academic achievement or performance predominantly concerns the quantitative measurement of student's mastery of a specific content, generally within the context of a summative, often standardized, norm-referenced or criterion-referenced, assessment (Webb, 2007). Finally, in the literature and academia as a whole, complexity and difficulty are not equivalent terms as they are in colloquial language. Rather, complexity describes the level of cognitive demand required of the student to perform a task or meet an objective, whereas difficulty indicates the effort involved to complete a goal where tasks and objectives are concerned or the percentage of students correctly responding to an item when in reference to an assessment (Webb, 2007; Tan & Othman, 2013). This chapter explores these concepts in the current literature and as the data indicates they relate to student achievement in the sciences.

Accountability in Education

The publication of *A Nation at Risk* in 1983 initiated an historic change to the education system in the United States (Guthrie, Springer, Rolle & Houck, 2007). The widespread concern brought about by this report led to a call for metrics specially geared to quantify school performance and, in turn, instituted a series of legislative actions which, over the years, has overhauled specific aspects of education reform and introduced the era of school-based accountability (Figlio & Ladd, 2015). One of the more notable enactments is the No Child Left Behind Act, passed in 2002 by President George H.W. Bush, which ushered in mandatory standardized assessments in reading and math, and established consequences for schools failing to meet "adequate yearly progress" based upon student performance (Guthrie, et al., 2007). Add to this the states' own interpretations of the bill and the addition of their own tests, leading to the creation of a climate of high-stakes accountability. Although President Barack Obama replaced No Child Left Behind with similar, yet less rigid, legislation, the Every Student Succeeds Act in 2015, more localized governing bodies have oft been reluctant to recuse themselves from much of the testing (Figlio & Ladd, 2015). As Tienken (2017) explains, the current state of public education is mired in a "system of performance," built upon terminology meant to separate and rank (p. 109). Thus, the administration of standardized assessments has become the accepted convention for judgment of an educator, school or district's level of efficacy; consequently, it is the same mode upon which this study relied.

Historical Performance in K-12 Science

Student performance worldwide in the content areas of mathematics, science and literacy has been a concept of study for some time. In 1969, the National Assessment of Educational Progress (NAEP) was the first nationwide assessment in the United States to provide some measure of student achievement, science being assessed every four years (Florida Department of Education, 2014). The NAEP in science measures science achievement in grades four, eight and twelve in both the content—life science, physical science, earth/space science—and practices of science (Institute of Education Sciences, 2012a). In 1995, the Trends in International Mathematics and Science Study (TIMSS) followed, assessing fourth- and eighth-grade students on an international level in the content areas of science and mathematics (Institute of Education Sciences, 2011). The most recent of these wide-ranging assessments is the Program for International Student Assessment (PISA) which is administered every three years to fifteen-year-old students and measures literacy in reading, mathematics and science (Florida Department of Education, 2014). Similar assessments can be found at the individual state levels, such as the Florida Comprehensive Achievement Test 2.0 Science (FCAT), now known as the Statewide Science Assessment (SSA).

Science Achievement Internationally. The TIMSS assessment, which was first administered in 1995, began with approximately 80% of assessments at the middle school level yet a scant 13% of the assessments focused solely on science content (Drent, Meelissen & Van Der Kleij, 2013). Data from the TIMSS 2011 grade eight science assessment resulted in an international benchmark score of 500 and determined the top-performing countries, including the United States, to be 23 out of the 56 that participated (Institute of Education Sciences, 2013). More recently, the TIMSS 2015 grade eight science assessment resulted in the United States ranking at 11 out of the 39 participating countries, with the highest performers being Singapore, Japan, Chinese Taipei, Korea and Slovenia (Martin, Mullis, Foy, & Hooper, 2016). The PISA resulted in similar data for science achievement. Top performers on this 2012 assessment included Japan, Finland, China and Singapore, yet a mere eight percent of students worldwide scored within the top two levels of the PISA; the United States was rated at 20 out of 34 in science (Organization for Economic Cooperation and Development, 2014a; 2014b). The 2015 PISA, when relying primarily on science content, showed the United States fared no better, scoring a mere three points above the international average and ranking at 25 out of 72 participating countries (Organization for Economic Cooperation and Development, 2016). The top-performing countries on the 2015 PISA science were Singapore, Japan, Estonia, Finland and Canada, respectively (Organization for Economic Cooperation and Development, 2016).

Science Achievement in the United States. On the TIMSS 2011 grade eight science, the United States scored 525, slightly better than the average international benchmark of 500, placing eight countries ahead of the United States which performed statistically significantly better (Institute of Education Sciences, 2013). These results are echoed in the TIMSS 2015 grade eight science, as the United States earned a slightly better, but not statistically different, score of 530 over the international benchmark score of 500 (Martin, et al., 2016). Although the United States’ raw score improved from 2011 to 2015, it's rank fell by two on the TIMSS 2015 grade eight science (Martin, et al., 2016). The United States did not fare as well on the 2012 PISA in which it ranked at 497, well under the mean international score of 501 (Organization for Economic Cooperation and Development, 2014a). On the 2015 PISA, the United States scored 496, one point lower than in 2012, though just above the international average of 493 (Organization for Economic Cooperation and Development, 2016).

On a national level, the 2011 NAEP assessment of grade eight science indicated that 64% of students scored at or above the "Basic" level; this level is considered to be mastery of grade-level content only in part (Institute of Education Sciences, 2012a; 2012b). When compared to the 2009 score of 62%, the difference is significant (Institute of Education Sciences, 2012b). This trend is continued in the 2015 NAEP, which indicated 67% of student participants reaching levels of Basic or above, though retaining a national average of 154 points out of a possible 300 (Institute of Education Sciences, 2016). This trend loosely aligns with the findings of Tretter, Brown, Bush, Saderholm, & Holmes (2013) in that in science, educators certified to teach high school have the greatest content knowledge, followed by the middle school certified teachers; those teachers certified to teach elementary school have the least amount of content knowledge which may indicate the changes.

Science Achievement in Florida. In terms of grade eight science achievement in Florida, the TIMSS 2011 indicated that Florida students scored an average of 530, not statistically better than the United States' performance on the whole (Institute of Education Sciences, 2013). However, the state of Florida performed significantly lower than the national average on the TIMSS 2015 scoring 508 points, a drop of 22 points in its own score from 2011 (Martin, et al., 2016). The PISA assessment does not provide a breakdown further than that of the country in science performance as the greater stress is placed upon student achievement in the field of mathematics.

In terms of the 2011 NAEP grade eight science assessment, Florida outscored just eight other states with a score of 148 on a scale of 300, slightly better than the 2009 score of 146 yet both below the national average for this assessment (Institute of Education Sciences, 2012b). By the 2015 NAEP grade eight science assessment, Florida demonstrated a slight improvement, ranking 30th out of the 46 states that participated (Institute of Education Sciences, 2016). The Florida Department of Education (2016; 2018) FCAT/SSA assessment in grade eight science indicated that through the years of 2012-2018 the average passing rate was between 47% and 52% of students scoring at or above grade level expectations. In the years of 2013-2015 and 2017-2018, the district in which the study will take place averaged higher than the state mean as well as outperforming the other members of the 'Urban Seven,' all of which have hovered around 50% passing rate (Florida Department of Education, 2016; 2018). The 'Urban Seven' are the seven counties in Florida—Hillsborough, Orange, Duval, Miami-Dade, Broward, Palm Beach, Pinellas—which are alike in size and demographics and thus most often compared to one another for generalization purposes. On the 2016 SSA, the district in which the study will take place again out-performed the state and five of the Urban Seven districts, averaging the same score as Pinellas County (Florida Department of Education, 2016).

General Findings on Student Achievement in Science. In an analysis of TIMSS data from its inception through 2011, Drent, et al. (2013) found great differences between and among participating countries with regards to typical classroom practices and factors as well as within school characteristics, thus making it difficult to generalize the results of this assessment in relation to specific instructional practices. For example, House (2008b) found that while cooperative learning in the classroom positively affected the results of student achievement in the United States, it was a negative factor when incorporated into the Asian science classrooms. This disparity may well be correlated to cultural expectations and norms (Su, 2014), which provides credence to the argument of Drent, et al. (2013). Regardless of how generalizable these data may be, certain trends have held true throughout analysis on multiple levels. In Japan, students have historically outperformed their counterparts in other countries in terms of science achievement, scoring well above the international averages (House, 2008a). One possible cause for this result, insofar as American achievement is concerned, may be the United States' drive for productivity in the quickest manner possible, as it has negatively affected education in that it deprives students the opportunity to wrestle with and internalize knowledge through difficulty (Nelson & Harper, 2006). Nelson and Harper (2006) further purport that this has become a vicious cycle of sorts, in that educators teach in the manner most similar to how they have been taught, unless they have been exposed otherwise to models of struggling with content, in which case they are then more likely to introduce this method in their classrooms.

Methods of Instruction in the K-12 Classroom

Teaching is an extensive field which contains an abundance of strategies, methods and instructional practices, teacher-directed and student-driven, although popular, accounting for a mere two of the plentiful methods. Traditional teaching methods are most closely associated with teacher-directed, yet other practices include Montessori, knowledge-centered, self-contained, community-centered, departmentalized, and assessment-centered, among others. With the advent of technology, virtual school (such as Florida Virtual Schools, FLVS) has become a reality as well. It is important to note that none of these methods are mutually exclusive; in fact, many would argue that a balance of these practices reflects the ideal learning environment (Marzano, 2007; Wu & Huang, 2007; Drent, Meelissen, & Van Der Kleij, 2013).

Characteristics of a Teacher-led Instructional Environment. When one typically thinks of teaching, the image which most often comes to mind is that of the educator as the possessor of information standing at the front of a classroom, desks all in rows, lecturing to the passive students, who may be listening attentively, taking notes, or otherwise engaged. This stand-and-deliver lecture-style of instruction is the norm for the teacher-led instructional environment (Odom & Bell, 2015). However, teacher-centered classrooms take many shapes and may appear, on the surface, to be student-centered. Odom and Bell (2015) cite a prime example of this in that many teachers utilize whole-group demonstrations in the science classroom in which the teacher completes the steps, with or without a student assistant, in an effort to solidify the understanding of a concept or engage the students' attention. To account for situations such as this, the International Center for Leadership in Education (ICLE), using Bloom's Taxonomy as a guide, created a structured, four-quadrant framework for rating student learning activities. When examining teacher-centered delivery, the ICLE categorizes these instructional methods into Quadrants A and C—teacher work and student work, respectively (McNulty & Quaglia, 2007). Typically, this mode of instruction represents a 'one size fits all' approach and does not account for much in the way of differentiation (McNulty & Quaglia, 2007). Activities in a teacher-led instructional environment may be engaging on a superficial level, as illustrated in Wu and Huang's (2007) study, in which the teacher asked questions, modeled demonstrations and utilized various digital simulations; yet the learning always returned to the focus on the teacher as the authority on the content.

Characteristics of a Student-driven Instructional Environment. In essence, the student-driven classroom is precisely the opposite of the teacher-led classroom. The aforementioned Quadrant system developed by the ICLE categorizes not only teacher-centered instructional practices, but student-centered as well. Quadrants B and D, student work and student work in the context of student think, respectively, describe classroom activities that align with the student-driven environment (McNulty & Quaglia, 2007). One instance of the student work, student think circumstance is described as the concept of ‘hands-on, brains-on,’ otherwise known as active learning (House, 2008b). Effective student-centered instructional delivery requires much thought on the part of the educator in reference to determining the cognitive demand of tasks and assessments and properly assigning these to students based upon their readiness levels (Webb, 2007). Webb’s Depth of Knowledge framework is one tool to aid the teacher in this quest. Cooperative grouping in the classroom, when implemented with fidelity and within the appropriate context, is a common scenario in learner-centered instructional environments (House, 2008b). Additional student-driven environmental traits are provided, as a checklist of sorts, by Turner (2011):

- an abundance of student-talk opportunities
- the use of formative assessment to drive instruction
- differentiation of instruction, scaffolding, and activities at a level most suitable for the student
- teaching to the multiple intelligences, inclusive of opportunities for student-choice
- apt student connections to previous knowledge as well as real-life application
- relevant, authentic classroom activities
- culturally-sensitive, respected norms

It is important to note that the all-important current which underlies all of these characteristics is the drive to meet each student’s learning needs in the manner which is most appropriate for him/her (Turner, 2011).

Cognitive Complexity and Student-centered Pedagogy

As previously mentioned, complexity refers to the level of cognitive demand required of the student to perform a task or meet an objective (Webb, 2007). In Portugal, the equivalent to the Florida Course Description (EC) was compared in terms of complexity to the Portuguese counterpart of the District Scope and Sequence (CG). The results consistently demonstrated that the complexity levels within the EC document were higher than those in the CG document; further suggesting that Portuguese middle school students may be receiving even lower complexity science instruction due to the rigor of the textbook being at an even lower than demand the CG, noting that these two items act as the primary resources for teachers (Calado, et al., 2013).

In the literature, the term rigor is often interchanged with complexity when describing a task or assessment. It is important to once again contrast complexity with difficulty in that difficulty indicates the effort involved to complete a goal where tasks and objectives are concerned or the percentage of students correctly responding to an item when in reference to an assessment (Tan & Othman, 2013). The two are not completely unrelated, however. In fact, it is in such a case that Tan and Othman (2013) found a relationship, albeit weak, between the difficulty of assessment items and the complexity of the thought processes involved in those items in a college-level mathematics course. It follows, then, that both complexity and difficulty be appropriately leveled in a student-driven classroom.

Levels of Complexity. Norman Webb, an individual whose name is practically synonymous with complexity in the world of academia, developed an infrastructure to better serve instruction in the classroom by classifying activities, standards and assessment items based upon the cognitive demand required to interact with and complete a task or meet the objective of an assessment item. These were divvied up into four ascending levels, Webb's (2007) Depth of Knowledge, of cognitive complexity as follows:

- **Level One**: This is the most basic level of cognitive engagement. Items and tasks mostly require minimal thinking and involve recall of facts and information as well as the usage of simple, memory-based formulas.
- **Level Two**: Student actions within this level are slightly more complex in terms of required thought processes. Comparing, contrasting and multi-step tasks and assessment items are common within this level.
- **Level Three**: At this level, students must use critical thinking skills to analyze evidence, justify a conclusion, or predict results in a given situation. In general, items and task within this level require more time to think through and complete.
- **Level Four**: This is the most demanding of the levels in terms of cognition involved and time committed. Tasks and assessment items may require students to initiate their own procedures or defend a self-developed argument.

These levels of complexity are associated with the extent of rigor in a given classroom. In providing a metaphor of rigor as earning a driver's license, Rabbat (2014) likens rigor to the actions of the instructor from the Department of Motor Vehicles, slow scaffolding, moving the new driver from a parking lot to side-roads to the highway. But, Rabbat (2014) cautions, these tasks cannot be completed with the instructor's foot constantly pushing down on the brake pedal, as is the case in the teacher-led instructional environment.

Complexity and Student-driven Instructional Methods. The complexity of classroom activities is also closely associated with specific student-driven and teacher-led instructional practices. For example, in McNulty and Quaglia's (2007) Quadrant D, student work and think is considered to be part of a student-centered classroom. It is in this very same quadrant that one would expect to see tasks lying well within Webb's Depth of Knowledge Levels Three and Four as they require more effort and metacognition on the part of the student (Webb, 2007). Similarly, the development of connections between and among new information, previous knowledge and life outside the classroom necessitates a great deal of thought as well as remaining consistent with a student-driven classroom environment (Turner, 2011). In general, those practices which are learner-centered, with the student as the driver of his/her own learning, tend to require higher levels of rigor simultaneously (Webb, 2007; McNulty & Quaglia, 2007).

Student-driven Instructional Delivery and Academic Achievement

As aforementioned, student academic achievement or performance predominantly concerns the quantitative measurement of student's mastery of a specific content, generally within the context of a summative, often standardized, norm-referenced or criterion-referenced, assessment. There has been a great deal of research conducted regarding the achievement of students worldwide in an effort to measure countries against one another. Further research has been undertaken to link specific demographics, school characteristics, patterns in home life and classroom practices to student performance. With regard to instructional delivery, many studies which examine the purported association between student-centered classroom instruction and achievement are available. However, these studies almost exclusively rely upon instruction in the English Language Arts or Mathematics classrooms. Those studies which involve student achievement in science, particularly in the middle school age group, in relation to instructional practices are examined below.

Student-centered Instruction as an Indicator for Positive Achievement. Studies involving student-centered instruction and occurring within the United States are sparse. Studies that do exist, though, bode well for student-driven instructional practices in the middle school science classroom. In the mid-west, student-centered and inquiry-based instruction techniques in grades seven and eight science classrooms were associated with higher achievement on a unit assessment (Odom & Bell, 2015). This same study came to the conclusion that teacher-centered classroom activities, particularly teacher demonstration and lecture, are associated with lower student achievement (Odom & Bell, 2015). Similarly, Tassell (2013) determined that statistically low-achieving students in mathematics and science courses experience very little student-directed learning and instruction and hypothesizes that the decrease of teacher-led instruction may improve the scores. It is important to note within this study, the classroom teachers reported via surveys that student-driven describes the majority of their class time, thus there may be some misinterpretation regarding the delineation between the two instructional methods (Tassell, 2013).

Not all related studies focus on the method of instructional delivery. Rather, others concentrate on specific classroom practices, which may be categorized as either student- or teacher-centered. In Korea, students who reported being highly engaged with the content during science class perform statistically better than their peers; it is inferred that student engagement as active learning is strongly associated with student-driven learning; therefore, student-centered learning is active learning (House & Telese, 2015). The researchers further report that higher levels of rigor in the science classroom lead to increased understanding of science concepts and that more relevant material is associated with creative extrapolation to a greater extent, consequently indicating that classroom practices associated with student-centered instruction are more likely to lead to higher student achievement than teacher-directed instructional delivery (House & Telese, 2015). Likewise, in the United States, the use of instructional conversations and cooperative learning in the classroom has been shown to be a positive predictor for student performance; an aspect of instruction that is often associated with more cognitively complex thinking and a segment of a student-driven classroom (Doherty & Hilberg, 2008; House, 2008a). In addition, when afforded the opportunity to develop self-generated laboratory procedures and reports, students perform significantly better on summative assessments than their peers provided the traditional, teacher-led laboratory report format (Nam, Choi & Hand, 2011). Moreover, science content that requires active, engaged learning and is relevant to students' lives has been shown to positively affect student achievement in science, specifically within the context of the life sciences (House, 2008b).

Conversely, those activities associated with teacher-driven classroom practices have been shown to negatively impact student achievement in science (Wyss, Dolenc, Xiaoqing & Tai, 2013; Su, 2014; House, 2008a). One of these practices which has particularly been studied is reading from the textbook. In a study attempting to correlate course grade and score on the American College Testing (ACT) college readiness assessment with time spent reading the textbook in high school Biology, the amount of time spent reading the textbook in class was found to be neither a predictor for course grade or achievement on the ACT (Wyss, Dolenc, Xiaoqing & Tai, 2013). In a similar manner, it was determined by Su (2014) that the sole act of reading from the textbook in United States middle school science classrooms is associated with low performance on the TIMSS. A similar teacher-directed activity, that of whole-class demonstration in which the teacher is the 'scientist' and students act as passive 'viewers,' has also been shown to negatively influence student achievement in science (House, 2008a).

Student-centered Instruction and Negative Results. As with any purported correlation, there are those studies which will contradict the results. Based on TIMSS 2011 data for the United States, positive student achievement was not linked to inquiry-based instructional practices, which are a characteristic of the student-driven environment (Su, 2014). However, Su (2014) alludes to two assertions which may have had an effect on these results. First, the author presumes that inquiry-based instruction is widely utilized in science classrooms across the United States, and conducted in the manner in which it is meant to be. The author further surmises that science in the elementary grades is taught regularly and with fidelity yet provides no evidence for this assumption.

Comparable results were found by Atar and Atar (2012) in Turkey as the resultant data analysis of TIMSS 2007 determined that inquiry-based instruction was shown to negatively impact student achievement. However, the authors provide reasonable explanations for the negative correlation, including the manner in which the assessment items were presented—specifically noting that survey questions revolved around the frequency of classroom activities as opposed to the quality of classroom experiences—and that science teachers at the time were not adequately prepared to effectively implement the student-centered model in their classrooms. Additionally, it is possible that errors existed in student comprehension and perception of the survey questions in regards to the given classroom scenarios (Atar & Atar, 2012). Furthermore, an in-depth analysis of all TIMSS data from 1995 through 2011 determined that studies of the older assessments did not account for discrepancies in the tests, which may affect the outcome here as well (Drent, Meelissen & Van Der Kleij, 2013).

Although the results of Atar and Atar (2012) align with the findings of Su (2014), together contradicting the aforementioned studies' findings of positive student achievement linked to student-driven instruction, both of these studies follow from researchers outside of the United States, one of which studied students from another country. Therefore, the results themselves may not be as applicable to the general populace of the United States education system and thus the disparity not be weighed as large as a deterrent when compared to the numerous studies indicating positive correlation. In addition, Su (2014) and Atar and Atar (2012) present within their work logical explanations for the variance in the results, both directly and by implication, further suggesting that the results may not be generalizable.

Gaps in the Literature

Gaps in the literature exist when considering student achievement, student-centered pedagogy and middle school science. The available literature regarding middle school science achievement, in general, is primarily in Asian countries—specifically Korea, Singapore and China—which is made even more apparent by the study by House and Telese (2015) as yet another work whose focal point is middle school science achievement in an Asian nation. Additionally, the current literature pertaining to student performance in science within the United States is sparse; the data is limited to TIMSS, the National Assessment of Educational Progress and individual state assessments. Existing literature analyzing the Florida Comprehensive Achievement Test – Science/Statewide Science Assessment in relationship to students and classroom practices is insubstantial. Moreover, available literature concerning student-driven instructional methods in the classroom are limited to accomplishments in reading, writing and mathematics.

Recommendations within the Literature

In addition to the existing gaps, the literature is rife with recommendations for future studies in this field. It is suggested that research be conducted to determine the long-term effects of student-driven instruction on student performance as compared to that of teacher-centered pedagogy (Wyss, et al., 2013). Odom and Bell (2015) stress the need to better understand the associations among teacher demonstration lectures, student attitudes and the subsequent student performance in science courses. Similarly, Su (2014) recommends a study of classroom science instructional approaches through observation, an in-depth analysis of educator perceptions related to science teaching and a review of student perspectives with regards to science education and cultural background. Moreover, it is suggested that there is a need for science education worldwide to increase the level of cognitive demand upon our students; one method to do so is to promote further study into the maintenance of high caliber metacognitive demand between curriculum standards and curriculum delivery (Calado, et al., 2013).

Conclusion

As evidenced by both literature and standardized assessment results, the manner in which middle school science education in the United States is currently progressing necessitates additional research to inform middle school science educators' teaching practices. To effect these teachers, the suppliers of professional development, as well as instructors and curriculum planners for pre-service teachers, must be made aware of the most recent research in relation to best practices in middle school science. Current literature sheds some light on these instructional practices in relation to mathematics and literacy, as well as some which take place in countries outside the United States. The existing gaps in the literature make it clear there is a need to determine if there is an association between instructional method (student-driven, teacher-centered and mixed pedagogies) and student achievement in middle school science in Florida.

CHAPTER III

METHODOLOGY

Research Questions and Hypotheses

The principal reasoning for this study was to determine if an existing correlation between the predominant pedagogy of middle schools in a large, urban district in South Florida and achievement of students on the Grade Eight Statewide Science Assessment can be established. To that end, the following research questions and hypotheses will be addressed:

1. In a large, urban school district, is one predominant modality of grades six through eight science teachers, mixed pedagogies versus student-driven pedagogy, correlated with higher student achievement than the other?
2. What school characteristics (i.e. demographics, average years of teacher experience, etcetera) are associated with a predominance of student-driven pedagogy or mixed pedagogies?

H_1: Schools with a greater tendency toward student-driven instruction will demonstrate higher student achievement on the Grade Eight Statewide Science Assessment.

H_0: No significant difference in student achievement on the Grade Eight Statewide Science Assessment will exist between schools with differing predominant pedagogies.

Context and Setting of the Study

This study took place within the confines of a large, urban school district which is situated in southeast Florida. The state of Florida boasts 67 school districts, each aligned with the county lines. Of the 67 school districts in Florida, seven are significantly larger than the others as well as having comparable compositions with regards to demographics and urban characteristics, thus they are referred to as the Urban Seven (Florida Department of Education, 2016). In these large districts, student populations range from 117,000 to 379,000 per the year 2000 United States Census (National Center for Education Statistics, 2000). The National Center for Education Statistics (2000) further reports the demographic makeup of the Urban Seven to be comprised of predominantly white or black individuals within the following ranges: 51-73% white and 19-42% black.

The school district at the focal point of this study is one of the largest in the country (eleventh) and the state of Florida (fifth of the Urban Seven) as it serves approximately 193,000 students in 180 schools, grades Pre-Kindergarten through grade 12 (SDPBC, 2016a). The ample student population originates from 197 different countries and/or territories and speaks 145 languages and dialects, with less than one-third of the population birthed in the state (SDPBC 2016a; SDPBC, 2016b). The schools of this large, urban Florida district regularly perform well in school grades, with over 60% rated as a level A or B, the two highest ratings provided by the State, respectively (SDPBC, 2016a). Demographically speaking, the county is comprised of individuals describing themselves as 59% white, 20% Hispanic origin, 18% black, 2.6% Asian and 0.6% American Indian/Alaskan Native; nearly 52% report as female while 48% self-identify as the male gender (SDPBC, 2016b). The sample size for this study has been selected to be taken from the public middle schools of the District, which claims 35 of its 180 schools to serve grades six through eight.

Description of the Sample

At the time of the study, this Florida school district employed over 27,000 people, the largest employer in the county (SDPBC, 2016b). Of this large number of employees, 12,800 served in the role of classroom teachers (SDPBC, 2016a). This study was designed toward a purposeful sampling of these 12,800 educators within the District, restricting the sample to teachers of middle school science only, roughly 350 teachers (SDPBC Research and Evaluation, 2016). There are 35 public middle schools in this large, urban district, and this study will attempt to sample science educators from all, save one, of these schools. The sole middle school whose teachers will not be solicited for participation in the survey is on the Prohibited Research School list provided by the District at the time of the study. The sample will consist of a large percentage of those educators who teach science in grades six, seven or eight and is expected to have included more female than male respondents, as the District reports that its male to female ratio of faculty is 21% to 79%, respectively (SDPBC Research and Evaluation, 2016). This data was not otherwise collected as a part of the study. Similarly, it was expected that the self-identified races and ethnicities would be close to the following percentages, also reflective of the District demographics: 69% white, 18% black, 11% Hispanic origin, and 2% Asian, Native (Alaska, Hawaiian or American Indian), or of two or more races (SDPBC Research and Evaluation, 2016).

Research Design – Rationale for Design

This research was devised as an *ex post facto*, correlational study of mixed-methods design. It qualified as *ex post facto* as data mining from the public domain will occur after students have sat for the 2018 Grade Eight Statewide Science Assessment and school-based achievement has been released by the Florida Department of Education. This study additionally qualified as correlational owing to the fact that the researcher was attempting to establish a positive association between student achievement on the Grade Eight Statewide Science Assessment and instructional method in the middle school science classroom. The study can be considered to be of mixed-methods design as the data collected and compared will be of both quantitative and qualitative form.

The rationale for this specific design was to ensure that an accurate, unbiased picture was created, depicting what is happening school-wide within the middle school science classrooms of a large, urban school district in south Florida. In order to do so, mixed methods of qualitative and quantitative data were required to construct a thorough understanding of teacher pedagogy in middle school science and its effect on student achievement. The qualitative data collected consisted of teacher characteristics relative to years of teaching experience, courses instructed, years teaching science at the current school and the like, as well as the regularity of specific instructional practices within the classroom that are considered to be features of a teacher-centered or student-driven classroom pedagogical model. These qualitative data additionally served to inform the extent to which an instructional method is correlated with school characteristics. Quantitative data gathered in the course of this study were primarily related to student achievement on the Grade Eight Statewide Science Assessment, and were analyzed with respect to the aforementioned qualitative data. Having obtained both of these data types contributed to the composite essence of middle school science instruction in this large, urban school district. Similarly, this study had been designed to ensure a complete, unbiased data collection procedure, as it attempted to anonymously sample from teachers of middle school science, originating from all schools within the District, with the exception of the one school that unable to be surveyed, at the discretion of the school district main office. In addition, the intention behind the design of this study was to ultimately make a case for one effective, successful pedagogical method that ought to be utilized within middle grades science instruction, in that a successful study would clearly indicate schools with a predominant pedagogy of 60% or higher student-driven or mixed-pedagogies would possess resultant student data achieving at a higher level comparatively.

Data Collection

Approval from the respective Institutional Review Boards at Lynn University and the subject school district were secured in January and February of 2018 (see Appendix A). As instructed by the Department of Research and Evaluation of the school district in question, the researcher formally sought the email addresses of all science teachers from the 34 middle schools through a public records request. Using this information, the initial data collection took place in May of 2018 followed by the data mining in June of 2018 as described in the subsequent paragraphs.

The researcher presented the study to this large, urban school district's middle school science department instructional leaders via the previously scheduled monthly District Department Instructional Leader meeting, held on May 10, 2018 and to middle school SECME (Science, Engineering, Communications, Mathematics, Enrichment) coordinators via a previously scheduled SECME Coordinator meeting held on April 24, 2018. These educators were requested to share the opportunity to participate with their individual learning communities. In accordance with the school district's calendar, the researcher sent an email to the obtained email addresses on May 12, 2018 from the researcher's Lynn University email address, providing a brief explanation as to the purpose of the research and requesting participation in the survey. The email request letter can be viewed in Appendix B. The researcher utilized an electronic survey instrument of 17 questions via Google Forms, a digital survey and data collection platform provided by the Google Suite of tools, to middle school science teachers that teach in this large, urban school district. The survey instrument was created by the researcher, based on the current literature, specifically for usage in this study. The survey instrument began with a request for informed consent; subsequent questions encompassed within the survey were developed on the framework of evidence-based research and similar existing tools. The complete survey instrument may be viewed in Appendix C.

The survey instrument was anonymous; it requested the following information for each teacher: informed consent and acknowledgment of participation (see Appendix D); school site; school demographics; years of teaching experience; years teaching science at current school; grade(s) of science taught. In addition, the survey instrument presented classroom characteristics based upon current literature, including research conducted by Odom and Bell (2015), McNulty and Quaglia (2007), Wu and Huang (2007) and Turner (2011), expounded upon within Chapter Two, that are associated with student-centered and teacher-led instruction, such as the extent to which the teacher is giver of knowledge versus facilitator of knowledge acquisition. Each characteristic was aligned with a Likert scale value, requesting that teachers indicated the frequency of which each characteristic is indicative of instructional practices within the confines of his or her individual classroom; the frequency increased with the number (see Appendix C). The one on the Likert scale corresponded to “Never,” i.e. this instructional practice does not take place in the teacher’s classroom. The two on the scale equated to “Quarterly,” meaning the teacher utilizes this instructional practice approximately once per grading period. The three on the Likert scale was equivalent to “Monthly,” that is, the teacher makes use of this instructional practice about once every month. The four on the scale corresponded to “Weekly,” meaning the teacher employs this instructional practice in the classroom at least once per instructional week. The highest ranking on the Likert scale, five, equated to “Daily,” i.e. the teacher applies this instructional practice in each class period. Should a participant have felt the need to recuse him/herself from the study, they were welcome to at any time, without penalty, simply by closing the internet browser housing the survey instrument.

The survey was open for a time period of approximately two weeks, from May 12 through May 26, 2018. The researcher was able to garner additional survey responses, encouraging educators to complete the survey through follow-up, face-to-face meetings and communication with select departments and individuals based on previously established relationships. The researcher also sent a follow-up email on May 25, 2018, the day prior to the survey close date to accrue added participation. This email letter may be viewed in its entirety in Appendix E. The researcher gathered data of student scores from the 2018 Grade Eight Statewide Science Assessment from the Florida Department of Education when it was released on June 13, 2018. A visual representation of the data collection procedures is shown here in Figure 1.

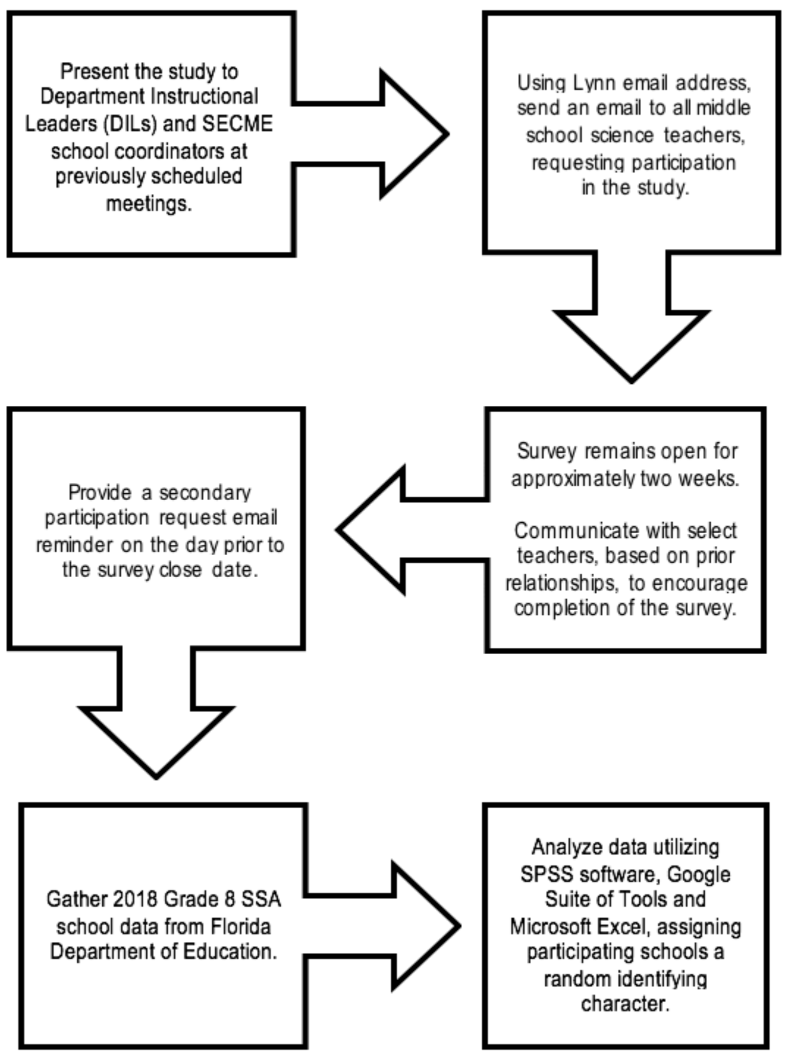

Figure 1. Visual Representation of Data Collection Procedures

All data collected was aggregate per school and the individual response data were collected anonymously, no identifying information was or will be assembled or released. After a period of no more than six months past the acceptance of the Dissertation in Practice, the data collected by the survey instrument in all forms will be permanently deleted. All participating schools were assigned a random identifying character for data analysis and discussion purposes.

Ethical Considerations

There were several ethical considerations for this study. First, the student achievement data was aggregate per school and within the public domain, available via the Florida Department of Education's website as part of the state's commitment to transparency. The data available on this website is composite for schools, thus ensuring the anonymity of student participants, their teachers, and the participating schools. Through the course of this study, no identifying student or teacher information was gathered or will be released; all data collected will already have been or was compiled into aggregate data per school. All participating schools were assigned a random identifying character for data analysis and discussion purposes. Additionally, all collected data remained secured via password-protected accounts and will only be accessed through password-protected internet. After a period of no more than six months past the acceptance of the Dissertation in Practice, the data collected by the survey instrument in all forms will be permanently deleted.

Quality of Data

The quantitative aspects of this study were ensured to be valid through the content of the survey instrument, which was based on the characteristics of pedagogies within the current literature. Specifically, the survey instrument was based upon fieldwork by the following educational researchers: Odom and Bell (2015), Turner (2011), McNulty and Quaglia (2007), and Wu and Huang (2007); the instrument also utilized the accepted Likert scale. The construct of the Grade Eight Statewide Science Assessment is criterion-referenced and has been assured to produce both valid and reliable results as the scores have been stable and consistent (Florida Department of Education, 2016).

The qualitative facets of this study were trustworthy as there was little associated researcher bias given that the identifying characteristics have been developed based on existing bodies of research. The researcher's bias was with regard to her role as a science educator and science instructional specialist, working in the same large, urban school district in which the study took place. Otherwise, the researcher was uninvolved in the direct collection of the data and the data analysis was straightforward and needing little interpretation, thus leaving no space for bias. Moreover, at a minimum, the results of this study will be able to be implemented to the other Urban Seven school districts in Florida, thus ensuring the applicability of the research.

Data Analysis

Data analysis procedures began after having collected all appropriate data, noting that the gathering of the school performance data primarily exists within the public domain, in June of 2018. The primary analysis tools utilized were the Google Forms and Google Sheets applications from the Google Suite of Tools, Microsoft Excel and the Statistical Package for Social Science data analysis package for data calculations.

Although the teacher survey data collected was qualitative in nature, the employ of the Likert scale allowed for simple conversion to quantitative data for analyzation purposes. The frequency responses were converted to numeric values as explained in the data collection procedures above. When determining the degree to which a school practices student-driven instructional methods, the teacher-directed frequency categories were inverted. All values were added and then divided by the number of responses per school, resulting in the percentage to which a school is partial to student-centered instruction. Based on these metrics, the category of school was considered to be student-driven for school values that expressed 60% or more of these characteristics and of mixed pedagogies for not meeting this requirement. The researcher identified trends in the 2018 Grade Eight Statewide Science Assessment and then compared the instructional data indicating predominant pedagogies to student scores on the Grade Eight Statewide Science Assessment. In addition, the researcher compared each instructional practice to student achievement on the Grade Eight Statewide Science Assessment. The researcher identified trends in school characteristics and demographics as they related to the predominant pedagogy, both in relation to the category as well as to the degree to which a school identified with each practice.

As is customary in educational research, statistical significance was accepted at an alpha value of less than 0.05. To determine the difference between school characteristics and predominant pedagogy/degree to which a school identified with student-driven instruction, the one-way analysis of variance (ANOVA) test was run to compare the two groups. To determine the correlation, strength and direction of the relationship between these two sets of data, Spearman's *rho* correlation coefficient was used. This procedure of tests was repeated for each instructional practice as well as for each school characteristic, both for the category of school (student-centered or mixed pedagogies) and the degree to which a school identified as student-driven. Finally, to determine the correlation of the predominant pedagogy and the degree to which a school self-identified with student-centered instructional practices, Spearman's *rho* correlation coefficient was run to determine the strength and direction of the relationship between student achievement on the Statewide Science Assessment and these variables.

Limitations and Delimitations

There were no identifiable delimitations for this study as the researcher did not any specific boundaries regarding who may or may not respond within the sample size. There were, however, several limitations. To begin with, should the sample size be too small in terms of teacher or school respondents, the data may prove to be an inaccurate picture. Confounding variables must also be considered. For example, the demographics of a given school or a student's prior experiences through his or her home life and motivation may affect the student's achievement on the Grade Eight Statewide Science Assessment. A similar factor may be the educator's knowledge of and comfort level with the content, which may also affect the method which the educator leans to as well as the student's academic progress. In addition, the ability to generalize the findings of this study may be limited to the Urban Seven school districts of Florida, as this state is the only one which utilizes the Next Generation Sunshine State Standards, whereas many other states have adopted the Next Generation Science Standards.

Summary

In the current climate of school-based accountability, student achievement is of increasing importance in schools, policy, and to the public at large. The present understanding of student performance in relation to the method of classroom instruction is incomplete at best. This study was designed in part to assist in filling the gaps in this knowledge. This study was outlined to determine the standing correlation between the predominant pedagogy of middle school science classrooms and the influence of these instructional methods on student achievement on the Grade Eight Statewide Science Assessment. The study followed a mixed-methods, *ex post facto* correlational design and utilized the Statistical Package for the Social Science to establish the statistical significance at an alpha level of 0.05. Chapter four summarizes the results gathered from these statistical tests. Chapter five explores the meanings of these results in relation to the research questions and hypotheses and in light of current literature within this realm.

CHAPTER IV

RESULTS

Introduction

The purpose of this study was to determine if there is an existing correlation between the predominant pedagogy of middle schools in a large, urban district in South Florida and achievement of students on the Grade Eight Statewide Science Assessment. This chapter will detail the data gathered, analysis processes and outcomes of the study. It will begin with an overview of the analyses, followed by an explanation of the qualitative and quantitative data collected and conclude with specified findings for research question one, research question two and the hypotheses presented.

Summary of Analyses

This study was conducted as an *ex post facto*, correlational study of mixed-methods design. The survey instrument may be viewed in its entirety in Appendix A. Data analyses included data mining from the public domain and analyses of qualitative and quantitative data, utilizing tools from the Google Suite (Google Forms and Google Sheets), Microsoft Excel and the Statistical Package for Social Science.

Qualitative Analyses. Of the seventeen questions included in the survey instrument, nearly all could be considered to be qualitative in nature. In order to analyze these data effectively, the researcher coded each of the qualitative responses as included in the subsequent explanation. The demographic questions “How many years of teaching experience do you possess?” and “How many years have you been teaching science at your current school?” had the same answer choices, thus these responses were coded the same. For the choice of 0-3 years, these responses were coded as one; selections of 4-10 years were coded as two, responses of 10-20 years were coded as three, and choices of 20 or more years were coded as four. The demographic question requesting participants to identify if their school was categorized as a Title I school or not included three answer choices—yes, no, not sure. The researcher used the list of Title I schools provided via the subject district's website to ensure these responses were accurate, and then coded "yes" as one and "no" as two. Similarly, schools that identified utilizing student-driven instructional practices 60% of the time or higher were classified as "student-centered" and coded as two; those schools which identified practicing less than 60% of student-driven pedagogical methods were classified as "mixed pedagogies" and coded as one. In addition, to protect the anonymity of participants and schools, schools which had at least one respondent were assigned a random pair of letters for identification purposes, using the random generator function of Google Sheets. The survey instrument questions which requested participants to identify the frequency to which each instructional practice was utilized in their classroom were based on the Likert scale, thus simplistic to code. The selection of "Never" on the survey instrument was coded as one, the choice of "Quarterly" was coded as two, answers of "Monthly" were coded as three, selections of "Weekly" were coded as four, and the choice of "Daily" was coded as five.

Quantitative Analyses. The researcher utilized an alpha level of 0.05 for all statistical tests, which included the one-way Analysis of Variance to determine whether there were significant differences among groups, followed by the Post Hoc criterion where results were statistically significant, and the two-tailed Spearman's *rho* correlation coefficient to determine the strength and direction of relationships. The researcher also executed frequency distributions to monitor the rates of responses, which can be viewed for each of the twelve pedagogy questions in Appendix B and Appendix C, for the teacher-centered and student-driven practices, respectively. These tests were carried out utilizing the Statistical Package for Social Science. Minimal quantitative data analyses were carried out via the Google Sheets tool, which functions much like Microsoft Excel. Using the coded Likert scale responses to the survey questions, the researcher inverted the responses for the frequency of those five pedagogical practices which align with teacher-centered instruction. Post-inversion, the researcher utilized Google Sheets functions to add the total responses per school and divide by the corresponding numeric value. This provided a percentage of student-driven instructional practices per school. Using this model, no school scored lower than 50% and no school scored higher than 71.67%. Thus, to split the difference, schools which self-identified as practicing student-driven instructional practices 60% of the time or more were labeled "student-centered" and coded as mentioned above. Schools that self-identified as less than 60% student-centered pedagogical practices were labeled "mixed pedagogies" and coded as aforementioned.

Summary of Data Gathered

As mentioned above, data was gathered in both quantitative and qualitative measures, as well as mined from the public domain. The mined data was strictly quantitative in nature, having been student achievement scores on the Grade Eight Statewide Science Assessment. The qualitative and quantitative data were both collected via the survey instrument created by the researcher.

Survey Respondents. The link to the survey instrument was included in an email message to 331 middle school science teachers from 34 middle schools within the subject district. One of the email messages failed to be delivered as the individual no longer works in the district. Of those emails which purportedly arrived at the correct location, 98 individuals opened the survey instrument and 97 responded to the survey instrument, as one participant declined the participant informed consent and thus was exited from the survey instrument, resulting in a 29.7% response rate. To protect the anonymity of participants, very little demographic information was collected from participants. In addition to the name of the school where the participant currently teaches, participants were asked to indicate what middle school science courses they have taught in the past three years (as the SSA is tested only in grade eight but includes content from all three grade levels), the number of years of teaching experience they possess as well as the number of years they have been teaching science at the current school. A summary of these responses is illustrated in Table 1 below.

Table 1

Survey Instrument Results: Participant Demographics

	Survey Choices	Frequency (n)	Percentage of Sample (%)
Years of Teaching Experience	0-3 years	15	15.5
	4-10 years	24	24.7
	10-20 years	36	37.1
	20+ years	22	22.7
Years Teaching Science at Current School	0-3 years	38	39.2
	4-10 years	35	36.1
	10-20 years	19	19.6
	20+ years	5	5.2
Science Courses Taught+	Grade 6	42	43.3
	Grade 7	60	61.9
	Grade 8	50	51.5

+*In the past three years, as the SSA covers content from grades six, seven and eight. Participants were able to select more than one option.*

The responses received represented individuals from 32 of the 34 solicited schools. 16 (50%) of the schools are labeled as Title I schools, meaning that the student population percentage which is eligible for free and reduced lunch has met the Federal threshold. Five of the participating schools had a single respondent, all others had a minimum of two respondents. Table 2 indicates the percentage of respondents for each school based on the number of teachers that received the request to participate, which ranged from eight to 100 percent response rates per school.

Table 2

Survey Participants Per School

School+	Number of Survey Respondents	Number of Teachers Receiving Request	Percentage of Participation Per School (%)
TK	2	10	20
LU	1	6	17
IK	6	14	43
JR	6	12	50
FU	1	9	11
TP	2	8	25
XK	2	8	25
BW	4	12	33
TU	3	15	20
BK	6	14	43
FO	2	9	22
CT	4	13	31
ZS	3	5	60
FF	3	7	43
NG	4	14	29
SE	2	10	20
NX	5	7	71
FC	3	9	33

IF	3	9	33
KG	2	13	15
CR	1	6	17
KV	2	15	13
XW	2	14	14
AB	1	5	20
VA	4	4	100
DW	3	15	20
VS	6	9	67
JZ	2	3	67
QZ	3	9	33
IW	2	8	25
HA	1	12	8
AM	6	10	60

+*Participating schools were assigned random identifying characters to protect anonymity.*

Grade Eight Statewide Science Assessment. The Florida Department of Education released aggregate data regarding student performance for schools, districts and the State in mid-June 2018. This data includes the percent of students within each subset that have scored on or above grade level. For the 2018 Grade Eight Statewide Science Assessment, the State average was 52% while the subject district was at 54% of students performing at or above grade level. The subject district's participating schools had a mean score of 53.75%, ranging in student achievement from 23% to 94%, these are the numerical values that were utilized throughout the statistical analyses.

Results for Research Question One

The primary reasoning for this study was to substantiate an existing correlation between pedagogy and student achievement. Research question one asked, "In a large, urban school district, is one predominant modality of grades six through eight science teachers, mixed pedagogies versus student-driven pedagogy, correlated with higher student achievement than the other?" The results for research question one are examined in detail below.

Results for the degree to which schools self-identify as student-centered. The degree to which schools self-identified as student-centered were tested against student performance on the Grade Eight Statewide Science Assessment using both the one-way Analysis of Variance and the two-tailed Spearman's *rho* correlation coefficient. Within the ANOVA, the dependent variable was student achievement while the independent variable was the degree to which a school was considered practicing student-driven methods. An alpha level of 0.05 was utilized for each of these statistical tests.

An one-way analysis of variance was computed, comparing student achievement on the Grade Eight Statewide Science Assessment and the degree to which a school self-identified with a student-centered pedagogical approach. No significant difference was found ($F(26,5) = 1.12$, $p > .05$), see Table 3. There is no significant difference between the degree to which a school self-identifies with student-centered instructional practices and student achievement on the Grade Eight Statewide Science Assessment.

Table 3

One-Way ANOVA of Student Achievement by Degree of Student-Centered Instruction

Source	*df*	*SS*	*MS*	*F*	*p*
Between Groups	26	11763.833	452.455	1.117	.501
Within Groups	5	2026.167	405.233		
Total	31	13790.00			

To determine the relationship between student performance on the Grade Eight Statewide Science Assessment and the degree to which a school self-identifies with student-centered pedagogical practices, the researcher completed a two-tailed Spearman's *rho* correlation coefficient computation. The results indicated a non-significant positive correlation that was extremely weak (*rho* (30) = .066, *p* > .05) as shown in Table 4 below. There is no identifiable relationship between student achievement on the Grade Eight Statewide Science Assessment and the degree to which a school utilizes student-driven instructional practices.

Table 4

Spearman's rho Correlation Coefficient for Student Achievement and Degree of Student-Centered Instruction

		Achievement	Degree of Student-Centered
Achievement	Correlation Coefficient	1.000	.066
	Sig. (2-tailed)		.719
	N	32	32
Degree of Student-Centered	Correlation Coefficient	.066	1.000
	Sig. (2-tailed)	.719	
	N	32	32

Results for the categorical pedagogy of schools. Student achievement on the Grade Eight Statewide Science Assessment was tested against the category of a school based upon pedagogy, utilizing a two-tailed Spearman's rho correlation coefficient and the one-way Analysis of Variance. Schools exhibiting 60% or higher student-driven practices were categorized as student-centered; those not meeting this threshold were labeled as mixed pedagogies. Within the ANOVA, the dependent variable was student achievement while the independent variable was the category of school (mixed pedagogies or student-centered). The researcher employed an alpha level of 0.05 for these statistical tests.

The researcher executed an one-way ANOVA to compare the category of school-wide pedagogy (student-centered or mixed pedagogies) and student achievement on the Grade Eight Statewide Science Assessment. Results indicated a marginally significant difference between schools fitting the categories of student-centered (*M* = 52.59, *sd* = 22.21) and mixed pedagogical practices (*M* = 60.09, *sd* = 18.99) *p* = .08. Table 5 provides additional details regarding this statistical test.

Table 5

One-Way ANOVA of School-wide Pedagogy Category by Student Achievement

Source	*df*	*SS*	*MS*	*F*	*p*
Between Groups	1	1346.675	1346.675	3.097	.082
Within Groups	95	41306.665	434.807		
Total	96	42653.340			

A two-tailed Spearman's *rho* correlation coefficient was calculated for the relationship between student achievement on the Grade Eight Statewide Science Assessment and the category of school-wide instructional practice (mixed pedagogies or student-centered). A very weak negative correlation was found that was marginally significant (*rho* (95) = -.184, $p > .05$) as seen in Table 6 below. The category of a school, either student-centered or of mixed pedagogical approach, is not related to student performance on the Grade Eight Statewide Science Assessment.

Table 6

Spearman's rho Correlation Coefficient for School-wide Pedagogy Category and Student Achievement

		Achievement	Pedagogy Category
Achievement	Correlation Coefficient	1.000	-.184
	Sig. (2-tailed)		.071
	N	97	97
Pedagogy Category	Correlation Coefficient	-.184	1.000
	Sig. (2-tailed)	.071	
	N	97	97

Results for student-centered instructional practices and student achievement. Individual pedagogical practices identified in the literature as aligning with student-centered instruction were tested against student performance on the Grade Eight Statewide Science Assessment using both the one-way Analysis of Variance and the two-tailed Spearman's *rho* correlation coefficient. Within the ANOVA, the dependent variable was student achievement; the independent variable changed as identified in the subsequent analyses. An alpha level of 0.05 was utilized for each of these statistical tests.

Students work in collaborative groups. The researcher completed an one-way ANOVA to compare the frequency which schools identified utilizing the practice of collaborative grouping and student performance on the Grade Eight Statewide Science Assessment. No significant difference was found (F(3,93) = 1.05, $p > .05$). There is no significant difference between the frequency of students working in collaborative groups within the classroom and student achievement on the Grade Eight Statewide Science Assessment (see Table 7 below).

Table 7

One-Way ANOVA of Student Achievement by Collaborative Grouping

Source	*df*	*SS*	*MS*	*F*	*p*
Between Groups	3	1390.283	463.428	1.054	.373
Within Groups	93	40883.676	439.609		
Total	96	42273.959			

A two-tailed Spearman's *rho* correlation coefficient was executed for the relationship between student achievement on the Grade Eight Statewide Science Assessment and the frequency which schools work in collaborative groups within the classroom. A weak, significant negative correlation was found (*rho* (95) = -.213, $p < .05$). Student achievement on the Grade Eight Statewide Science Assessment decreases with increased frequency to which schools report students working in collaborative groups as depicted in Table 8, found on the subsequent page.

Table 8

Spearman's rho Correlation Coefficient for Student Achievement and Collaborative Grouping

		Achievement	Collaborative Grouping
Achievement	Correlation Coefficient	1.000	-.213*
	Sig. (2-tailed)		.036
	N	97	97
Collaborative Grouping	Correlation Coefficient	-.213*	1.000
	Sig. (2-tailed)	.036	
	N	97	97

**Correlation significant at the 0.05 level (2-tailed).*

Formative assessment drives instruction. An one-way analysis of variance was computed, comparing student achievement on the Grade Eight Statewide Science Assessment and the frequency which schools identified utilizing formative assessment to drive instruction in the classroom. A significant difference was found among the schools ($F(4,92) = 2.94$, $p < .05$). See Table 9 below for additional detail. Post hoc analyses utilizing Tukey's HSD to establish the nature of the contradistinctions among the schools was not significant.

Table 9

One-Way ANOVA of Student Achievement by Formative Assessment

Source	*df*	*SS*	*MS*	*F*	*p*
Between Groups	4	4788.973	1197.243	2.938	.025*
Within Groups	92	34784.986	407.445		
Total	96	42273.959			

**Difference significant at the 0.05 level.*

To determine the relationship between student performance on the Grade Eight Statewide Science Assessment and the frequency which a school uses formative assessment to drive classroom instruction, the researcher completed a two-tailed Spearman's *rho* correlation coefficient computation. The results indicated a significant negative correlation that was weak (*rho* (95) = -.293, $p < .01$) as indicated in Table 10. Student achievement on the Grade Eight Statewide Science Assessment decreases with increased frequency to which a school uses formative assessment to drive instruction.

Table 10

Spearman's rho Correlation Coefficient for Student Achievement and Formative Assessment

		Achievement	Formative Assessment
Achievement	Correlation Coefficient	1.000	-.293**
	Sig. (2-tailed)		.004
	N	97	97
Formative Assessment	Correlation Coefficient	-.293**	1.000
	Sig. (2-tailed)	.004	
	N	97	97

***Correlation significant at the 0.01 level (2-tailed).*

Students develop their own inquiry labs. The researcher employed the one-way ANOVA to compare the frequency which schools identified utilizing the practice of student-created inquiry labs in the classroom and student performance on the Grade Eight Statewide Science Assessment. Results indicated no significant difference ($F(3,93) = .443$, $p > .05$) among schools' student performance and usage of student-created inquiry labs for classroom learning. For results of this one-way analysis of variance, see Table 11 on the following page. Based on the statistical test results, student performance on the Grade Eight Statewide Science Assessment does not significantly differ based upon use of inquiry labs that are developed by the students who use them.

Table 11

One-Way ANOVA of Student Achievement by Inquiry Labs

Source	*df*	*SS*	*MS*	*F*	*p*
Between Groups	3	595.356	198.452	.443	.723
Within Groups	93	41678.603	448.157		
Total	96	42273.959			

A two-tailed Spearman's *rho* correlation coefficient was calculated for the relationship between student achievement on the Grade Eight Statewide Science Assessment and the frequency which schools permit students to develop their own inquiry labs in the classroom. A very weak, non-significant negative correlation was found (*rho* (95) = -.038, $p > .05$) as depicted in Table 12 on the following page.. There is no association between a schools' use of student-created inquiry labs and Grade Eight Statewide Science Assessment student achievement.

Table 12

Spearman's rho Correlation Coefficient for Student Achievement and Inquiry Labs

		Achievement	Inquiry Labs
	Correlation Coefficient	1.000	-.038
Achievement	Sig. (2-tailed)		.714
	N	97	97
	Correlation Coefficient	-.038	1.000
Inquiry Labs	Sig. (2-tailed)	.714	
	N	97	97

Choice is provided for in classroom activities. An one-way analysis of variance was calculated, comparing student achievement on the Grade Eight Statewide Science Assessment and the frequency which schools identified allowing for student choice within classroom tasks. The results showed no significant difference among the schools ($F(4,92) = .732$, $p > .05$), see Table 13 below. The incorporation of student choice in classroom activities does not cause student achievement on the Grade Eight Statewide Science Assessment to significantly differ.

Table 13

One-Way ANOVA of Degree of Student Achievement by Student Choice

Source	*df*	*SS*	*MS*	*F*	*p*
Between Groups	4	1303.286	325.821	.732	.573
Within Groups	92	40970.673	445.333		
Total	96	42273.959			

To determine the relationship between student performance on the Grade Eight Statewide Science Assessment and the frequency which a school provides opportunities for student choice in classroom activities, the researcher completed a two-tailed Spearman's *rho* correlation coefficient computation as shown in Table 14. The results indicated a non-significant positive correlation that was extremely weak (*rho* (95) = .007, *p* > .05). No identifiable relationship exists between student performance on the Grade Eight Statewide Science Assessment and the frequency of student-choice opportunities in the classroom.

Table 14

Spearman's rho Correlation Coefficient for Student Achievement and Student Choice

		Achievement	Student Choice
Achievement	Correlation Coefficient	1.000	.007
	Sig. (2-tailed)		.947
	N	97	97
Student Choice	Correlation Coefficient	.007	1.000
	Sig. (2-tailed)	.947	97
	N	97	97

Teacher acts as facilitator of knowledge. The researcher executed an one-way ANOVA to compare the frequency which schools identified utilizing the practice of the teacher as the facilitator of knowledge within the classroom and student performance on the Grade Eight Statewide Science Assessment. No significant difference was found (F(4,92) = .888, *p* > .05). Table 15 provides additional details regarding this statistical test. There is no significant difference between the frequency of the teacher acting as the facilitator of knowledge in the classroom and student achievement on the Grade Eight Statewide Science Assessment.

Table 15

One-Way ANOVA of Student Achievement by Teacher as Facilitator of Knowledge

Source	*df*	*SS*	*MS*	*F*	*p*
Between Groups	4	1571.231	392.808	.888	.475
Within Groups	92	40702.727	442.421		
Total	96	42273.959			

A two-tailed Spearman's *rho* correlation coefficient was executed for the relationship between student achievement on the Grade Eight Statewide Science Assessment and the frequency which schools identified the teacher as the facilitator of knowledge within the classroom. An extremely weak, non-significant positive correlation was found (*rho* (95) = .007, $p > .05$) as illustrated in Table 16. There is no association between a schools' emphasis on the teacher as the facilitator of knowledge and Grade Eight Statewide Science Assessment student achievement.

Table 16

Spearman's rho Correlation Coefficient for Student Achievement and Teacher as Facilitator of Knowledge

		Achievement	Facilitator
Achievement	Correlation Coefficient	1.000	.007
	Sig. (2-tailed)		.943
	N	97	97
Facilitator	Correlation Coefficient	.007	1.000
	Sig. (2-tailed)	.943	
	N	97	97

Students take part in self-evaluation. An one-way analysis of variance was computed, comparing student achievement on the Grade Eight Statewide Science Assessment and the frequency which schools identified utilizing student self-evaluations in the classroom. A significant difference was not found among the schools (F(4,92) = .379, *p* > .05), see Table 17. The use of student self-evaluations as part of classroom learning does not cause student achievement on the Grade Eight Statewide Science Assessment to differ significantly.

Table 17

One-Way ANOVA of Degree of Student Achievement by Student Self-evaluation

Source	*df*	*SS*	*MS*	*F*	*p*
Between Groups	4	686.144	171.536	.379	.823
Within Groups	92	41587.815	452.041		
Total	96	42273.959			

To determine the relationship between student performance on the Grade Eight Statewide Science Assessment and the frequency which a school has students take part in self-evaluation in the classroom, the researcher completed a two-tailed Spearman's *rho* correlation coefficient computation. The results indicated a non-significant positive correlation that was extremely weak (*rho* (95) = .051, *p* > .05). There is no identifiable relationship between student achievement on the Grade Eight Statewide Science Assessment and the frequency to which a school has students participate in self-evaluation in the classroom (see Table 18).

Table 18

Spearman's rho Correlation Coefficient for Student Achievement and Student Self-evaluation

		Achievement	Self-evaluation
	Correlation Coefficient	1.000	.051
Achievement	Sig. (2-tailed)		.619
	N	97	97
	Correlation Coefficient	.051	1.000
Self-evaluation	Sig. (2-tailed)	.619	
	N	97	97

Emphasis is on process of learning. The researcher completed an one-way ANOVA to compare the frequency which schools identified a classroom emphasis on the process of learning and student performance on the Grade Eight Statewide Science Assessment. No significant difference was found ($F(3,93) = 1.75$, $p > .05$). See Table 19 for additional detail. There is no significant difference between student achievement on the Grade Eight Statewide Science Assessment and the frequency which schools place an emphasis on the process of learning.

Table 19

One-Way ANOVA of Student Achievement by Process of Learning

Source	*df*	*SS*	*MS*	*F*	*p*
Between Groups	3	2257.127	752.376	1.749	.163
Within Groups	93	40016.832	430.289		
Total	96	42273.959			

A two-tailed Spearman's *rho* correlation coefficient was calculated for the relationship between student achievement on the Grade Eight Statewide Science Assessment and the frequency which schools identified emphasizing process of learning in the classroom. A very weak, non-significant negative correlation was found (*rho* (95) = -.122, *p* > .05) as illustrated in Table 20. There is no association between a schools' emphasis on the process of learning and Grade Eight Statewide Science Assessment student achievement.

Table 20

Spearman's rho Correlation Coefficient for Student Achievement and Process of Learning

		Achievement	Process of Learning
Achievement	Correlation Coefficient	1.000	-.122
	Sig. (2-tailed)		.233
	N	97	97
Process of Learning	Correlation Coefficient	-.122	1.000
	Sig. (2-tailed)	.233	
	N	97	97

Results for teacher-centered instructional practices and student achievement. Student achievement on the Grade Eight Statewide Science Assessment was tested against those instructional practices characterized as teacher-centered pedagogy within the literature, utilizing a two-tailed Spearman's rho correlation coefficient and the one-way Analysis of Variance. Within the ANOVA, the dependent variable was student achievement; the independent variable changed as identified in the subsequent analyses. The researcher employed an alpha level of 0.05 for these statistical tests.

Whole-class teacher demonstration. An one-way Analysis of Variance was computed, comparing student achievement on the Grade Eight Statewide Science Assessment and the frequency which schools identified utilizing the practice of whole-class teacher demonstration in the classroom. A significant difference was found among the schools (F(3,93) = 3.53, $p < .05$), see Table 21. Post hoc analyses were not able to be performed as one group ("Weekly," $n = 1$) had fewer than two cases.

Table 21

One-Way ANOVA of Student Achievement by Teacher Demonstration

Source	*df*	*SS*	*MS*	*F*	*p*
Between Groups	3	4318.318	1439.439	3.527	.018*
Within Groups	93	37955.641	408.125		
Total	96	42273.959			

**Difference significant at the 0.05 level.*

A two-tailed Spearman's *rho* correlation coefficient was executed for the relationship between student achievement on the Grade Eight Statewide Science Assessment and the frequency which schools identified using whole-class teacher demonstrations within the classroom. An extremely weak, non-significant positive correlation was found (*rho* (95) = .035, $p > .05$). There is no association between a schools' use of whole-class teacher demonstrations and Grade Eight Statewide Science Assessment student achievement as depicted in Table 22.

Table 22

Spearman's rho Correlation Coefficient for Student Achievement and Teacher Demonstration

		Achievement	Teacher Demonstration
Achievement	Correlation Coefficient	1.000	.035
	Sig. (2-tailed)		.733
	N	97	97
Teacher Demonstration	Correlation Coefficient	.035	1.000
	Sig. (2-tailed)	.733	
	N	97	97

Teacher delivers content in the form of notes. The researcher executed an one-way ANOVA to compare the frequency which schools identified utilizing the practice of content delivered to students in the form of notes and student performance on the Grade Eight Statewide Science Assessment. No significant difference was found ($F(4,92) = 1.48$, $p > .05$). There is no significant difference between the frequency of providing content in the form of notes and student achievement on the Grade Eight Statewide Science Assessment. Table 23 provides additional details regarding this statistical test.

Table 23

One-Way ANOVA of Student Achievement by Content Delivered as Notes

Source	*df*	*SS*	*MS*	*F*	*p*
Between Groups	4	2555.168	638.792	1.480	.215
Within Groups	92	39718.791	431.726		
Total	96	42273.959			

To determine the relationship between student performance on the Grade Eight Statewide Science Assessment and the frequency which a school practices content delivery in the form of notes, the researcher completed a two-tailed Spearman's *rho* correlation coefficient computation. The results indicated a marginally significant positive correlation that was extremely weak (*rho* (95) = .199, p = .05). See Table 24 for additional detail.

Table 24

Spearman's rho Correlation Coefficient for Student Achievement and Content Delivered as Notes

		Achievement	Notes
	Correlation Coefficient	1.000	.199
Achievement	Sig. (2-tailed)		.050
	N	97	97
	Correlation Coefficient	.199	1.000
Notes	Sig. (2-tailed)	.050	
	N	97	97

Teacher acts as giver of knowledge. An one-way analysis of variance was calculated, comparing student achievement on the Grade Eight Statewide Science Assessment and the frequency which schools identified utilizing the practice of the teacher as the giver of knowledge. The results showed no significant difference ($F(3,93) = 1.36$, $p > .05$). There is no significant difference between student performance on the Grade Eight Statewide Science Assessment and the frequency to which schools that defer to the teacher as the giver of knowledge (see Table 25).

Table 25

One-Way ANOVA of Student Achievement by Teacher as Giver of Knowledge

Source	*df*	*SS*	*MS*	*F*	*p*
Between Groups	3	1782.113	594.038	1.364	.259
Within Groups	93	40491.846	435.396		
Total	96	42273.959			

A two-tailed Spearman's *rho* correlation coefficient was executed for the relationship between student achievement on the Grade Eight Statewide Science Assessment and the frequency which schools identified the teacher as the giver of knowledge within the classroom. An extremely weak, non-significant positive correlation was found (*rho* (95) = .045, *p* > .05) as shown in Table 26. There is no association between a schools' emphasis on the teacher as the giver of knowledge and Grade Eight Statewide Science Assessment student achievement.

Table 26

Spearman's rho Correlation Coefficient for Student Achievement and Teacher as Giver of Knowledge

		Achievement	Giver
Achievement	Correlation Coefficient	1.000	.045
	Sig. (2-tailed)		.665
	N	97	97
Giver	Correlation Coefficient	.045	1.000
	Sig. (2-tailed)	.665	
	N	97	97

Students complete pre-developed hands-on activities. The researcher employed the one-way ANOVA to compare the frequency which schools identified utilizing the practice of pre-developed hands-on activities in the classroom and student performance on the Grade Eight Statewide Science Assessment. Results indicated no significant difference ($F(4,92) = 2.01$, $p = .10$) among schools' student performance and usage of pre-developed hands-on activities for student learning. Table 27 provides additional detail.

Table 27

One-Way ANOVA of Student Achievement by Pre-developed Hands-On Activities

Source	*df*	*SS*	*MS*	*F*	*p*
Between Groups	4	3393.919	848.480	2.008	.100
Within Groups	92	38880.040	422.609		
Total	96	42273.959			

To determine the relationship between student performance on the Grade Eight Statewide Science Assessment and the frequency which a school utilizes pre-developed hands-on activities in the classroom, the researcher completed a two-tailed Spearman's *rho* correlation coefficient computation. The results indicated a non-significant positive correlation that was extremely weak (*rho* (95) = .054, $p > .05$). As illustrated in Table 28 below, there is no identifiable relationship between student achievement on the Grade Eight Statewide Science Assessment and the frequency to which a school utilizes pre-developed hands-on activities in the classroom.

Table 28

Spearman's rho Correlation Coefficient for Student Achievement and Pre-developed, Hands-on Activities

		Achievement	Pre-developed Activities
Achievement	Correlation Coefficient	1.000	.054
	Sig. (2-tailed)		.602
	N	97	97
Pre-developed Activities	Correlation Coefficient	.054	1.000
	Sig. (2-tailed)	.602	
	N	97	97

Emphasis is on product of learning. An one-way analysis of variance was computed, comparing student achievement on the Grade Eight Statewide Science Assessment and the frequency which schools identified classroom emphasis on the product of learning. No significant difference was found ($F(4,92) = .99$, $p > .05$). Table 29 provides additional details regarding this statistical test. There is no significant difference among schools' student achievement and their indication that the classroom emphasis is on the product of learning.

Table 29

One-Way ANOVA of Student Achievement by Product of Learning

Source	*df*	*SS*	*MS*	*F*	*p*
Between Groups	4	1736.142	434.036	.985	.420
Within Groups	92	40537.816	440.628		
Total	96	42273.959			

A two-tailed Spearman's *rho* correlation coefficient was calculated for the relationship between student achievement on the Grade Eight Statewide Science Assessment and the frequency which schools identified emphasizing product of learning in the classroom. A very weak, non-significant positive correlation was found (*rho* (95) = .142, *p* > .05). There is no association between a schools' emphasis on the product of learning and Grade Eight Statewide Science Assessment student achievement. See Table 30 below.

Table 30

Spearman's rho Correlation Coefficient for Student Achievement and Product of Learning

		Achievement	Product of Learning
Achievement	Correlation Coefficient	1.000	.142
	Sig. (2-tailed)		.164
	N	97	97
Product of Learning	Correlation Coefficient	.142	1.000
	Sig. (2-tailed)	.164	
	N	97	97

Results for Research Question Two

The focus of research question two was looking at relationships that could be determined based upon school characteristics and predominant pedagogy. Research question two asked, "What school characteristics (i.e. demographics, average years of teacher experience, etcetera) are associated with a predominance of student-driven pedagogy or mixed pedagogies?" The results for research question two are broken into categories and detailed below.

Results for the degree to which schools self-identify as student-centered. The degree to which schools self-identified as student-centered were tested against specified school demographic characteristics (years of teaching experience, years teaching science at the current school, Title I/non-Title I), utilizing the two-tailed Spearman's *rho* correlation coefficient, to determine if an association exists. An alpha level of 0.05 was utilized for these statistical tests.

Years of teaching experience. To determine the relationship between the number of years of teaching experience of the educators and the degree to which a school self-identifies with student-centered pedagogical practices, the researcher completed a two-tailed Spearman's *rho* correlation coefficient computation. The results indicated a non-significant positive correlation that was extremely weak (*rho* (95) = .010, *p* > .05). As shown in Table 31 below, there is no identifiable relationship between years of teaching experience an educator possesses and the degree to which a school utilizes student-driven instructional practices.

Table 31

Spearman's rho Correlation Coefficient for Degree of Student-Centered Instruction and Years of Teaching Experience

		Degree of Student-Centered	Years Experience
Degree of Student-Centered	Correlation Coefficient	1.000	.010
	Sig. (2-tailed)		.925
	N	97	97
Years Experience	Correlation Coefficient	.010	1.000
	Sig. (2-tailed)	.925	
	N	97	97

Years teaching science at current school. A two-tailed Spearman's *rho* correlation coefficient was calculated for the relationship between the degree to which a school self-identifies with student-centered pedagogical practices and the number of years an educator has been teaching science at the current school. A very weak, non-significant negative correlation was found (*rho* (95) = -.093, *p* > .05), see Table 32. There is no association between the degree to which a school utilizes student-driven instructional practices and the number of years an educator has been teaching science at the current school.

Table 32

Spearman's rho Correlation Coefficient for Degree of Student-Centered Instruction and Years at Current School

		Degree of Student-Centered	Years at Current School
Degree of Student-Centered	Correlation Coefficient	1.000	-.093
	Sig. (2-tailed)		.363
	N	97	97
Years at Current School	Correlation Coefficient	-.093	1.000
	Sig. (2-tailed)	.363	
	N	97	97

Current school is Title I. To determine the relationship between the socioeconomic status of the school (Title I or non-Title I) and the degree to which a school utilizes student-driven instructional practices, the researcher performed a two-tailed Spearman's *rho* correlation coefficient computation. The results indicated a non-significant, negative correlation that was weak (*rho* (95) = -.148, *p* > .05). There is no evident relationship between the degree to which a school self-identifies with student-centered pedagogical practices and the socioeconomic status of the school, with respect to Title I (see Table 33).

Table 33

Spearman's rho Correlation Coefficient for Degree of Student-Centered Instruction and School Socioeconomic Status (Title I or non-Title I)

		Degree of Student-Centered	Socioeconomic Status
Degree of Student-Centered	Correlation Coefficient	1.000	-.148
	Sig. (2-tailed)		.149
	N	97	97
Socioeconomic Status	Correlation Coefficient	-.148	1.000
	Sig. (2-tailed)	.149	
	N	97	97

Results for the categorical pedagogy of schools. Specified school demographic characteristics (years of educator experience, years teaching at the current school, Title I/non-Title I) were tested against the category of a school based upon pedagogy, using both the one-way Analysis of Variance and the two-tailed Spearman's *rho* correlation coefficient. Schools exhibiting 60% or higher student-driven practices were categorized as student-centered; those not meeting this threshold were labeled as mixed pedagogies. Within the ANOVA, the dependent variable was the category of school (mixed pedagogies or student-centered) while the independent variable was the characteristic. The researcher employed an alpha level of 0.05 for these statistical tests.

Years of teaching experience. An one-way Analysis of Variance was computed, comparing the category of a school (mixed pedagogies or student-centered) and the number of years of teaching experience of the educators. No significant difference was found among the schools (F(3,93) = .980, $p > .05$), see Table 34. The number of years of educators' teaching experience does not result in the category of a school, identified as either student-centered or mixed pedagogies, to differ significantly.

Table 34

One-Way ANOVA of School-wide Pedagogy Category by Years of Teaching Experience

Source	*df*	*SS*	*MS*	*F*	*p*
Between Groups	3	.733	.244	.980	.406
Within Groups	93	23.205	.250		
Total	96	23.938			

A two-tailed Spearman's *rho* correlation coefficient was executed for the relationship between the number of years of educators' teaching experience and category of a school as either mixed pedagogies or student-centered. An extremely weak, non-significant negative correlation was found (*rho* (95) = -.024, $p > .05$). There is no association between a school's label as student-centered or mixed pedagogies and the number of years of teaching experience of the educators as is indicated in Table 35, located on the subsequent page.

Table 35

Spearman's rho Correlation Coefficient for School-wide Pedagogy Category and Years of Teaching Experience

		Pedagogy Category	Years Experience
Pedagogy Category	Correlation Coefficient	1.000	-.024
	Sig. (2-tailed)		.819
	N	97	97
Years Experience	Correlation Coefficient	-.024	1.000
	Sig. (2-tailed)	.819	
	N	97	97

Years teaching science at current school. The researcher employed the one-way ANOVA to compare the number of years teaching science at the current school and the label of the school (student-centered or mixed pedagogies). Results indicated no significant difference ($F(3,93) = .786$, $p > .05$) among schools' labels and the number of years teaching science at the current school. The category of school as either mixed pedagogies or student-centered does not significantly differ based upon the number of years an educator has been teaching science at the current school. Table 36 provides additional details regarding this statistical test.

Table 36

One-Way ANOVA of School-wide Pedagogy Category by Years at Current School

Source	*df*	*SS*	*MS*	*F*	*p*
Between Groups	3	.579	.193	.768	.515
Within Groups	93	23.359	.251		
Total	96	23.938			

To determine the association between the category—mixed pedagogies or student-centered—of a school and the number of years teaching science at the current school, the researcher completed a two-tailed Spearman's *rho* correlation coefficient computation. The results indicated a non-significant, negative correlation that was every weak (*rho* (95) = -.130, $p > .05$), as seen in Table 37 below. There is no identifiable relationship between the category of a school as student-centered or mixed pedagogies and the number of years teaching science at the current school.

Table 37

Spearman's rho Correlation Coefficient for School-wide Pedagogy Category and Years at Current School

		Pedagogy Category	Years at Current School
Pedagogy Category	Correlation Coefficient	1.000	-.130
	Sig. (2-tailed)		.204
	N	97	97
Years at Current School	Correlation Coefficient	-.130	1.000
	Sig. (2-tailed)	.204	
	N	97	97

Current school is Title I. An one-way Analysis of Variance was computed, comparing the socioeconomic status of schools (Title I or non-Title I) and their corresponding labels as either student-centered or mixed pedagogies. A significant difference was found among the schools ($F(1,95) = 5.89$, $p < .05$). Post hoc analyses were not able to be performed as there were fewer than three groups (Title I and non-Title I), see Table 38.

Table 38

One-Way ANOVA of School-wide Pedagogy Category by Socioeconomic Status (Title I or non-Title I)

Source	*df*	*SS*	*MS*	*F*	*p*
Between Groups	1	1.398	1.398	5.891	.017*
Within Groups	95	22.540	.237		
Total	96	23.938			

**Difference significant at the 0.05 level.*

A two-tailed Spearman's *rho* correlation coefficient was calculated for the category of schools (mixed pedagogies or student-centered) and the socioeconomic status of schools with regard to Title I. A weak, significant negative correlation was found (*rho* (95) = -.242, $p < .05$). Schools which are categorized as student-centered are more likely to be Title I, and those schools labeled as mixed pedagogies are more likely to be non-Title I, as shown in Table 39.

Table 39

Spearman's rho Correlation Coefficient for School-wide Pedagogy Category and Socioeconomic Status (Title I or non-Title I)

		Pedagogy Category	Socioeconomic Status
Pedagogy Category	Correlation Coefficient	1.000	-.242*
	Sig. (2-tailed)		.017
	N	97	97
Socioeconomic Status	Correlation Coefficient	-.242*	1.000
	Sig. (2-tailed)	.017	
	N	97	97

**Correlation significant at the 0.05 level (2-tailed).*

Results for Hypotheses

The primary interest of this study was to establish if an association between the predominant pedagogy of middle schools in a large, urban district in South Florida and achievement of students on the Grade Eight Statewide Science Assessment can be demonstrated. The hypotheses were as follows:

H_1: Schools with a greater tendency toward student-driven instruction will demonstrate higher student achievement on the Grade Eight Statewide Science Assessment.

H_0: No significant difference in student achievement on the Grade Eight Statewide Science Assessment will exist between schools with differing predominant pedagogies.

The results of this study indicate that the null hypothesis (H_0) be accepted, as no significant difference has been established providing evidence that schools with a greater tendency toward student-centered pedagogy do not result in increased student performance on the Grade Eight Statewide Science Assessment, while the alternative hypothesis (H_1) failed to be supported by the data analyses and results discussed above.

Summary of Results

Within the study outcomes, the majority of findings were not statistically significant. However, using an alpha value of 0.05, there were statistically significant results among groups with respect to the following pedagogical practices: whole-class teacher demonstrations, formative assessment, collaborative grouping, and socioeconomic status with regards to Title I. In addition, there were results which approached significance and/or appeared to be marginally significant. All of these findings, coupled with references to literature, will be explored and discussed in detail in the subsequent chapter.

CHAPTER V

DISCUSSION, CONCLUSIONS & RECOMMENDATIONS

Introduction

This chapter will attempt to interpret and rationalize the study results presented in the previous chapter, beginning with a brief synopsis of the study findings. The text will then proceed to discuss these results in depth, followed by an examination of the study's limitations and delimitations. The researcher will then explicate the implications for practice, succeeded by recommendations for future research in this realm. The chapter will conclude with an encapsulation of this dissertation in practice.

Summary of Results

The researcher utilized the Statistical Package for Social Science to execute the one-way Analysis of Variance, Post Hoc criterion and two-tailed Spearman's *rho* correlation coefficient to determine statistical significance with respect to differences between groups and relationships between variables. An alpha level of 0.05 was used for all of these statistical tests. Results for research question one, "In a large, urban school district, is one predominant modality of grades six through eight science teachers, mixed pedagogies versus student-driven pedagogy, correlated with higher student achievement than the other?", had several significant results. Significant differences were identified with regard to student achievement on the Grade Eight Statewide Science Assessment and whole-class teacher demonstrations, students working in collaborative groups, and formative assessment use in the classroom. Findings of marginal significance were noted for student achievement on the Grade Eight Statewide Science Assessment and content delivery in the form of notes as well as for school-wide category of pedagogy (mixed pedagogies or student-centered) and student achievement on the Grade Eight Statewide Science Assessment. Results for research question two, "What school characteristics (i.e. demographics, average years of teacher experience, etcetera) are associated with a predominance of student-driven pedagogy or mixed pedagogies?", were primarily non-significant in nature with the exception of one aspect. Findings were significant with respect to the school-wide category of pedagogy (student-centered versus mixed pedagogies) and the school's socioeconomic status (Title I or non-Title I). There were no results of marginal significance for research question two. Results from both research questions will be carefully examined and expounded upon in the subsequent pages of this chapter.

Discussion of Results

Findings from this study regarding student achievement, pedagogy and school characteristics varied greatly among the tests and variables. This section of the text is segmented into three distinct sections. First, the researcher will interpret findings that were statistically significant or approaching significance, followed by an examination of those results which were not statistically significant. The discussion subdivision will conclude with consideration of other factors which are related to or may have affected the findings. When reviewing the findings below, it is important for the reader to be mindful that the results below may be correlational but are certainly not causational, nor does the researcher claim for this to be true.

Findings that were statistically significant or approaching significance. For research question one, there were four results of statistical significance. The one-way Analysis of Variance, comparing student achievement on the Grade Eight Statewide Science Assessment (as the dependent variable) and the pedagogical practice of whole-class teacher demonstration (as the independent variable) resulted in a significant difference between the groups at the .018 level. These findings demonstrate that students attending schools that consistently utilize whole-class teacher demonstrations perform significantly differently on the Grade Eight Statewide Science Assessment than students attending schools whose frequency of whole-class teacher demonstrations are less. Because the two-tailed Spearman's *rho* correlation coefficient test resulted in very weak, non-significant results, a relationship between the variables cannot be determined. However, with further study and based on the research of Odom and Bell (2015) and Su (2014), it is probable that a negative correlation may be discovered. A second one-way Analysis of Variance which proved to have significant findings is that of student achievement on the Grade Eight Statewide Science Assessment (dependent variable) as compared to the use of formative assessment to drive classroom instruction (independent variable). Students perform significantly differently on the Grade Eight Statewide Science Assessment when exposed to the regular use of formative assessment as a part of classroom instruction as opposed to students that are not. Interestingly, modern leading educational researchers such as Robert Marzano espouse the importance of daily formative assessment and yet this study's two-tailed Spearman's *rho* correlation coefficient on the topic of formative assessment indicates that there is a statistically significant negative association between the two, albeit extremely weak. It has been this researcher's experience that many classrooms employing formative assessment tend to rely upon questioning that is at the lower end of Webb's (2007) Depth of Knowledge, thus not preparing students for the rigor of the Grade Eight Statewide Science Assessment, which is comprised of between 60% and 80% questions of moderate complexity and between 10% and 20% questions of high complexity. Deductive reasoning can thereby allow us to conclude that it is logical for students exposed regularly to low-level questioning to perform poorly on the Grade Eight Statewide Science Assessment. The final statistically significant result for research question one is the correlation between the use of collaborative grouping in the classroom and student success on the Grade Eight Statewide Science Assessment. The two-tailed Spearman's *rho* correlation coefficient revealed that there is a significant, very weak negative relationship between these two variables. Although recent literature encourages grouping of students for collaborative work, cogent reasoning may also suggest that when faced with the struggle of an individual, high-stakes standardized assessment, students may fare better on having been able to reason through problems on their own merit.

With regard to research question two, there were two statistically significant results, both of which are related to the same construct. The one-way Analysis of Variance, comparing the school-wide category of pedagogy, mixed pedagogies or student-centered, (as the dependent variable) and the school characteristic of socioeconomic status, Title I or non-Title I, (as the independent variable) resulted in a significant difference between the groups at the .017 level. These findings were solidified by the significant, albeit weak, negative correlation between these two variables, thus it can be stated that schools which are categorized as student-centered are more likely to be Title I, and those schools labeled as mixed pedagogies are more likely to be non-Title I. This is predictably related to student engagement, which researchers Wu and Huang (2007) show is a determining factor of the student-centered classroom. This concept builds upon the work of Lareau (2011) in that classrooms of lower socioeconomic status must be equipped with a wider variety of strategies to garner student engagement, in contrast with classrooms of higher socioeconomic status, in which there is a greater degree of compliance.

In the study findings, there were three results that were approaching significance, with alpha levels less than 0.10. When comparing student achievement on the Grade Eight Statewide Science Assessment to the instructional practice of delivering content in the form of notes, the two-tailed Spearman's *rho* correlation coefficient indicated these variables to have a marginally significant, extremely weak positive correlation. Both the one-way Analysis of Variance and the two-tailed Spearman's *rho* correlation coefficient pointed to a possible relationship between the school-wide category of pedagogy, student-centered or mixed pedagogies, and student achievement on the Grade Eight Statewide Science Assessment. Although no definitive statements may be made regarding the above findings, it can be noted that these results seem to trend in the direction of and approximate, but do not reach, statistical significance.

Results that were not statistically significant. Although many of the results of this study proved to be non-significant, this leaves several avenues to be explored with regard to the reasoning for the lack of findings. First, the implementation of this study was operated under the presumption that student achievement on the Grade Eight Statewide Science Assessment is actually influenced by the pedagogical method the student experiences within the science classroom in grades six, seven and eight. Based on the data collected and the findings of this research, this assumption may not be supported. However, this is contrary to a great deal of research, which indicates that student performance is directly affected by classroom learning experiences (Odom & Bell, 2015; Su, 2014; Wyss, et al., 2013). The subsequent paragraphs supply an in-depth view as to why these results may have turned out as they did.

In order for students to be successful in upper grades, foundational knowledge is a must. Romance and Vitale (2001) report that success in science curriculum in grades three through eight is most dependent upon success in grade one science. Building on this concept, the lack of essential foundational knowledge in earlier grades, particularly in kindergarten through grade four, where science is not assessed by a state test in Florida may be hindering student performance in the middle school years. Thus, in the classrooms of those teachers who consistently implement student-driven instructional practices, students may be ill-equipped to be successful to construct mastery of concepts due to a lack of a firm foundational building block and consequently constraining student achievement on the Grade Eight Statewide Science Assessment.

Similarly, the schools that received higher marks on the Grade Eight Statewide Science Assessment were more likely, though not significantly, to be less student-centered and non-Title I schools and thus be comprised of students of a generally higher socioeconomic status. Lareau's (2011) extensive anthropological work in this area demonstrated that students of higher socioeconomic status were generally afforded better opportunities, both in and out of the school system, and possessed stronger background knowledge for core content. It can be logically deduced, then, that students fitting these characteristics are more likely to achieve higher on assessments such as the Grade Eight Statewide Science Assessment, regardless of the pedagogical approach. Moreover, additional research may even indicate that students within these confines may fair even better with consistent, student-centered instructional learning experiences.

A second aspect to consider is the results of the survey instrument itself. In reviewing the frequency distribution histograms, see Appendices B and C, there is a lack of normal distribution in the quantities of results and, by way of illustration, a large standard deviation (over one on a five-point scale) among the responses in some cases, which may have been within the same school. It is possible that the larger standard deviations indicate experimental error in the technique or data set. Also, the survey instrument demographic question referring to how many years the participant has been teaching science at the current school did not take into account the fact that the subject district has a mandated time frame for new teachers. When entering this district as a teacher, regardless of years of experience elsewhere, teachers are contractually obligated to remain at their assigned school for a minimum of three years before a transfer will be considered.

Other notables for consideration. Outside of the specified research questions, the researcher came across several unexpected trends in the data and diverting pieces of information. To begin with, similar response intervals were provided by participants with regard to essentially opposite instructional practices (see Appendices B and C for the graphical representations of these frequencies). For example, when viewing the response interval histograms for "Teacher Acts as Giver of Knowledge" and "Teacher Acts as Facilitator of Knowledge," the mean response scores were 4.24 (*sd* = .788) and 4.55 (*sd* = .791), respectively. This indicates that the majority of participants selected "Weekly" or "Daily" when communicating the frequency to which each of these instructional practices occur in their particular classrooms. When consulting the current literature, however, the practice of the teacher as the authority on the content—the giver of knowledge—aligns with teacher-led instruction whereas the teacher as facilitator of knowledge, who assists the student in the journey to mastery, is considered to be a characteristic of the student-driven classroom (McNulty & Quaglia, 2007; Odom & Bell, 2015; Turner, 2011; Wu & Huang, 2007). The close proximity of the responses for these contrasting pedagogical approaches, then, may illustrate some confusion on the part of the study participants in that they are misinterpreting the role of the teacher as the facilitator versus the giver of knowledge in the classroom.

A small number of the study participants were also unclear as to their school's socioeconomic status and whether their school was labeled as a Title I or not. Four of the participating teachers (4.1%) answered this question on the survey instrument as either "Unsure" (three responses) or incorrectly (one response), based upon the Title I school list provided on the subject district's website. This discrepancy, however small, is important to note. It would generally be expected of school-based personnel to be familiar with the culture of their school in order to form effective relationships, which includes socioeconomic status (McNulty & Quaglia, 2007). With this vital piece of knowledge absent from the teacher's cognition, it serves to make one wonder as to what other expected understanding is lacking for these educators. Case in point, a major assumption at the start of this study included the conviction that middle school science educators in this large, urban district have been teaching the curriculum with fidelity, as required by the state course descriptions, inclusive of addressing the content as laid out in the state Item Specifications document, which implies how the curriculum will be assessed on the Grade Eight Statewide Science Assessment. If this assumption is in fact flawed, it could reasonably be expected that student performance on the Grade Eight Statewide Science Assessment will be proportionally faulty, consequently distorting the student achievement results.

Another assumption which may have proven, however inadvertently, to be erroneous is that of the study participants' answering the survey instrument questions honestly and accurately. To be clear, the researcher is not accusing the teachers of purposely providing fraudulent responses, rather of following the social construct of wishing to provide the "right" answer as so many have been psychologically conditioned (Bruner, 1960). This desire is possible reasoning as to why the results turned out as they did, in that a large number of respondents likely had some prior relationship with the researcher, leading to implicit bias based on what sound instructional practices the researcher may have shared with them in interactions which were related to the researcher's role as an instructional specialist and took place previous to the study implementation. These instances may be mitigated by doing outside research or having an outside auditor, as noted in the forthcoming *Recommendations for Future Research* subdivision of the text.

Limitations and Delimitations of the Study

As with any research which involves human participants, there are limitations to this study. To begin with, the researcher was dependent upon the subject district's public records manager to access the correct email addresses for all middle school science teachers within the district, a limitation which was not foreseen prior to the start of the study. This turned out to be a true limitation as the researcher was provided email addresses for all teachers with job codes for middle school science as well as middle school social science, that is, social studies, which had to be sorted and removed prior to sending the survey request email. In addition, the public records manager failed to provide email addresses for two of the requested schools and for several teachers within the remaining 32 schools, thus the researcher had to seek these out separately. Hence, it is possible that the researcher was missing other teacher email addresses, inadvertently narrowing the sample size.

Similarly, a second limitation to be considered is sample size with regard to response rate. The email including the survey request was sent to 331 teachers, 97 of which responded to the survey, a 29.7% response rate. The school response rate was healthier, as 32 of the 34 (94%) requested schools participated in the survey. However, only one middle school had a 100% response rate of teachers receiving the request to teachers participating in the study, while 15 schools had a response rate of just 30% or more, and five schools garnered participation from a single educator. As a result, the data may not have proven to be an accurate picture of pedagogy at each of these schools.

The study participants themselves may also be considered a limitation. To begin with, assumptions for this study included a trust that the participating teachers would answer accurately and honestly, which is not guaranteed. Also, the study participants' comfort level and knowledge of the science content, labeled as confounding variables, may affect student achievement on the Grade Eight Statewide Science Assessment. Additional confounding variables include the students whose assessment results comprise each school's data. Students that sat for the Grade Eight Statewide Science Assessment may not have performed well due to lack of sleep or food, or emotional instability. Conversely, students may have performed well based on personal motivation or increased foundational knowledge and prior experiences that are a result of extracurricular exposure.

The final limitation to be considered is the generalizability of findings of the study. Although the findings can be generalized to the Urban Seven districts in Florida, each of which is comparable to the others with regard to demographic and characteristic consistency, widespread application of the results is not likely. Within the state of Florida, the remaining 60 districts vary greatly from the Urban Seven in population and traits. Outside of Florida, which utilizes the Next Generation Sunshine State Standards for Science as the content basis for instruction in K-12 science courses, most other states have adopted a new science curriculum, the Next Generation Science Standards, which are not commensurate with the Florida standards.

With respect to delimitations, there were not any expected prior to the implementation of the study as the researcher did not incorporate specific boundaries regarding who may or may not respond within the sample size, so long as the participants were teaching middle school science in the subject district and were not from the designated research prohibited school. However, post-implementation of the study has led the researcher to reflect upon the following two delimitations. The first is the survey instrument itself (viewable in its entirety in Appendix A), as it had not previously been piloted and was created by the researcher specifically for use in this study, thus the reliability of the results may be questionable. Furthermore, the grouping of the years of teaching experience and years teaching at the current school (0-3 years, 4-10 years, 10-20 years, 20 or more years) may have inadvertently left valuable data undiscovered. Additionally, within the email survey request, the researcher indicated the time commitment to participate was between ten and 15 minutes, yet study participants reported a length of time closer to five minutes to complete the survey instrument. As a result, the researcher may have deterred possible participants by erring on the side of caution when inflating the possible length of time to participate in the study.

Implications for Practice

In today's educational system of student performance as a metric for accountability, it serves all stakeholders to better understand the instructional methods which lead to higher student achievement. This study contains a small piece of the pedagogy puzzle, which can be further researched, as noted in the following subdivision of this text.

The trend which was most evident throughout all aspects of the study findings is that of educator misinterpretation, which clearly indicates an increased need for higher quality teacher preparation programs and professional development. The results of the study point to teachers misunderstanding the cultural setting of their school, confusing the actions of facilitating versus providing knowledge, the effective use of formative assessment and grouping strategies and other pedagogical actions which distinguish student-driven and teacher-centered instructional methods. This may be compounded by the "classic" teaching to which many were exposed as students themselves (Odom & Bell, 2015). Accordingly, it can be inferred that teachers may also misunderstand the evidence-based approach to student-centered instruction and thus are not implementing such instructional strategies with the fidelity required to obtain positive results. This information can and should be used to inform suppliers of professional development as well as instructors of new and pre-service educators. To gain success, it is vital that these practices be targeted beyond the "newbie" teacher, instead reaching out to all educators, particularly in light of the teacher shortages nationwide, which have forced districts to accept classroom teachers with little or no training and experience.

Further, these training and professional development opportunities must model and build upon the bodies of existing literature, demonstrating for participants the ways in which pedagogy has evolved over time. Teachers as students must practice and master concepts in the student think, student work quadrants of learning to raise their comprehension of rigor and engage with content at a cognitively complex level (McNulty & Quaglia, 2007; Webb, 2007). While doing so, these teacher-students are active learners, constructing understanding through the manipulation of transdisciplinary connections (Bruner, 1960). It is vital that these practices are occurring in our K-12 schools, at the collegiate level and beyond to achieve the success for which we striving.

Recommendations for Future Research

Within the realm of pedagogical practices in science education and their effects on student achievement there is still a great deal to learn. To that end, the researcher proposes several options for future research in this area. Building upon this study, it is recommended that the survey instrument be piloted by an unbiased researcher who has no prior relationship with the study participants and is able to follow the survey implementation with site-based observational visits, qualitative in nature, similar to the suggestion for future research put forth by Su (2014). This would serve to assist in confirming the reliability of the survey instrument. Wyss, et al. (2013) recommended that studies be performed to examine the long-term effects of student-centered instructional practices on student achievement as compared to that of teacher-centered pedagogy. To some degree, this study attempted to address this as it incorporated the pedagogy in regards to an assessment of three years of content, but could be improved upon with a true longitudinal study. A third recommendation would be to replicate this study within other school districts of Florida's Urban Seven to verify or dispute the results of this study. In a similar manner, valuable information may be garnered from repeating this study utilizing the Grade Five Statewide Science Assessment, which is similar to the Grade Eight Statewide Science Assessment in that it assesses three years of content (from grades three, four and five) at the end of the fifth-grade year. The findings from a study such as this may be more exacting should participants be selected from schools whose educators "loop" with the students, meaning that the students have the same teacher as they move upwards in grade levels. Finally, a most intriguing suggestion for future research would involve expanding this study to students of the same curricular level (grade eight) that sit for a standardized state science assessment similar to that of Florida in content.

Summary

The primary purpose of this study was to determine if a correlation exists between pedagogical practices in middle school science classrooms and student achievement on the Grade Eight Statewide Science Assessment. Student achievement in science within the State of Florida is lacking, and could greatly benefit from this information. From a broader viewpoint, science is moving to the forefront of our global economy, which only increases the need for an understanding of effective pedagogy and science education (Vilorio, 2014). Non-significant results withstanding, the catalyst is pedagogy; time to move achievement upwards.

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Approval from Subject School District

February 27, 2018

Ms. Brittany E. Kiser
[redacted]

Dear Ms. Kiser:

The Superintendent's Research Review Committee has approved your request to conduct research entitled, " An Examination of Pedagogy in Middle School Science Classrooms and Its Effect on Student Achievement", in the School District of Palm Beach County (the District). According to documentation submitted, the purpose of this study is to establish if there is a positive correlation between instructional method (specifically student-driven versus teacher-centered) in the public middle schools of a large urban school district and student achievement in the Grade Eight Statewide Science Assessment.

This research is approved and limited to the study, scope, and methods outlined in the proposal. The study will utilize information gathered through an online survey to teachers.

Before research study can commence, provide the official copy of your IRB approval. IRB is usually presented on school's letterhead.

As this study is conducted, please be governed by the following guidelines and policies as outlined in District's Policy 2.142:

- Section 4 – General Provisions, Item C – *No Right to Access*: There is no right to access district students, staff or data related thereto for research purposes. Researcher may only access schools, students, staff, and data relevant to the research as approved by the Department of Research and Evaluation.

- Section 7 – Document, Character, and Other Requirements, Item F – *Data Requests:* Researchers may not request data directly from schools or departments. All data requests must be submitted to the Department of Research and Evaluation for handling. Researchers may not receive data hereunder unless the Researcher provides the Department of Research and Evaluation with written evidence of compliance with the requirements in this Policy. In particular, Researchers may not receive personally-identifiable student level data unless the Researcher also provides the Department of Research and Evaluation with written evidence that the parent or student if 18 or over, has consented to the release of student records.

- Teacher participation is strictly voluntary. Obtain written Informed consent from teacher participants.

Approval from Subject School District Continued

- District policy provides that no one has the right to access students, staff or data, and prohibits researchers from requesting data directly from schools or departments.

- Researcher must submit a Public Records Request in order to obtain information regarding teacher email addresses or employment records – http://www.palmbeachschools.org/publicrecords/.

- When contacting school administrators, either by email or in person, please provide a copy of your approval letter.

- Research activities at schools must not occur during the testing window of the Florida Standards Assessments and End-of-Course Assessments – February 26 – May 11, 2018.

RESEARCH REQUEST: Brittany Kiser - " An Examination of Pedagogy in Middle School Science Classrooms and Its Effect on Student Achievement"
February 27, 2018

- Summarize findings for reports prepared from this study and do not associate responses with a specific school or individual. Information that identifies the District, schools, or individual responses will not be provided to anyone except as required by law.

- This research study must be concluded by January 23, 2019, when the IRB expires.

- If the study requires the use of additional resources or change in participants in the future, a written request must be submitted to this office. Please wait for an approval before proceeding.

Please submit one copy of the study results to the Department of Research and Evaluation no later than one month after completion of the research.

Thank you for your interest in our District.

[redacted]

Paul Houchens
Director

PH/RP:wl

APPENDIX B

First Email Request for Participation

Dear Educator,

I am writing to request your participation in a brief survey. I am currently a candidate for the Doctorate of Education at Lynn University and am in the process of writing my dissertation. The purpose of the research is to determine whether the predominant pedagogy of a middle school is correlated with student achievement on the Grade Eight Statewide Science Assessment.

The anonymous survey should take you approximately 10-15 minutes to complete. Please click the link below to go to the survey website, or you may copy and paste the link into your browser's address bar.

Survey link: **https://goo.gl/hw2GrR**

Your participation in this survey is completely voluntary and greatly appreciated.

Thank you,

Brittany Kiser
[redacted]

APPENDIX C

Survey Instrument – Section One

Pedagogy in Middle School Science Classrooms

This survey is a part of the Dissertation in Practice for doctoral candidate Brittany Kiser.

* Required

Participant Informed Consent & Acknowledgement of Participation *

Thank you for considering taking part in this survey. Your participation in this study through the survey instrument is crucial to developing a complete picture of pedagogy in this district's middle school science classrooms.

Please answer all questions honestly and to the best of your recollection. The data collected will be aggregate per school, with each participating school being assigned a random identifying character. The individual response data will be collected anonymously and no identifying information will be released.

Participation in this survey is voluntary. There are no known risks for participation in this survey. Participants may withdraw from the survey at any time, with no penalty, by simply closing the survey instrument or browser web page.

If you have any questions regarding this study or your participation, please contact
Brittany Kiser
[redacted]

By taking part in this survey, you agree to be a participant. Please click YES to continue to survey. If you do not agree with the consent form and wish not to participate in this project, please click NO to exit from this survey.

◯ YES

◯ NO

Survey Instrument – Section Two

Educator Experience

What middle school science courses do you instruct, now or in the past three years? *
Please check all that apply.

- ☐ Grade 6 Science
- ☐ Grade 7 Science
- ☐ Grade 8 Science

At what school do you currently teach science? *

Choose

How many years of teaching experience do you possess? *

- ○ 0-3 years
- ○ 4-10 years
- ○ 10-20 years
- ○ 20+ years

How many years have you been teaching science at your current school? *

- ○ 0-3 years
- ○ 4-10 years
- ○ 10-20 years
- ○ 20+ years

My current school is a Title I school.

- ○ Yes
- ○ No
- ○ Not Sure

Survey Instrument – Section Three

Instructional Practice

Please respond to each instructional practice honestly and to the best of your recollection.

How often do these instructional practices occur in your classroom? *

	Never	Quarterly	Monthly	Weekly	Daily
Whole-class teacher demonstration	○	○	○	○	○
Teacher delivers content in the form of notes	○	○	○	○	○
Students work in collaborative groups	○	○	○	○	○
Formative assessment drives instruction	○	○	○	○	○
Students develop their own inquiry labs	○	○	○	○	○
Choice is provided for in classroom activities	○	○	○	○	○
Teacher acts as facilitator of knowledge	○	○	○	○	○
Teacher acts as giver of knowledge	○	○	○	○	○
Students take part in self-evaluation	○	○	○	○	○
Students complete pre-developed hands-on activities	○	○	○	○	○
Emphasis is on product of learning	○	○	○	○	○
Emphasis is on process of learning	○	○	○	○	○

APPENDIX D

Participant Informed Consent and Acknowledgement of Participation

Thank you for considering taking part in this survey. Your participation in this study through the survey instrument is crucial to developing a complete picture of pedagogy in this district's middle school science classrooms.

Please answer all questions honestly and to the best of your recollection. The data collected will be aggregate per school, with each participating school being assigned a random identifying character. The individual response data will be collected anonymously and no identifying information will be released.

Participation in this survey is voluntary. There are no known risks for participation in this survey. Participants may withdraw from the survey at any time, with no penalty, by simply closing the survey instrument or browser web page.

If you have any questions regarding this study or your participation, please contact
Brittany Kiser
[redacted]

By taking part in this survey, you agree to be a participant. Please click YES to continue to survey. If you do not agree with the consent form and wish not to participate in this project, please click NO to exit from this survey.

APPENDIX E

Final Email Request for Participation

Dear Educator,

If you have already participated in the survey for my dissertation, thank you!

If you have not yet, I am requesting your participation in this brief survey before it closes on tomorrow. The purpose of the research is to determine whether the predominant pedagogy of a middle school is correlated with student achievement on the Grade Eight Statewide Science Assessment.

The anonymous survey should take you approximately 10-15 minutes to complete. Please click the link below to go to the survey website, or you may copy and paste the link into your browser's address bar.

Survey link: **https://goo.gl/hw2GrR**

Your participation in this survey is completely voluntary and greatly appreciated.

Thank you,

Brittany Kiser
[redacted]

APPENDIX F

Frequency Distributions for Teacher-Centered Pedagogical Practices

Figure 2. Whole-class Teacher Demonstration

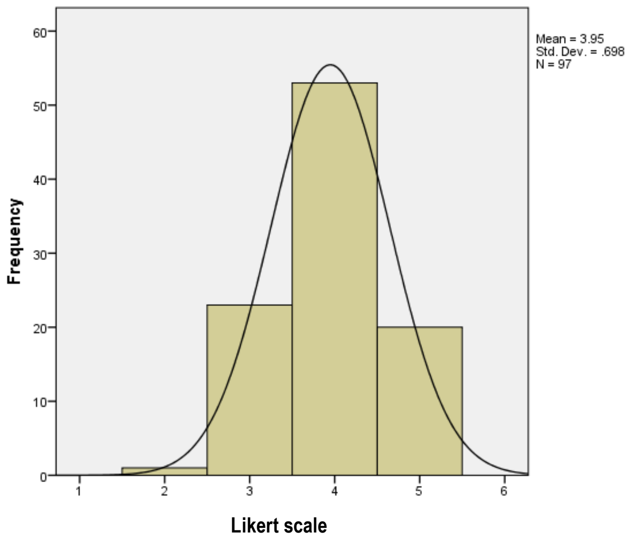


Figure 3. Teacher Delivers Content in the Form of Notes

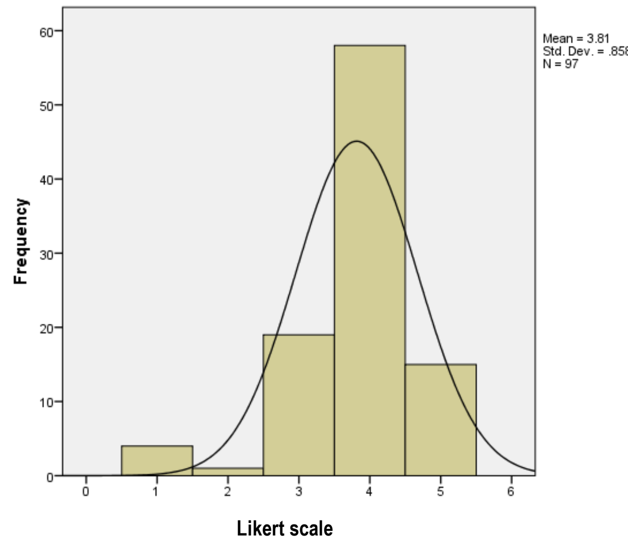


Figure 4. Teacher Acts as Giver of Knowledge

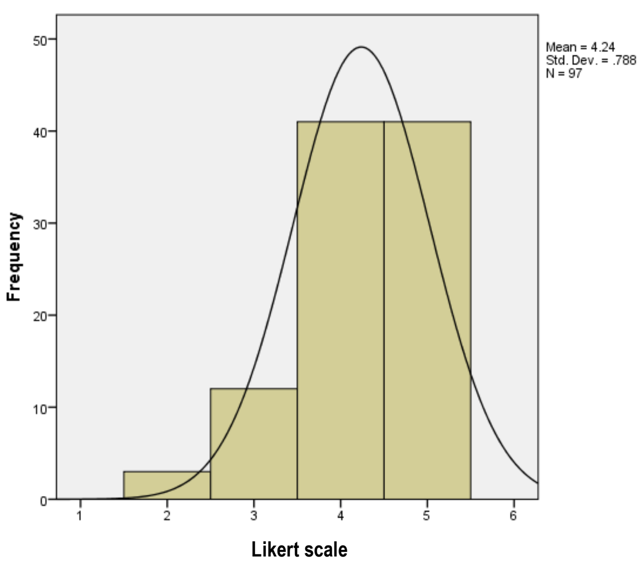


Figure 5. Students Complete Pre-developed Hands-On Activities

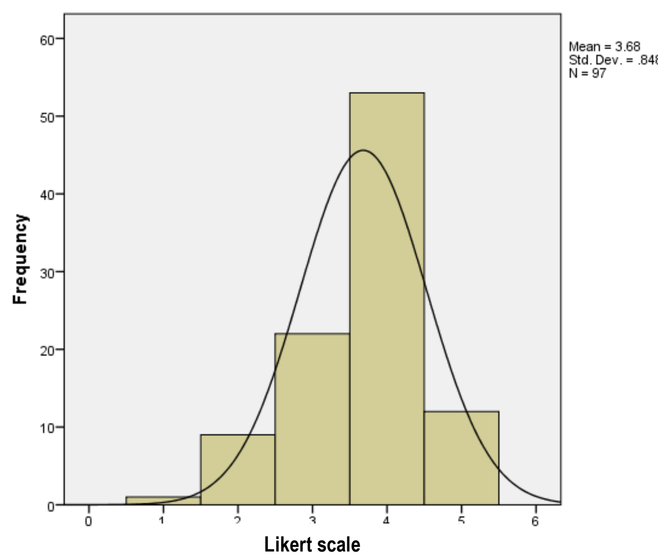
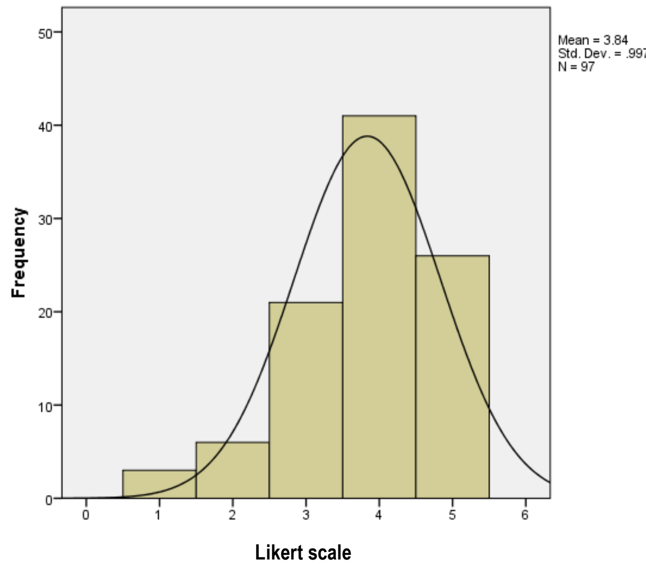


Figure 6. Emphasis is on Product of Learning



APPENDIX G

Frequency Distributions for Student-Centered Pedagogical Practices

Figure 7. Students Work in Collaborative Groups

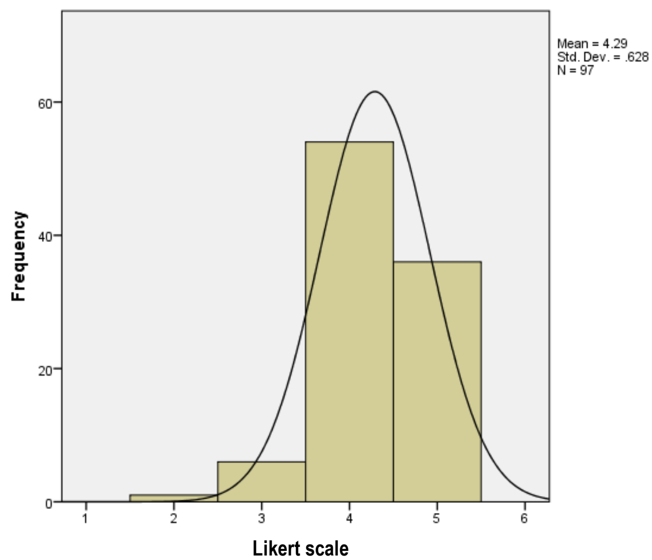


Figure 8. Formative Assessment Drives Instruction

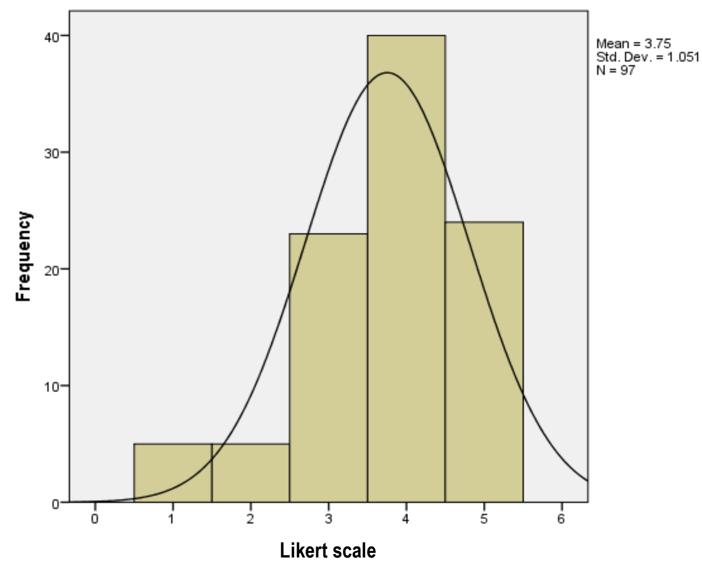


Figure 9. Students Develop Their Own Inquiry Labs

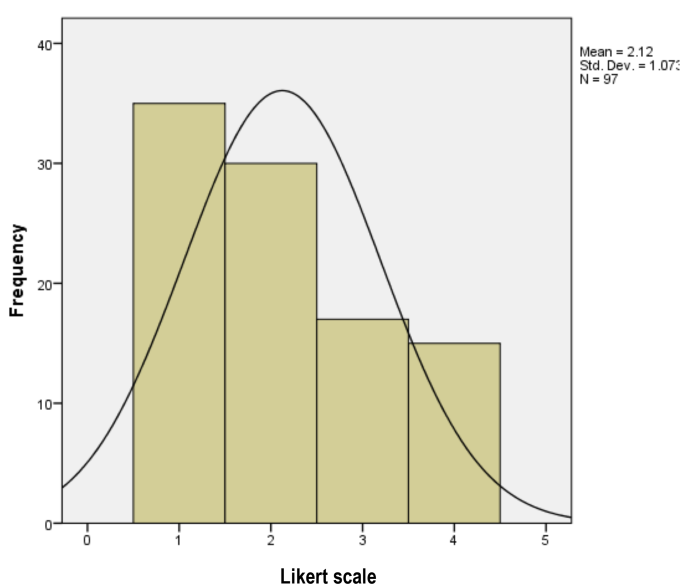


Figure 10. Choice is Provided for in Classroom Activities

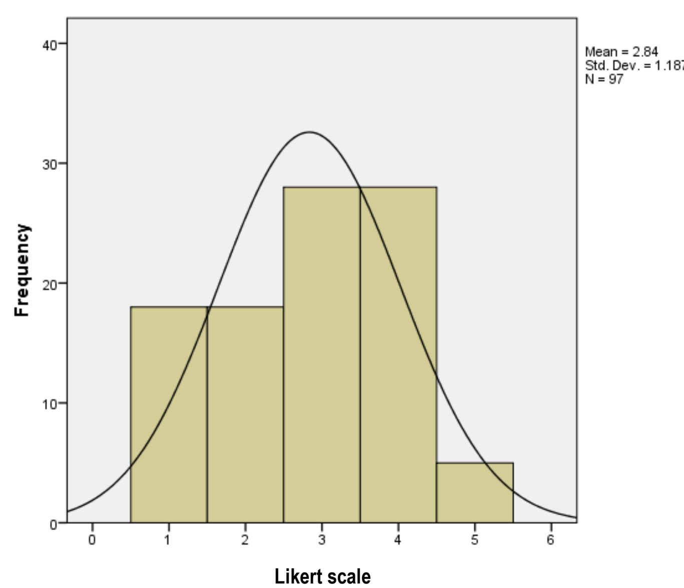


Figure 11. Teacher Acts as Facilitator of Knowledge

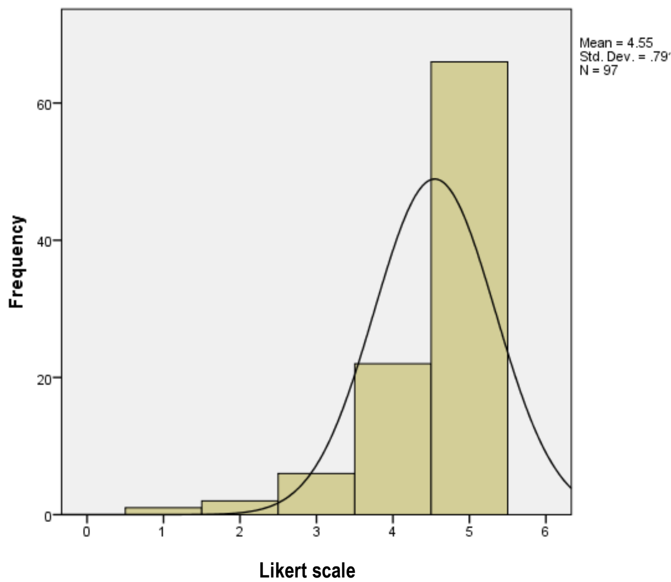


Figure 12. Students Take Part in Self-Evaluation

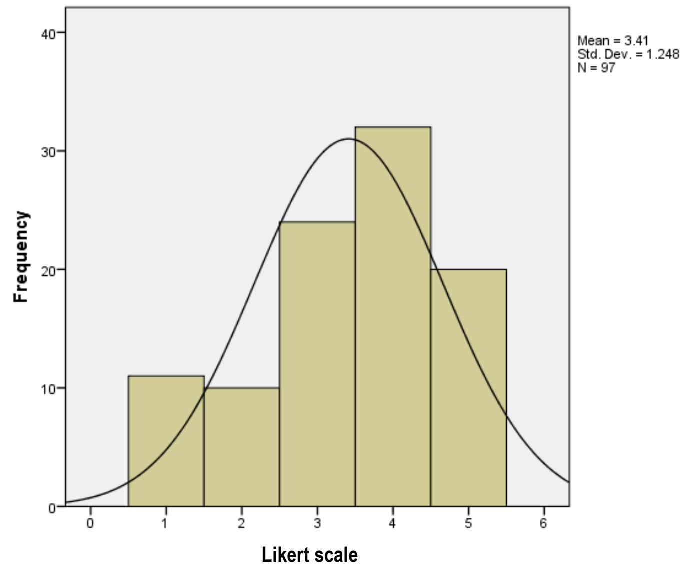


Figure 13. Emphasis is on Process of Learning