THE RELATIONSHIP BETWEEN SCIENCE CLASSROOM FACILITY CONDITIONS AND NINTH GRADE STUDENTS' ATTITUDES TOWARD SCIENCE

by

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Liberty University

A Dissertation Presented in Partial Fulfillment

Of the Requirements for the Degree

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ABSTRACT

Over half of the school facilities in America are in poor condition. Unsatisfactory school facilities have a negative impact on teaching and learning. The purpose of this correlational study was to identify the relationship between high school science teachers' perceptions of the school science environment (instructional equipment, demonstration equipment, and physical facilities) and ninth grade students' attitudes about science through their expressed enjoyment of science, importance of time spent on science, and boredom with science. A sample of 11,523 cases was extracted, after a process of data mining, from a databank of over 24,000 nationally representative ninth graders located throughout the United States. The instrument used to survey these students was part of the High School Longitudinal Study of 2009 (HSLS:2009). The research design was multiple linear regression. The results showed a significant relationship between the science classroom conditions and students' attitudes. Demonstration equipment and physical facilities were the best predictors of effects on students' attitudes. Conclusions based on this study and recommendations for future research are made.

Keywords: school facilities, science classrooms, science enjoyment, science engagement, data mining

Dedication

First, I would like to dedicate this accomplishment to my Lord and Savior Jesus Christ, without whom I could not have completed this project. Next, I dedicate this work to my family for their unending support and encouragement. My husband David deserves many thanks for selflessly taking care of the day-to-day requirements of keeping our home and family in order while I worked on researching, writing, and editing. My children, Brooke, Anna, and Alexander, were endlessly supportive, especially when I desired to work in a coffee shop with silent company. A special thanks goes to my mom and dad for giving me my start in life and to my brothers, Dennis and Steve for their support. Finally, there are many other family members and friends who have been a continual support, to all of you, my sincerest thanks.

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List of Abbreviations

American Society of Civil Engineers (ASCE)

Commonwealth Assessment of Physical Environments (CAPE)

Educational Data Analysis Tool (EDAT)

High School Longitudinal Study of 2009 (HSLS:09)

My Classroom Appraisal Protocol © (MCAP)

National Center for Education Statistics (NCES)

National Science Teachers Association (NSTA)

Public-use data file (PUF)

President’s Council of Advisors on Science and Technology (PCAST)

CHAPTER ONE: INTRODUCTION

Background

American high school students and educators spend a large portion of each week inside school buildings. The current conditions of these buildings vary drastically, from state-of-the-art facilities that are aesthetically pleasing to structures that are unattractive, unhealthy, and even unsafe. According to the National Center for Educational Statistics (NCES, 2014), in 2012-2013, over 53% of school facilities in the United States required improvements to be at a level of satisfactory condition. NCES (2014) defined satisfactory condition as, “meets all the reasonable needs for normal school performance, is most often in good condition, and generally meets some, but not all, of the characteristics of an excellent facility” (p. c-3). At least 29% of schools throughout the nation were in need of improvements specifically in the area of safety. Needed safety improvements included basic structural concerns, life safety features, and security system features. Features were missing in some schools and were deemed poor or fair in others; however, the survey was subjective and was not based on nationally established standards (NCES, 2014). In 2013, a separate evaluation of school facilities by the American Society of Civil Engineers (ASCE) gave the grade of “D” to the nation’s schools (ASCE, 2013). The meaning of this grade is defined as “below standard,” “significantly deteriorate(d),” and “of significant concern with a strong risk of failure” (ASCE, 2013).

Another area of concern is that many schools in America are overcrowded, or above the capacity for which they were originally designed (ASCE, 2013; NCES, 2000). In a study conducted by NCES (2000), in 1999 over 20% of the schools in America were overcrowded. In a similar study on school facilities conducted in 2012-2013 these conditions were not examined (ASCE, 2013; NCES, 2014).

Even though high numbers of schools in the United States require improvements, repairs, expansion, or even complete replacement, and these poor conditions are believed to affect occupants, only about 60% of schools have long-range plans for facility care and/or improvement (NCES, 2014). Beyond health and safety concerns, evidence shows that school facility conditions also affect teaching and learning (Bowers & Urick, 2011; Earthman & Lemasters, 2011; Tanner, 2008). Buildings in poor condition or disrepair are not as conducive to teaching and learning as those that are in satisfactory or excellent condition (Bowers & Urick, 2011; Earthman & Lemasters, 2011; Tanner, 2008). Studies support the idea that improvements to school facilities increase student success (Baker & Bernstein, 2012) and reduce teacher turnover (Buckley, Schneider, & Shang, 2005; Horng, 2009).

Earthman and Lemasters (2011) proposed a theoretical construct model to use when studying school building conditions. This model was introduced in a study by Cash (1993) and further developed by Lemasters (1997) and then reintroduced by Earthman and Lemasters (2011), who explained a detailed number of propositions that support aspects of the model. Earthman and Lemasters (2011) suggested using this model consistently to expand and clarify evidence-based research about the effects of the conditions of school buildings on teachers and students. The model has the school building conditions at the center, the causes for those conditions to the left, and the effects the current conditions have on occupants to the right.

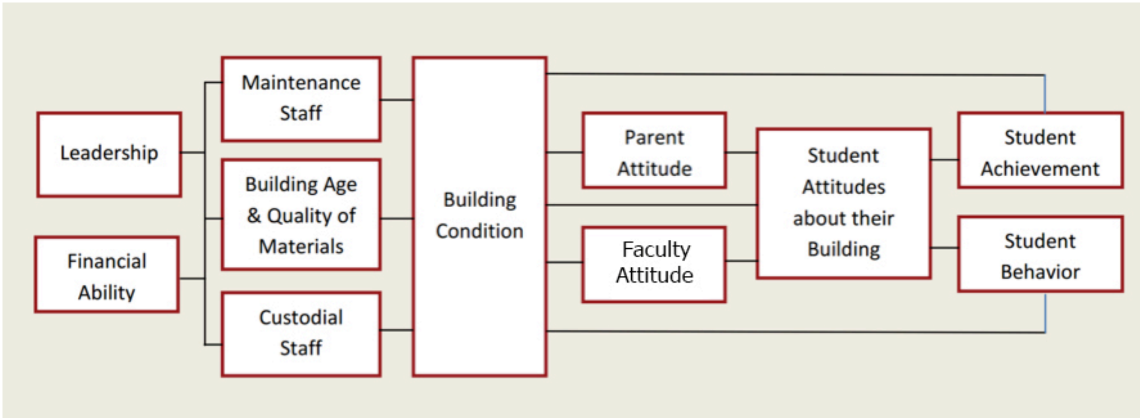

Figure 1. School building conditions are the result of various factors and those conditions affect the occupants. The Earthman and Lemasters Model (2011) gives a visual representation of the theoretical framework for studies about school facilities. Model used with permission from Earthman, G. I., & Lemasters, L. K. (2011). The influence of school building conditions on students and teachers: A theory-based research program (1993-2011). The ACEF Journal, 1(1), 15-36. (see Appendix B for permission).

Studies using this model or similar concepts support the proposition that teachers are affected by the conditions of the building and the condition of their classrooms (Earthman & Lemasters, 2009; Horng, 2009; Johnson, Kraft, & Papay, 2012; Mompremier, 2012) which in turn can affect student attitudes, motivations, and achievements (Earthman & Lemasters, 2011; Johnson et al., 2012). Evidence also shows there is a relationship between school building conditions and teachers' decisions to begin work or remain working in certain schools, with teachers less likely to begin work in unsatisfactory facilities and more likely to leave buildings in poor condition (Horng, 2009; Johnson et al., 2011). Each of these studies supports the model (see Figure 1).

In addition to school facility features, it is imperative to understand that the resources provided in learning spaces help to construct the physical learning environment (Cleveland & Fisher, 2014; Savasci & Tomul, 2013). The available educational resources have been found to correlate with the quality and condition of school facilities (Kozol, 2012; Uline & Tschannen-Moran, 2008; Uline, Tschannen-Moran, & Wolsey, 2009; Uline, Wolsey, Tschannen-Moran, &

Lin, 2010). Subsequently, there is evidence that the availability of educational resources within the learning spaces affects academic achievement (Savasci & Tomul, 2013). The increased rigor of successful high school science curriculum, such as hands-on inquiry based lessons, demands that both the facilities and the resources within them be considered critical components of the curriculum (National Science Teachers Association [NSTA], 2007).

High school science classrooms are unique classrooms within the school building and have specific structural requirements, resource requirements, and safety features in order to be satisfactory learning spaces (Motz, Biehle, & West, 2007; NSTA, 2007; NSTA, 2013). Additionally, science classrooms require spaces for the completion of lab work, and should include easy access to electrical outlets, running water, and a variety of safety features such as eye washing stations (NSTA, 2007).

As stated earlier, safety of the physical spaces is a major concern in school buildings. Life safety features, such as "sprinklers, fire alarms, and smoke detectors, as well as security system features, such as cameras and alarms, are critical" (NCES, 2014). However, the focus within the science classroom is also on the design and maintenance of the learning space due to the increased hands-on activities that should take place (NSTA, 2007). Without proper safety precautions/equipment, teachers may have to sacrifice safety in order to complete appropriate and necessary demonstrations (NSTA, 2007). Effective and safe science curricula are supported by flexible indoor and outdoor learning spaces (Motz et al., 2007).

The United States has guidelines on what makes a quality science classroom; however, many science classrooms were built before the current science standards were instituted (Motz et al., 2007). Therefore, these classrooms are out of date with current specifications such as square foot per student, specific layouts, and equipment. Unfortunately, in some facilities, even new science classroom construction ignores design standards that incorporate flexibility, increased space for movement, and ample equipment (Motz et al., 2007).

Since poor school building conditions have been shown to affect learning, this study was intended to identify possible predictive relationships between the quality of the learning spaces and resources available in the physical science classroom and students' feelings about the field of science. The President's Council of Advisors on Science and Technology (PCAST, 2010) stated that there is a need to increase not only the academic achievement of students in science but also the interest of students in science fields. Therefore, studies that can identify areas that may be affecting achievement, attitudes, and/or interest could be beneficial to science education.

Problem Statement

Conditions of many school facilities in the nation are *fair*, defined as, "the facility meets minimal needs for normal school performance but requires frequent maintenance or has other limitations. It requires some upgrading to be considered in good condition" (NCES, 2014, p. c-3) or *poor*, defined as, "the facility does not meet minimal requirements for normal school performance" (p. c-3). Evidence is plentiful that school facilities affect occupants in areas that include teaching and learning (Bowers & Urick, 2011; Cleveland & Fisher, 2014; Earthman & Lemasters, 2011). Earthman and Lemasters (2011) and Tanner (2015) encouraged researchers to add to the literature base on how and why school facilities have an impact. They encouraged studies that will strengthen the evidence and provide a more clear understanding of what aspects of the building or specific building features have the greatest influence on students' academic achievement and behavior (Tanner, 2015). Many of the studies that have been conducted have been either in only one state or from an even smaller sample. Therefore, samples from larger regions could add to the literature. Earthman and Lemasters (2011) also suggested further validity and reliability testing on assessments that establish school building conditions and their effects. Unfortunately, school building evaluations that examine the effectiveness of learning spaces are not clearly defined and require increased development (Cleveland & Fisher, 2014). Pearlman (2010) suggested that the lack of evaluations and therefore the lack of implementations or appropriate changes in learning spaces is allowing the learning space to dictate what pedagogies the teacher can utilize.

President Obama has called for improvements in STEM education (Peters-Burton, Lynch, Behrend, & Means, 2014), and one area of possible improvement might be to further understand the impact of providing adequately constructed and supplied science classrooms. Examining the effects of the physical facilities on teachers and students within specific disciplines is a way to expand the body of knowledge. Cash (1993) found that "science achievement of students was higher in buildings with better quality science facilities than in those with lower quality science facilities" (p. 77). General classroom studies have shown that the conditions of classrooms affect the attitudes of teachers and the behavior and performance of students (Lumpkin, Goodwin, Hope, & Lutfi, 2014). The problem is that there is a lack of generalizable research on science teachers' perceptions of the physical science classroom and the impact of those perceptions on students' attitudes toward the subject.

Purpose Statement

The purpose of this correlational study was to identify the relationship between teachers' perceptions of their classroom facilities and students' attitudes toward science. Data mining was used to discover available datasets that could provide variables toward this end. Archival data from the High School Longitudinal Study of 2009 was used (NCES, 2012). In this dataset, the sample of teachers was asked for their perceptions of the science classroom facilities (instructional equipment, demonstration equipment, and physical facilities). The nationally representative sample of ninth grade students was questioned about their attitudes about their expressed enjoyment of science, importance of time spent on science, and boredom with science. The predictor variables were the science teachers' perceptions of their classroom instructional equipment (equipment used by the students), demonstration equipment (equipment used by the teacher), and the physical facilities (the structure and layout of the classroom). The criterion variables were self-reported attitudes of ninth grade students about how much they enjoyed science, how valuable it was to spend time on science, and their boredom levels with science.

Significance of the Study

While there is a growing body of research regarding the effects of school facilities, there remains a gap in the literature focusing on the effects of the science classroom conditions and available science classroom resources. This study builds on previous studies that demonstrate the effects school facilities conditions have on students (Bowers & Urick, 2011; Earthman & Lemasters, 2011; Tanner, 2009; Uline & Tschannen-Moran, 2008; Uline et al., 2009; Uline et al., 2010). Studies have been conducted about certain technologies and pedagogies within science classrooms (Berk et al., 2014; Campbell, Zhang, & Neilson, 2011; Chen, 2013; De Jong, Linn, & Zacharia, 2013; Freeman et al., 2014; Gilmore, 2013). However, research studies that specifically examine the effects of physical high school science classrooms on students' attitudes about science are scarce. There appears to be a number of studies available examining the effects of classroom spaces at the college level and even more specifically in college science (Park & Choi, 2014). There is a need for additional studies that identify the most effective features of high school science classrooms that enable teachers to utilize modern teaching techniques (Cleveland & Fisher, 2014), especially those features shown to increase success with this current generation of students, often called millennials: students born between 1984 and 2002 (Elmore, 2010; Howe & Strauss, 2000).

Evidence shows that millennials, as with all students, exhibit improvements in academic success when they are taught using varied teaching methods (Caballero et al., 2014). Teachers that are open to the changes in pedagogy are quickly aware that the learning spaces need to adapt to effectively implement many of the new methods (Pearlman, 2010). Unfortunately, teachers are often forced to choose teaching methods that can be accomplished in the available learning spaces (Parkay, Anctil, & Hass, 2010; Pearlman, 2010). Flexible learning spaces encourage varied pedagogy and can improve school occupants' satisfaction with their environments (Makela, Kankaaranta, & Helfenstein, 2014).

This study builds the literature concerning the conditions of the science classroom, as part of the building, and the resources available within the science classroom affect teachers' perceptions and how these perceptions then affect students' attitudes about science. The focused examination of the effects of the science classrooms and available science resources could add to the existing body of literature by increasing understanding about possible variables affecting students' attitudes toward science. Such studies will be valuable for stakeholders and decision makers when considering school building funding and resource allocation. Effective school building improvements and effective distribution of resources could encourage teachers and students and ultimately increase academic achievement.

The PCAST (2010) has encouraged studies that identify factors that increase science motivation and science self-efficacy of students and aid in the formation of science identity. Students' attitudes toward academic programs can affect their motivation, self-efficacy, and identity with those programs (Bandura, 1997). Gilmore (2013) stated that students gain more meaning from science and enjoy the subject more when they are engaged in hands-on projects that call for students to apply specific content. Elmore (2010) emphasized the need for more active learning with millennials and Caballero et al. (2014) found evidence for significant increases in academic success when curriculum is taught with a variety of pedagogies. Both Project-Based Learning (PBL) and the Flipped Classroom are examples of active learning that encourage active classroom time and have been found to be successful (Bell, 2010; Keengwe, 2014; Roehl, Reddy, & Shannon, 2013). PBL promotes active learning by having students attempt to solve problems as opposed to receiving lections, reading, and memorizing text. Flipped classroom instruction can be active by encouraging the passive acts of receiving lections, reading, and watching videos outside of the classroom to free up class time for interactions or other activities, applying what has been studied (Keengwe, 2014). These examples of active learning, and others, require appropriate facilities and resources (Gilmore, 2013). Active classrooms, which contain flexible learning spaces for a variety of teaching/learning styles, have been studied at the collegiate level and have shown great success (Park & Choi, 2014).

Evidence shows that American students are falling behind in STEM proficiency and interest (Chen, 2013; Peters-Burton et al., 2014). Studies that provide understanding about possible improvements to enjoyment and engagement in STEM education may help with the achievement of individual students and the international ranking that American students can achieve. The significance of this study was to add to the existing body of knowledge by identifying variables that may improve high school students’ attitudes toward science.

Research Questions

RQ1: How accurately can ninth grade students' *enjoyment* of their science class be predicted from a linear combination of science teacher indicators about their schools' science classroom facilities (instructional equipment, demonstration equipment, and physical facilities)?

RQ2: How accurately can ninth grade students' *boredom* with their science class be predicted from a linear combination of science teacher indicators about their schools' science classroom facilities (instructional equipment, demonstration equipment, and physical facilities)?

RQ3: How accurately can ninth grade students' *value* of their science class be predicted from a linear combination of science teacher indicators about their schools' science classroom facilities (instructional equipment, demonstration equipment, and physical facilities)?

Null Hypotheses

$H_0$1: High school students' *enjoyment* of their science class cannot be predicted from a linear combination of science teachers' perceptions of their available instructional equipment, available demonstration equipment, and condition of physical facilities.

$H_0$2: High school students' *boredom* with their science class cannot be predicted from a linear combination of science teachers' perceptions of their available instructional equipment, available demonstration equipment, and condition of physical facilities.

$H_0$3: High school students' *value* of their science class cannot be predicted from a linear combination of science teachers' perceptions of their available instructional equipment, available demonstration equipment, and condition of physical facilities.

Definitions

1. *Instructional equipment* – The equipment the student would use during instruction (NCES, 2012).

2. *Demonstration equipment* – The equipment used by the teacher during instruction for demonstration of science concepts (NCES, 2012).
3. *Physical facilities* – The science classroom in which the teacher is teaching the student being interviewed (NCES, 2012).
4. *Public-use data file (PUF)* – A file available to the public through NCES with all identifying components have been removed to protect those that were surveyed.
5. *Satisfactory, acceptable, or good condition* – "Meets all the reasonable needs for normal school performance, is most often in good condition, and generally meets some, but not all, of the characteristics of an excellent facility" (NCES, 2014, p. c-3).
6. *Unsatisfactory or unacceptable condition* – Also labeled fair or poor condition, means in need of improvement (NCES, 2014).

a. *Fair* – "The facility meets minimal needs for normal school performance but requires frequent maintenance or has other limitations. It requires some upgrading to be considered in good condition" (NCES, 2014, p. c-3).

b. *Poor* – "The facility does not meet minimal requirements for normal school performance" (NCES, 2014, p. c-3).

7. *Life safety features* – "Includes sprinklers, fire alarms, and smoke detectors" (NCES, 2014, Instructions and Definitions Page, Fast Response Survey).
8. *Security systems* – "Includes surveillance cameras, perimeter intrusion alarms, metal detectors, and door controllers" (NCES, 2014, Instructions and Definitions Page, Fast Response Survey).
9. *Data Mining* – "The field of discovering novel and potentially useful information from large amounts of data" (Baker, 2010, p. 113).

10. *Enjoyment* – A pleasurable and positive emotion or attitude (Tamborini, Bowman, Eden, Grizzard, & Organ, 2010), and/or a characteristic of intrinsic motivation (Deci & Ryan, 1985).
11. *Boredom* – “A state of relatively low arousal and dissatisfaction which is attributed to an inadequately stimulating situation" (Mikulas & Vodanovich, 1993, p. 1), and a lack of intrinsic motivation (Caldwell, Darling, Payne, & Dowdy, 1999).
12. *Value* - Importance, intrinsic importance, and/or usefulness (Eccles et al., 1983).

CHAPTER TWO: LITERATURE REVIEW

Introduction

The focus of this literature review was to investigate both previous and current literature about the impact of school building conditions on teaching and learning among students in America. Studies conducted on the effects of school building conditions are both varied and extensive (Bowers & Urick, 2011; Cash, 1993; Cleveland & Fisher, 2014; Earthman & Lemasters, 2011; Lemasters, 1997; Tanner, 2015). An additional aspect of this review was to investigate literature on how available educational resources affect learning. This area of research appears to be less robust. Special attention was given to studies that mentioned, even remotely, the condition of science classrooms and available science equipment within those classrooms. The end target of this review was to explore how science classroom conditions and resources affect students' attitudes toward science.

School facility conditions are defined as either satisfactory or unsatisfactory or as acceptable or unacceptable (NCES, 2014). Science classroom equipment is described as either demonstration equipment for teacher use or instructional equipment for student use (NCES, 2012). Searches for available and valid studies were conducted in these areas: (a) school building conditions, (b) school building effects on students' academics and behavior, (c) available educational resources and the possible effects, (d) current science classroom conditions, and (e) the effects of the science classroom conditions and available resources on students' attitudes. Though this review is not exhaustive, it represents a broad spectrum of the literature on this topic.

Conceptual Framework

A theory-based research program has been established to help organize studies that investigate school building conditions (Earthman & Lemasters, 2011). This approach attempts to illustrate both how school buildings end up in the current condition in which they are found and the effects these conditions have on those who work and learn in the spaces. See Figure 1 for the model as proposed by Earthman and Lemasters (2011).

Many studies investigating how school buildings become and remain acceptable or become unacceptable focus on the variables of the leadership of the school and/or school district, the financial status of the school and/or school district, the quality and age of the original school buildings, and the maintenance and custodial staff (Baker & Bernstein, 2012; Earthman & Lemasters, 2011). Many other studies examine the effects of those current conditions on those utilizing the spaces, such as faculty, staff, and students (Baker & Bernstein, 2012; Bowers & Urick, 2011; Cleveland & Fisher, 2014; Earthman & Lemasters, 2011).

Earthman and Lemasters (2011) encouraged research on all aspects of this model in order to strengthen the evidence that supports the propositions that the model supports. The first two propositions deal with how the buildings get to be in their current condition. The third proposition proposes that the condition of the school buildings has a direct effect on the attitudes of the people that occupy the spaces. The fourth and fifth propositions suggest that the students' impressions about school facilities affect their self-concept and academic achievement. The final preposition put forth by this model states that if school buildings are in good condition the students will be able to attain higher levels of academic achievement. Baker and Bernstein (2012) also encouraged research that would provide information on prioritizing building projects based on those that would have the most positive impact on the occupants and how certain building features may interact with one another.

The emphasis of this literature review focuses on the right side of Earthman and Lemaster's (2011) model with studies that examine the effects of the buildings rather than on the left side of the model and how the buildings end up in the condition in which they are found. This study sought to add to the literature already available about how the physical school buildings affect teaching and learning through adding support to the final four propositions. The main focus of this study was to show how the physical science classroom, as one part of the school building, affects how first-year high school students feel about science.

Literature Section

Kozol (2012) brought to light many of the inequalities in the public education system, including those related to disparities found in the conditions of K-12 facilities. Kozol discussed deplorable conditions of inner-city schools where children were attending classes in buildings without basic elements such as appropriate climate control, working plumbing, and adequate lighting. Kozol also emphasized the presence of affluent schools, often within minutes of these poor schools, which were far more functional, clean, and even inviting. Kozol's study mainly examined urban schools. However, many similar conditions can be found in rural schools (NCES, 2014). A premise pushed forward by Carter and Welner (2013) is that these disparate conditions create an opportunity gap that intensifies the achievement gap.

The earliest study this researcher found that introduced a theoretical model for studying school facilities was in 1993 by Cash. The model discussed by Cash was a precursor to the model Lemasters (1997) worked with and the one used as the conceptual framework for this study (Earthman & Lemasters, 2011). During her studies of school conditions in the state of

Virginia, Cash (1993) developed the Commonwealth Assessment of Physical Environment (CAPE), which is an objective assessment tool about the physical state of school facilities. CAPE has been used in a number of studies about the conditions of school facilities (Bowers & Urick, 2011; Leigh, 2012; Wheeler, 2014; Whitley, 2009). Throughout Cash's (1993) foundational study, seven building elements were considered: lighting, acoustics, climate control, color, building age, density, and aesthetics. Cash found significant difference in academic scores with students in poor buildings and those in buildings in good condition. Science classrooms and achievement were examined and were determined to affect science performance. Earthman, Cash, and Van Berkum (1996) completed a similar study to Cash's (1993) study, with similar results. This study was conducted in North Dakota and the CAPE was renamed State Assessment of Facilities in Education (SAFE).

Prior to promoting the modified theoretical model in 2011, Earthman and Lemasters (2011) had both contributed to the literature on educational facilities. Lemasters (1997), when originally working with the model created by Cash (1993), completed a systematic synthesis of studies pertaining to color, maintenance, age, classroom structure, climate control, density, noise, and lighting in education facilities. Lemasters (1997) examined how different studies showed evidence for relationships between building elements and student achievement and student behavior. Lemasters found that students in satisfactory or better buildings were more academically successful than students in unsatisfactory buildings.

Earthman (2006) developed *My Classroom Appraisal Protocol* © (MCAP) to measure teachers' perceived attitudes about their working conditions and when used, provided evidence that a relationship existed between the physical work environment of teachers and their attitudes (Earthman & Lemasters, 2009). Earthman (2007) also established an instrument to measure the students' attitudes about the educational facilities, *Students School Building Attitude Scale©*. A study by Leigh (2012) used both the MCAP and the CAPE instrument for a study that found elementary teachers' attitudes correlated with the condition of the building they occupied.

Bailey (2009) conducting a study similar to Lemasters (1997) also found a relationship between building conditions and the effects on students and teachers. Bishop (2009) conducted a qualitative study that found teachers reacted positively to the effects of a new school building and believed that their students also reacted with positive improvements. Statistically significant relationships have been found between specific design elements of the school building and student outcomes (Baker & Bernstein, 2012; Tanner, 2008). Movement and circulation patterns of the design affected students' success in English, math, and science (Tanner, 2008). Evidence showed that appropriate day lighting most significantly influenced science and reading and that students who were afforded a view where they could rest their eyes at least 50 feet from where they were seated produced increases in their success in a variety of subjects (Tanner, 2008). In a study of 71 schools many of the above results were replicated (Tanner, 2009). Tanner (2008, 2009) suggested that future research be conducted that would look deeper into the particular aspects and features of school designs that affect student achievement and possibly replicate his findings. Tanner (2008) acknowledged these types of studies might be expensive and time-consuming; however, he also expressed that they would be meaningful and helpful to upcoming generations of students.

Between 2008 and 2010 a group of researchers conducted a series of three studies that investigated facilities effects on student academic achievement and inequity throughout school structures in America (Uline & Tschannen-Moran, 2008; Uline et al., 2009; Uline et al., 2010). The first study in their series confirmed a link between school facility conditions and student achievement through the mediating variable of school social climate (Uline & Tschannen-Moran, 2008). In other words, if the school facilities are in poor quality the school climate is negatively affected and this in turn has a negative impact on achievement. This first study discussed school design features that encourage a positive social atmosphere as critical to improving the school climate. Such features are those that increase “human comfort, pleasing appearance, adequacy of space, functional furniture and equipment, and a clean and orderly environment, and regular maintenance” (p. 69). Uline and Tschannen-Moran (2008) also stated that the results of this particular study were based on a sample of only 82 schools and the variables were based on self-reported measures of teachers. The subjective nature of such a study weakens the results; however, replicated studies have been conducted that provide similar evidence (Baker & Bernstein, 2012; Tanner, 2015).

The second study in the series was a multiple case study that discovered themes relating to the perceived quality of the physical school structure (Uline et al., 2009). These themes consisted of movement, aesthetics, lighting, adaptable classrooms, and the density of the population of the building. This qualitative study was limited to two schools from the sample of 82 used in the first study and was based on data collected from students, educators, and parents. The emerging themes showed the importance of students feeling a sense of ownership and autonomy within the learning spaces and the ability to move freely throughout the building without movement being obstructed by overpopulation (Uline et al., 2009). The discussion also pointed out that small changes, such as transforming an unused area into a sitting area for students and visitors changed the atmosphere of that part of the building and improved the overall feeling. As with the first study in this series, other studies have been conducted that provide similar findings (Baker & Bernstein, 2012; Tanner, 2015).

The third and final study in the series by Uline et al., (2010) utilized a different set of nine schools from the first two studies and again found a strong relationship between the quality and condition of school buildings and the school social climate. The sample for this mixed methods study was from Southern California; whereas, the first two studies utilized samples from Virginia. The use of different demographic areas that produced similar results demonstrates that the effects of school building conditions are not just regional. The four aspects of the school climate that were investigated in this study were academic press, community engagement, teacher professionalism, and collegial leadership. The research questions investigated how aware the occupants were of the substandard features, how these features related to the climate, and how the occupants compensated for the poor physical conditions to create or maintain a positive learning environment.

During this study, the idea of equity in school buildings emerged as those being interviewed (teachers, parents, custodians, and students) expressed knowledge that other school buildings, even those geographically close, were in much better condition and much more equipped for modern learning (Uline et al., 2010). Kozol (2012) had recognized similar issues of equity in his studies in the early 1990s and Carter and Welner (2013) compiled a number of essays linking equity concerns with the achievement gap. Uline et al. (2010) also found evidence to indicate the physical school building can have an influence on a teacher’s choice to work in a certain school. Teachers in less than satisfactory facilities feel less supported and are often less successful than those in facilities that provide clean, safe, and encouraging learning spaces (Ladd, 2011).

Another aspect of the school facility that has been the subject of studies is that of school population size. Tanner and West (2011) conducted a study on the effect of school size on academic outcomes. Overall, the results did not show a statistical difference in the academic success of the students based on school size alone. However, the researchers suggested measuring with other indicators outside of academics to get a clearer picture for the measurement of success. They suggested those measures could include engagement in extra-curricular activities or other social measures. The thought was fostered that the size of schools might affect students in ways outside of academic achievement such as attendance and safety (Tanner & West, 2011). The thought was also introduced that the density of the student population in contrast to the physical school size may be more important than the size of the school alone.

One of the most recent meta-analyses conducted in the area of school facility effects was completed using six education facility dissertations and found evidence to support significant effects in a number of school design patterns (Tanner, 2015). Some of the design patterns that were found to affect students' accomplishments were room for movement, appropriate lighting, safe and secure learning spaces, places to display students' work, appropriate storage, quiet places, green spaces, outdoor learning areas, instructional neighborhoods, appropriate technology, color configurations, and the overall impression of the school environment. Tanner (2015) did not find significant evidence to support the importance of climate control, adequate public areas, and a structurally sound roof; however, he attributed the lack of findings to the restricted number of studies included in the meta-analysis and specifically the limited number that examined these features. The scope of this meta-analysis was limited to six dissertations and more widely spread meta-analyses might be beneficial and more conclusive.

Conditions of Schools in America

Kozol (2005, 2012) examined the marked disparities in educational facilities in America, with a focus on the deplorable conditions of inner city schools that serve many minority students.

He emphasized that many students were attending schools that were unclean, unhealthy, and unsafe. Kozol (2012) wrote about school buildings in the late 1980s and early 1990s, yet upon revisiting schools in the early 2000s found many conditions had not improved (2005).

A more current and nationally representative assessment of schools shows that over half of the school buildings in America that are currently in use are well over 40 years old, and 53& of the total number of buildings in use are in need of repairs to be in satisfactory or acceptable condition (NCES, 2014). With the grade of "D" being given to the infrastructure of school buildings in America it is apparent that much needs to be done to improve the places where students learn (ASCE, 2013). Improvements include those that will bring buildings up to a satisfactory level and those that will turn low performing schools into high performing schools (Baker & Bernstein, 2012).

Schools in need of repair can be found in rural, urban, and suburban schools, with 54% of urban schools reporting a need for improvement in 2012-2013 and 53% of rural schools reporting that same need. Unsatisfactory conditions are also found in every region of America. The west region has the highest need with 59% of the schools in need of repair. The central region is close behind with 53%, and the northeast and southeast are at 49% and 45% respectively (NCES, 2014).

Even though a high percentage of school administrators (83%) indicated facilities inspections had been conducted in the past five years, the inspections were further defined to include environmental hazards and energy use the percentages were lower (NCES, 2014). Chan and Dishman (2011) suggested periodic, if not daily, inspections of school buildings for both physical safety and strategic safety. According to Chan and Dishman (2011) physical safety includes the building structures and strategic safety includes the planning or procedures to appropriately maneuver students to safe spaces within the buildings in case of emergencies.

The need for repairs in school facilities, however, are not limited to, repair of structural inadequacies, leaky roofs, faulty electrical systems, lighting issues, and HVAC (NCES, 2014). When considering structural issues such as roofing and electrical concerns, safety can be paramount, and it can be noted that roughly 29% of schools are not considered satisfactory in the area of safety due to one or more element in need of repair or upgrade (NCES, 2014). Kozol (2005) told of schools that were still being occupied even after being condemned because other options were unavailable. In other words, even buildings that are not considered safe for occupancy are still used as educational facilities. Tanner (2015) found that students who feel safe are able to learn more effectively. Once the important structural elements are assessed as safe and satisfactory, concern can then be given to elements that determine the health of the built environment and how those elements encourage or discourage students' abilities to concentrate and learn (Baker & Bernstein, 2012).

In order for students to learn they must be able to see, and this requires appropriate lighting. In America, 24% of school administrators in 2012-2013 reported having problems with lighting conditions in their permanent buildings (NCES, 2014). In addition to being able to see, students need learning spaces where they can hear the instruction. Regrettably, acoustics is a problem in 14% of permanent school structures (NCES, 2014).

Being in healthy and comfortable spaces includes being able to adjust the temperature. HVAC systems are an integral component for keeping buildings at a comfortable and healthy temperature year round. Unfortunately, 31% of American schools have HVAC problems (NCES, 2014). Closely linked to climate control is appropriate ventilation and indoor air quality.

Current conditions of these breathing related factors within school buildings are below average in 26% of permanent school buildings (NCES, 2014). These are the current conditions around the nation even though over $20 billion has been spent each year on building or improving school facilities over the past 10 years (Baker & Bernstein, 2012).

Although the focus of this literature review is the effects of school building conditions and not how they come to be in their current state, it can be helpful to have a rudimentary understanding of a few of the causes for these conditions. Kozol (2005, 2012) discussed the cause of the poor conditions of the 1980s through early 2000s as funding disparities, which caused the poorer districts to not have enough funds for even basic needs such as maintenance and minor repairs. Funding disparities may still be a contributing factor in many districts; however, another reason for the current decline in the condition of schools across America can be linked to the recession of 2008 and the adjustment of property values, which directly adjusted the tax revenues often used for school building repairs, maintenance, and construction (ASCE, 2013).

In many school districts, less is being spent annually now than prior to the recession (ASCE, 2013). Decreased spending has contributed to the current almost failing grade of school facilities, which were given a grade of "D" by the ASCE. School facilities that house public education are a part of the infrastructure of the nation and yet, the buildings being used by teachers and students are below average at best with many failing completely as safe, clean, healthy facilities to teach and learn (ASCE, 2013).

In additions to the budgetary inequities and restrictions that affect school facility construction, improvements, and maintenance, facility managers must consider the fact that some schools were poorly designed and/or poorly constructed. Other school buildings have been poorly supervised and/or maintained and may have been highly abused and even vandalized contributing to the need for additional improvements to become safe, healthy, and highly functional schools (Chan & Dishman, 2011).

Science Classrooms and Available Science Resources

Science classrooms throughout rural, suburban, and urban school buildings in America are not immune to the need for repair and improvement. Yet, in addition to the features mentioned above, science classrooms require additional elements to be both functional and safe for the teachers and students to explore effectively the subjects inherent to studying science (NSTA, 2013). Carter and Welner (2013) discussed the need for equitable classrooms and resources to give all students the same opportunities for achievement. Kozol (2012) told of schools where science labs had stations with holes where pipes were supposed to be. He also told of science labs with no lab tables, no equipment, and no basic supplies. He witnessed students being taught science experiments without the equipment and supplies needed for demonstrating and/or experiencing the most basic of hands-on activities. Hands-on learning experiences are essential to learning science, and the need for the appropriate facilities and resources is critical for educators to provide these fundamental experiences (Berk et al., 2014; Campbell et al., 2011; Chen, 2013; De Jong et al., 2013; Freeman et al., 2014; Gilmore, 2013).

Science classrooms also need adequate space to be conducive to hands-on activities (NSTA, 2013). In order for teachers to use pedagogy that involves active engagement of students in the area of science, teachers must have access to appropriate classroom spaces and stations in addition to appropriate demonstration and instructional equipment (NSTA, 2013). Savasci and Tomul (2013) stated that a relationship exists between appropriate access to such resources, willingness of teachers to continue teaching, and academic achievement of students.

In 2007, National Science Teachers Association (NSTA) listed declarations for science rooms that remain in place as current guidelines. These declarations include the following: science classrooms should only be used for science; enough space should be provided for each student as well as the adequate number of lab stations with access to gas, electricity, and water; correct safety equipment, correct technical, and support equipment for instruction should be provided; and adequate storage space for needed supplies should be readily available. Appropriate and secure storage should be provided for science lab chemicals that could be dangerous if handled inappropriately (Chan & Dishman, 2011).

Science labs should not be used for non-science classes, especially by non-science teachers, because these teachers may not be aware of the safety precautions necessary around the specialized equipment (NSTA, 2007). Adequate space should be available, and therefore, a science lab should not be overcrowded. Overcrowding is a concern in any educational setting; however, it is of special concern in science classrooms, where overcrowding increases risks of accidents and injuries (Motz et al., 2007). Kozol (2012) told of science classrooms in America as “too high for lab capacity” (p. 193).

Overcrowding of science labs limits the teachers’ abilities to appropriately monitor students (NSTA, 2014; Roy, 2015). This inability to properly supervise each student increases the likelihood of accidents (NSTA, 2014; Roy, 2015). It is recommended that a high school science classroom have 60 square feet per student (NSTA, 2007; Roy 2015). Overcrowding includes many factors: the number of students in the class, the workspace available to each student, and the maximum allowed occupancy for the classroom (NSTA, 2014).

Appropriate and adequate lab spaces and the equipment necessary for each student to participate in demonstrations are critical to provide a suitable learning environment and also to ensure the highest level of safety (NSTA, 2013). The science classroom and lab should also provide workstations for students with disabilities (NSTA, 2007). Science curricula also require access to outdoor areas as part of the science classroom and curriculum, and these considerations should be part of science classroom design (NSTA, 2007).

Science classrooms require designs that allow for current trends in teaching and flexibility for future changes in pedagogy (NSTA, 2007). Science classrooms can either be separated spaces for classroom work and lab work, or can consist of a combined classroom and lab space. Current recommendations include combining classrooms to allow for more flexibility in teaching appropriate science curriculum. Another design choice is the creation of generic science classrooms to be used for all sciences, as opposed to subject specific science classrooms such as those designed for physics or those designed for chemistry. The recommendation is that subject specific classrooms are more effective (NSTA, 2007).

Technology in the Science Classroom

Classrooms for science related studies are more effective if they offer access to technology (Shen, Lei, Chang, & Namdar, 2013; Shieh, 2012). One study by Shieh (2012) supported the use of specific physics technology, Technology-Enabled Active Learning (TEAL). TEAL uses pedagogical approaches that include technology, hands-on activities, and small group work, which all require appropriate physical facilities to accommodate. TEAL was found to increase student success (Shieh, 2012). Technology Enhanced Model-Based Instruction (TMBI) is another pedagogical technique that utilizes technology and group learning to improve science achievement (Shen et al., 2013). Technology could be a cost effective way of improving science education due to being able to create individualized practice for students based on their unique responses (Butler, Marsh, Slavinsky, & Baraniuk, 2014). Shen et al. (2013) suggested future studies that identify the best TMBI programs to be both more effective for the students and cost effective for stakeholders.

A technology consideration of modern science classrooms is the inclusion of the required technology for virtual labs. De Jong et al. (2013) conducted a study comparing the value of physical and virtual laboratories, and found that both have advantages for learning. However, a combination of both physical and virtual lessons appeared to have the most positive impact on achievement. The use of science equipment in physical labs helped the students develop practical skills in a real world situation that included problems with equipment, flaws in measurements, and observations over a long period of time (De Jong et al., 2013).

The virtual labs had advantages in that experiments did not need to take as much time to complete and elements such as heat and time could be altered in ways that were not possible within many physical laboratories (De Jong et al., 2013). Both physical labs and virtual labs are helpful as stand-alone features of a science classroom; however, the most advantage appeared to be when the two were used in combination. Both types of learning can and do enhance the curriculum. However, both require the consideration of additional resources and an appropriately designed science classroom (De Jong et al., 2013).

Facility Conditions Affect Teaching and Learning

Carter and Welner (2013) proposed that the achievement gap is at least in some way attributable to the opportunity gap, which could include the opportunity to learn in a clean, safe school with adequate resources and opportunities for advancement. Kozol (2005, 2012) told of urban schools that were without heat or air conditioning, without working plumbing, with holes in the ceilings, and with many other deplorable conditions. Through his qualitative studies, he painted the picture of the bleakness of many schools in the nation's biggest cities, where many classes did not even have their own rooms and second graders were sharing a single classroom with sixth graders and where many rooms did not even have windows. He discussed one school that was in an old skating rink because no actual school building existed in the neighborhood. Carter and Welner (2013) emphasized how these unequal conditions affect student achievement; for students in satisfactory conditions achievement is higher and for students in fair or poor conditions achievement is lower.

In addition to the urban schools that are in poor condition, it should be noted that many rural schools are also in less than satisfactory condition (NCES, 2014). NCES reported only a 1% difference in the number of rural and urban schools that needed improvements to be in satisfactory condition, with urban schools in the lead. Unfortunately, the percentage of rural schools with a long-range plan for improvement was at 52% and the percentage of urban schools with such a plan was at 63% (NCES, 2014). Even though the needs are roughly the same in urban and rural districts, the urban districts are planning for improvements.

Generally, evidence suggests that the condition of school facilities affects the occupants' attitudes and performance (Bowers & Urick, 2011; Cleveland & Fisher, 2014; Earthman & Lemasters, 2011). A study conducted in Virginia showed that students scored 2.2-3.9% higher in subjects, including science, when in satisfactory buildings compared to students in unsatisfactory buildings (Bullock, 2007). A study conducted in Los Angeles found that when facilities were improved academic performance also improved (Buckley, Schneider, & Shang, 2004). Another study in Texas provided evidence that academic achievement was 4-9% higher in schools in the best conditions as opposed to schools in worst condition (Blincoe, 2008).

Many school buildings in America, in a variety of locales, are not adequate and these poor conditions affect teaching and learning. Many of these features are overlapping and related.

These features include lighting, acoustics, climate control, color, building age, density and school size, aesthetics, and indoor air quality.

Lighting

Lighting plays a major role in body rhythms (Figuerio & Rea 2010; Tanner, 2008; Tanner 2015). Poor lighting, either natural or artificial, can negatively affect learning (Marchand, Nardi, Reynolds, & Pamoukov, 2014); whereas, appropriate lighting can have a positive effect (Tanner, 2008). Classrooms with optimal lighting have been shown to produce higher reading scores and an atmosphere where students made fewer errors (Barkmann, Wessolowski, & Schulte-Markwort, 2012). Studies have supported the notion that natural lighting increases academic achievement (Figuerio & Rea 2010; Tanner, 2009). Tanner (2015) in a meta-analysis also found a statistically significant relationship between natural lighting and student achievement. In this meta-analysis natural lighting included adequate windows and skylights.

Acoustics

Just as being able to see is important to learning, so is being able to hear. Increased noise levels in classrooms have been shown to have a negative impact on performance due to the increased distraction of students (Halin et al., 2014; Klatte, Bergström, & Lachmann, 2013), and appropriate acoustics have been found to have a positive effect (Tanner, 2009). Students trying to read struggle more when background voices can be heard (Halin et al., 2014). The distractions appeared to be more challenging when the students were trying to read easy materials, even more so than when the students were trying to read difficult materials.

Increases in noise levels have been shown to affect achievement in both verbal tasks and reading (Klatte et al., 2013). Children who have attention disorders and who are not proficient in the primary language in the classroom are most affected by increased noise (Klatte et al., 2013).

Students need to be able to hear the lessons being presented without the distraction of outside noise, and they need a reasonably quiet atmosphere to concentrate during their individual study and reading time (Klatte et al., 2013).

Climate Control

When students are too hot or too cold it can be difficult to concentrate on the task at hand. Students perceive that the temperature can have a negative effect on their learning when it is not kept in a normal, comfortable range (Marchand et al., 2014). Teli, James, and Jentsch, (2013) found that children may desire different classroom temperatures than the adults, making the choices about such climate control more complicated. Therefore if teachers feel comfortable, the students may or may not feel the same comfort. Teli, James, and Jentsch (2013) suggested further studies on the classroom temperature preferences of students.

When climate control is a problem, humidity concerns are often increased as well. Classrooms with too much humidity are not good for the health of students or other school occupants (Angelon-Gaetz et al., 2014). It is important to remember that schools need properly functioning HVAC systems to be able to control the humidity year round in order to prevent mold and other problems associated with high humidity (Angelon-Gaetz et al., 2014).

Tanner (2015), in a meta-analysis, did not find that climate control significantly affected students' achievement. However, he refuted his findings stating that they did not line up with the bulk of the literature. Only three of the studies in his six-dissertation meta-analysis considered climate control, which weakened the final results.

Color

Color within classrooms can have an effect on learning, and combined with changes in lighting, those effects can be even more significant (Johnson & Maki, 2009; Johnson & Ruiter, 2013; Tanner, 2013). Evidence shows that white walls have unfavorable effects (Grube, 2013) and yet colors should not be too over-stimulating such as predominantly primary colors (Tanner, 2013). Color has been shown to influence motivation (Tanner, 2015) and white walls have been shown to increase anxiety and the inability to stay on task, as well as to cause depression in some individuals (Grube, 2013). Off-task behavior decreased in a study that introduced new wall colors of beige and blue-gray or other darker colors (Johnson & Maki, 2009). Having more than one color on the walls in classrooms may have more of a positive effect than one color throughout the whole space (Johnson & Maki, 2009; Tanner 2015).

Even though white or colors close to white such as off white and light gray are not the best choice, most classroom walls are still painted either white or something close to white (Grube, 2013). With all of the other advancements being made with new school construction and school renovations, color is often an overlooked yet inexpensive component that could be changed (Grube, 2013).

Building Age

Studies on building age are inconclusive because older schools that have been well maintained may be in more satisfactory condition than younger schools that have not had proper maintenance (Tanner, 2008). Even new schools that are in disrepair or are unclean are known to have negative effects (Baker & Bernstein, 2012; Uline et al., 2010). School cleanliness, regardless of school age, affects the health condition of the facility (Chan & Dishman, 2011). Schools that follow the building codes, including appropriate maintenance and repairs, have safer buildings and are shown to produce higher academic achievement (Lumpkin et al., 2014) regardless of the original age of the structure (Tanner, 2008).

Overcrowding and School Size

Overcrowding in schools is a recognized problem (ASCE, 2013; NCES, 2000). Kozol (2005) told of many schools that were experiencing overcrowding, where 40 or more students were placed in classrooms built and equipped to hold around 30 students. He told of others where the school day had to be shortened so that some of the students could attend in the morning and some in the afternoon because the number of students was over double the occupancy of the building. School populations where the student-teacher ratio are higher causes monitoring students to be more difficult and overcrowding to become a safety concern. Beyond the initial concerns of overcrowding, evidence has shown that students feel more comfortable and feel an increased sense of belonging in a school with open spaces for moving around (Tanner, 2013, 2015). Such open spaces that allow for movement also showed significant effects on students' academic scores (Tanner, 2009).

The overcapacity of students in schools seems to have more consequence than the actual size of the school population (Tanner & West, 2011). In other words, if the physical school building is large and has the appropriate open spaces and allows for easy movement, a large population does not seem to have a negative effect. It is in the schools where the structure is not designed to accommodate a large population, where there are negative effects. Some studies have shown that schools with smaller populations of students might lead to higher academic scores and safer environments; however, a fairly recent study on the size of schools did not find a significant impact on academics (Tanner & West 2011).

Tanner and West (2011) proposed a curvilinear relationship between school size and academic achievement and suggested further studies to confirm or deny that assumption. The evidence of a curvilinear relationship between size and benefits may indicate an optimal size to a school building or population, and a threshold size where the benefits of increased size are no longer apparent and in fact become detrimental. The ability of a larger school to offer more variety in classes and an increase in diversity of activities reaches a point where those benefits are outweighed by the sheer size of the population.

Aesthetics

Aesthetics is the subdivision of philosophy dealing with art and beauty and can be highly subjective. Within a school building, aesthetics includes features that have already been discussed such as lighting, color, and even density (Tanner, 2013). It also includes having an interesting and attractive look, which has been shown to affect academics and behavior (Uline & Tschannen-Moran, 2008, Uline et al., 2009). Cheryan, Ziegler, Plaut, and Meltzoff (2014) termed the décor of a classroom the *symbolic classroom* and discussed how the items placed with the class can affect performance and students' attitudes about subjects. They encourage educators to evaluate whether the décor makes all of the students comfortable and motivated. One example they gave was of classrooms that are not encouraging to female or minority students due to the exclusive display of wall art depicting white male scientists and astronauts. They go on to explain that an easy fix for this situation would be to hang neutral photos.

Often aesthetic decisions can be made by individual teachers for their classrooms; however, aesthetics goes beyond these elements to include the way in which spaces within a school are organized and the views available from the classroom windows (Tanner, 2013, 2015). If the organization of a school is to be aesthetically pleasing it should have an artistic or interesting layout; the architecture itself should be on display (Marable, 2015; Tanner, 2013). There appears to be a direct connection with the sustainability movement in school construction and an increase in the amount of aesthetically pleasing architecture and green spaces that are visible within and outside of school facilities (Marable, 2015; Tanner, 2013).

Cleanliness and appropriate maintenance could also be considered a part of the aesthetics of the school environment. Both cleanliness and maintenance have been shown to affect the school climate (Chan & Dishman, 2011; Uline et al., 2010). If a school is kept clean and is well maintained, students and teachers are more comfortable and able to focus (Baker & Bernstein, 2012; Uline et al., 2010).

Indoor Air Quality

In addition to the seven school building elements originally listed by Cash (1993) and reiterated by Earthman and Lemasters (2011), one feature of school learning spaces that has received increased attention over the past few years is that of indoor air quality. Poor indoor air quality is linked to health issues with students and teachers (Baker & Bernstein, 2012; Muscatiello et al., 2015). Evidence also supports the idea that poor indoor air quality correlates with a decrease in the ability of students to pay attention, and to effectively memorize, and concentrate (Bakó-Biró, Clements-Croome, Kochhar, Awbi, & Williams, 2012).

Humidity, cleanliness, the materials present, and air circulation are factors that affect indoor air quality. As discussed with climate control, high humidity is not conducive to quality indoor air (Angelon-Gaetz et al., 2014). Cleanliness and the use of chemicals in cleaning schools can either increase or decrease the quality of indoor air quality (Chan & Dishman, 2011). Poor indoor air quality is often more prominent in classrooms that lack windows and thus lack airflow (Tanner, 2013).

In addition to the effects of indoor air quality, outdoor air quality around the school site can also have an effect on student health and academic achievement (Mohai, Kweon, Lee, &

Ard, 2011). Kozol (2012) told of schools where the indoor and outdoor air quality were poor and the number of students with breathing related issues were high. Clean air is a critical element to consider when examining the condition of an educational facility.

Students' Attitudes Toward Science: Enjoyment, Engagement, and Value

Students' attitudes toward science can be predictive of their achievement; therefore, understanding variables that contribute to students' attitudes toward science could be beneficial in helping to encouraging positive attitudes and ultimately helping students to be more successful (Newell, Zientek, Tharp, & Moreno, 2015). Tytler and Osborne (2012) stated as a reason for the interest in students' attitudes about science, "It is the supposed failure of school science to engage sufficient students in studying science for a future career that has pushed students' attitudes to the fore as a matter of concern for society and policy makers" (p. 597).

Students' attitudes toward science, including their self-efficacy and interest in the subject, can also reflect their future participation or career plans (Newell et al., 2015; Unfried, Faber, Stanhope, & Wiebe, 2015). With this being the case, educators are encouraged to discover ways to improve students' attitudes toward science (PCAST, 2010; Unfried et al., 2015). Surveys are being created to better measure students' attitudes toward science (Unfried et al., 2015) as the understanding of aspects of attitudes are increasing (Newell et al., 2015). The current and somewhat limited understanding of students' attitudes about science are based on their "beliefs, values, and feelings" about the subject (Newell et al., 2015, p. 217).

Evidence shows that students find more value in their science classes when they do hands-on experimentation than if they are just passively receiving the information (Campbell et al., 2011; Gilmore, 2013). Evidence also supports the theory that active learning increases students' interest in science and their confidence in being able to perform and apply science concepts (Berk et al., 2014). A study that demonstrated the success of using hands-on medical problem solving required specific equipment and classroom space and showed an increase in student self-efficacy in the area of science (Berk et al., 2014).

Freeman et al. (2014) also found that with all class sizes active learning helped to increase overall academic achievement and decrease failure rates. A meta-analysis that examined 225 studies supported the positive effects of active learning for STEM classes (Freeman et al., 2014). Studies completed on active learning classrooms in college have provided evidence that such classrooms increase academic success (Park & Choi, 2014). Campbell et al. (2011) emphasized the importance of hands-on activities that cause the students to get “messy” while learning science, in order to experience the true value of the subject. In order to do the science experiments they have to have access to the correct resources. The inequities in available resources may be contributing to lower interest and lower achievement for those students that do not have adequate access (Carter & Welner, 2013).

Studies have suggested that appropriate classrooms, and resources, including appropriate and adequate technology, increase academic achievement (Baker & Bernstein, 2012; Tanner, 2015). Technology has been found to help students become more interested in their science subject within the classroom as well as increasing their extra-curricular participation in science activities (Butler et al., 2014; Shen et al., 2013; Shieh, 2012). Early on in the research about the effects of school buildings on academic achievement, Cash (1993) stated “science achievement scores were better in buildings with better science laboratory conditions” (p. 7).

Summary

The goal of this literature review was to show that even though much research has been conducted in the area of school facility effects, the need remains for replicate studies, studies with larger and more nationally representative samples, studies that examine subject specific classrooms, and studies that assess individual features within educational spaces. Currently, evidence shows that the conditions of the physical school buildings affect teaching and learning (Baker & Bernstein, 2012; Cash, 1993; Earthman & Lemasters, 2011; Lemasters, 1997; Uline et al., 2010) and the health of the occupants (Angelon-Gaetz et al., 2014; Baker & Bernstein, 2012; Muscatiello et al., 2015). Elements that have been examined include lighting, acoustics, climate control, color, building age, density and school size, aesthetics, movement and circulation, and indoor air quality.

In addition to researching the effects of the physical facilities, this review attempted to review literature about the importance of appropriate equipment and resources within classrooms, specifically within science classrooms. Research was scant on the need for appropriate science equipment; however, many studies discussed the benefits of hands-on learning in science classrooms, which requires flexible spaces (Duncanson, 2014) and access to equipment and supplies (Savasci & Tomul 2013). In order to perform many types of hands-on learning, teachers and students need access to the appropriate instructional and demonstration equipment. Another concept that emerged was the need for appropriate technology within the science classrooms. As mentioned earlier, Kozol (2012) found science classrooms where textbooks and lab equipment were non-existent and those where technology was antiquated or missing.

Many studies support the benefits of higher quality building elements; however, some studies have provided contradictory evidence. Areas where the evidence of studies have conflicting outcomes such as in the effects of school building age and school size (Tanner, 2008; Tanner & West, 2011) represent areas that need additional research or need to be understood through additional variables. For building age it is important to note that if a building has been properly maintained and updated the age may not have a significant effect (Tanner, 2008). For school size it was found that the population in comparison to the building capacity was a more appropriate variable to study (Tanner & West, 2011).

This literature review highlighted the need to focus on the effects of science classroom facilities and available equipment on students' attitudes toward science. Science classrooms that are old and have not been updated may not provide the appropriate physical spaces for teaching and learning, and science classrooms that are filled beyond capacity negatively affect learning and create an unsafe learning space.

CHAPTER THREE: METHODS

Design

This correlational study investigated a predictive relationship between high school science teachers' perceptions of the physical classrooms and school science resources and ninth grade students' attitudes about their current science class. A correlational design was chosen because this method is appropriate to use when attempting to identify relationships between predictor variables and criterion variables (Gall, Gall, & Borg, 2007).

The archival data used in this study came from the High School Longitudinal Study of 2009 (HSLS:09) conducted by the National Center for Educational Statistics (2011a). The predictor variables were science teachers' responses to questions about the effects of available instructional equipment, available demonstration equipment, and the available physical facilities for science instruction. Instructional equipment was defined as the equipment that students would use during instruction (NCES, 2011a). Demonstration equipment was defined as the equipment used by the teacher during instruction for the purpose of demonstrating science concepts (NCES, 2011a). The physical facilities were defined as the classroom in which the teacher was teaching the subject of science (NCES, 2011a). The criterion variables were the students' responses to questions about their attitudes toward the subject of science in which they were enrolled at the time they filled out the survey. The individual criterion variables were students' enjoyment of their science class, boredom with their science class, and perceived value of their science class (NCES, 2011a).

Research Questions

RQ1: How accurately can ninth grade students' *enjoyment* of their science class be predicted from a linear combination of science teacher indicators about their schools' science classroom facilities (instructional equipment, demonstration equipment, and physical facilities)?

RQ2: How accurately can ninth grade students' *boredom* with their science class be predicted from a linear combination of science teacher indicators about their schools' science classroom facilities (instructional equipment, demonstration equipment, and physical facilities)?

RQ3: How accurately can ninth grade students' *value* of their science class be predicted from a linear combination of science teacher indicators about their schools' science classroom facilities (instructional equipment, demonstration equipment, and physical facilities)?

Null Hypotheses

$H_0$1: High school students' *enjoyment* of their science class cannot be predicted from a linear combination of science teachers' perceptions of their available instructional equipment, available demonstration equipment, and condition of physical facilities.

$H_0$2: High school students' *boredom* with their science class cannot be predicted from a linear combination of science teachers' perceptions of their available instructional equipment, available demonstration equipment, and condition of physical facilities.

$H_0$3: High school students' *value* of their science class cannot be predicted from a linear combination of science teachers' perceptions of their available instructional equipment, available demonstration equipment, and condition of physical facilities.

Participants and Setting

High School Longitudinal Study of 2009

Archival data used for this study came from the High School Longitudinal Study of 2009 (HSLS:09), which was conducted by NCES. The HSLS:09 is the fifth and most recent in a series of longitudinal studies conducted by NCES to examine trends in education (NCES, 2011a). The HSLS:09 was intended to examine transitions of high school students from their high school freshman year into adulthood, focusing on their choices related to STEM education and careers (NCES, 2011a). The objective for HSLS:09 was to collect data at a number of times throughout the life of these students until they were in their mid-thirties (NCES, 2011a). The population of HSLS:09 was all ninth graders in 2009 from across the United States attending a school that had both ninth and eleventh grades (NCES, 2011a).

The sample for the HSLS consisted of a two-step process. First, 1,889 schools were randomly identified from across the nation. Of those 1,889 schools, 944 participated in the HSLS:09. Second, approximately 25 ninth grade students were randomly chosen from each of those 944 schools (NCES, 2011a). Students with severe disabilities or barriers of language were excluded from the sample. The total students sampled were 24,658. The students were the primary unit of analysis. Therefore, science teachers were chosen for participation only if they were teaching one of the sampled students (NCES, 2011a).

The electronic student survey was administered at the respective school of each student; however, a small percentage of students took the survey at home over the phone with an interviewer (NCES, 2011a). The setting for the web-based science teachers' survey was chosen by each of them at his or her convenience. Teachers also had the option to complete the survey via a phone conversation (NCES, 2011a). The data for the base year of the HSLS:09 was obtained in the fall of 2009. Therefore, both the ninth grade students and the science teachers were surveyed within the same time period (NCES, 2011a).

Sample for this Study

The researcher of this study further refined the sample from the HSLS:09 dataset by starting with the entire dataset of 24,658 cases and deleting all cases with any of the missing predictor or criterion variables. The final number of cases totaled 11,523.

The make-up of the student sample (N = 11,523) for the criterion variable is shown in Table 1 and Table 2. The school region and locale in which the sampled students attended are shown in Table 3 and Table 4.

Table 1

Student Gender

Sex	Sample
Male	5762
Female	5761

Table 2

Student Race/Ethnicity Sampled in HSLS:09

Race/ethnicity	Sample
American Indian/Alaska Native	68
Asian/Pacific Islander	986
Black or African American	999
Hispanic	1627
White	6811
Other race, more than one race or missing	1032

Table 3

Schools by Region

Region	Sample
Northeast	1689
Midwest	3156
South	4238
West	1719
Missing/Not Applicable	721

Table 4

Schools by Locale

Locale	
City	3002
Suburban	3264
Town	1366
Rural	3172
Missing/Not Applicable	719

The make-up of the teacher sample (*N* = 11,523) for the predictor variables consisted of the science teachers that were matched on the student sample in the fall of 2009 (NCES, 2011a). Therefore, the school information shown was the same for the teachers as it was for the students. Teacher gender and race/ethnicity are displayed in Table 5 and Table 6. The highest degree earned by the science teacher is displayed in Table 7.

Table 5

Science Teacher Gender

Sex	Sample
Male	5066
Female	6456
Missing	1

Table 6

Science Teacher Race/Ethnicity Sampled in HSLS:09

Race/ethnicity	Sample
Asian/Pacific Islander	219
Black or African American	423
Hispanic	395
White	10233
Other race, more than one race or missing	253

Table 7

Science Teacher Highest Degree Earned

Degree	Sample
Bachelor's degree	4911
Master's degree	5834
Educational Specialist diploma	380
Ph.D./M.D./law degree/other prof degree	398

Instrumentation

The data used for this study came from two instruments that are both part of The High School Longitudinal Study of 2009 (HSLS:09). The instruments are *HSLS:09 Base Year Student Questionnaire* and HSLS:09 (see Appendix C) and *Base Year Science Teacher Questionnaire* (NCES, 2011a; see Appendix D).

As stated earlier, the HSLS:09 is the fifth and most recent in a series of longitudinal studies developed and conducted by NCES to examine trends in education (NCES, 2011a). Longitudinal studies conducted by NCES began in 1972 and are projected to continue well into the future as they add to literature about educational trend. The HSLS:09 was intended to examine transitions of high school students from freshman year into adulthood, focusing on their choices related to STEM education and careers. Another focus of the HSLS:09 study was the changing environment of high school (NCES, 2011a). Field tests were conducted of the HSLE:09 instruments prior to the establishment of the actual instruments (NCES, 2011b). The validity of the instruments was increased as many items included had "known measurement properties" (based on initial field tests as well as an extensive use of redundancy and triangulation (Ingels et al., 2010, p. 20).

For the base year of the HSLS:09 study, instruments were given to students, administrators, counselors, parents, math teachers and science teachers (NCES, 2011a). The purpose of the HSLS:09 was to "attempt to identify factors such as motivation, beliefs, and interests that lead to academic goal-setting and decision-making" (NCES, 2011a, p. iii). The first follow-up surveys were administered in 2012, the second follow-up surveys were administered in 2013 with additional plan for follow-ups in the future (NCES, 2011a).

Because the dataset was public use from the NCES website, permission to use the data was not required. The data contained in the HSLS:09 study have been used in various government reports (Ingels, Dalton, Holder, Lauff, & Burns, 2011; Ingels et al., 2010) and peer-reviewed journal articles (Fuerst, 2014; Hill, & Dalton, 2013; Middleton, 2013).

The Student Survey

The student survey contained questions about demographics, school related experiences, locating information, and subject related topics (NCES, 2011b). The student instrument was designed to take no more than 35 minutes and was to be administered by computer during a school day. However, a few of the surveys were administered by phone to students who were unable to complete them at school. There were nine sections for the student survey. Section A obtained contact information for parent and for follow-up. Section B contained demographic questions. Section C inquired of the students' recent school experiences. Section D was constructed of questions about the students' mathematic experiences, identification, and link to the math teacher. Section E was the same as section D, except it dealt with the students' science experience, identification, and a link to the science teacher. Section F asked the students questions about their attitudes toward school including mathematics and science. Sections G and H inquired about the students' future plans for college and career. Section I contained questions about contact information for an alternate family member or friend for follow-up. The variables used for this study were taken from questions that consisted of four-point Likert scale responses.

The following were the actual items taken directly from the HSLS:09 student survey (NCES, 2011a) and used in this study. The responses were used as the criterion variables.

Question wording: How much do you agree or disagree with the following statements about your [fall 2009 science] course?

Variable: S1SENJOYING

Item wording: You are enjoying this class very much

1=Strongly agree

2=Agree

3=Disagree

4=Strongly disagree

Variable: S1SWASTE

Item wording: You think this class is a waste of your time

1=Strongly agree

2=Agree

3=Disagree

4=Strongly disagree

Variable: S1SBORING

Item wording: You think this class is boring

1=Strongly agree

2=Agree

3=Disagree

4=Strongly disagree

The Teacher Survey

The science teacher questionnaire was designed to take less than 30 minutes and could be completed at the convenience of the teachers (NCES, 2011b). The science teacher survey contained four sections. Section A collected background information. Section B was omitted from this study as it was intended for math teachers. Section C asked questions about the science department and science instruction in the school. Section D inquired about the teachers’ beliefs about teaching and the school. The variables used for this study were taken from questions that consisted of four-point Likert scale responses.

The following items were taken directly from the HSLS:09 science teacher questionnaire (NCES, 2012) and used in this study. The responses were used as the predictor variables.

Question wording: In your view, to what extent do the following limit how you teach?

Variable: N1STUEQUIP

Item wording: Shortage of other instructional equipment for students' use

0=Not applicable

1=Not at all

2=A little

3=Some

4=A lot

Variable: N1DEMOEQUIP

Item wording: Shortage of equipment for your use in demonstrations and other exercises

0=Not applicable

1=Not at all

2=A little

3=Some

4=A lot

Variable: N1FACILITIES

Item wording: Inadequate physical facilities

0=Not applicable

1=Not at all

2=A little

3=Some

4=A lot

Procedures

The researcher for this study began by data mining public-use data files (PUFs) for datasets that would provide variables about the effects of science classroom facilities and resources on student achievement. The projected path changed slightly when this researcher found the High School Longitudinal Study of 2009 (HSLS:09) dataset that would provide variables that could be analyzed to determine if there is a relationship between the condition of the facilities and available resources and students' thoughts and attitudes about science. After discovering the PUF, the next step for this study was to seek and receive Institutional Review Board (IRB) approval (see Appendix A). After approval was granted, archival data was obtained from the HSLS:09 database (NCES, 2011a). The complete dataset was acquired through the Education Data Analysis Tool (EDAT) section of the NCES website (NCES, n.d.) and was downloaded directly onto the researcher's password protected computer and then imported into SPSS 22. This dataset consisted of all surveyed students as individual cases. Each individual student case had all of the variables from the student survey, the teachers' surveys, the parents' surveys, and the administrators' surveys.

The researcher identified the necessary variables to be extracted out of the 4000 plus available variables using the documentation available on the dataset (NCES, 2011a). The researcher used EDAT to create a syntax file that could be run through SPSS to sparse out the required variables from the complete HSLS:09 dataset. The researcher then ran the syntax file and extracted the necessary variables. The researcher then manually coded the remaining variables to ensure that missing data would be examined appropriately. Missing data had originally been entered as -9, -8, and -7. Through the discrete missing variable feature on SPSS those entries could be excluded from analysis. In other words, cases where responses on the necessary variables were missing from the student or science teacher were excluded from the dataset. The final number of cases with all the predictor and criterion variables equaled 11,523 cases. Once the dataset had been downloaded, extracted, and prepared for the study it was ready for the data analysis.

Data Analysis

The data was screened for missing data and data inconsistencies using the sort function on SPSS. Data screening was conducted on each of the predictor variables (instructional equipment, demonstration equipment, physical facilities) and criterion variables (enjoyment of science, value of science, and boredom with science). Histograms and box and whisker charts were also analyzed to examine normality and outliers on all the variables (Warner, 2013, p. 153-154).

The data was analyzed using a multiple linear regression in order to see if the combined set of variables had a predictive value on the criterion variables of *enjoyment* of the science class, *boredom* with the science class, and *value* of the science class that the student was currently enrolled in. Multiple linear regression is an appropriate method for analyzing the strength and effect of a combination of predictors on criterions (Warner, 2013).

The analysis was conducted to examine how well the model of predictor variables consisting of science teachers' responses to questions about the effects of available instructional equipment, available demonstration equipment, and the available physical facilities for science instruction predict the criterion variables of students' enjoyment of their science class, boredom with their science class, and perceived value of their science class using the .01 alpha level in order to ensure a high level of significance.

CHAPTER FOUR: FINDINGS

Research Questions

RQ1: How accurately can ninth grade students' *enjoyment* of their science class be predicted from a linear combination of science teacher indicators about their schools' science classroom facilities (instructional equipment, demonstration equipment, and physical facilities)?

RQ2: How accurately can ninth grade students' *boredom* with their science class be predicted from a linear combination of science teacher indicators about their schools' science classroom facilities (instructional equipment, demonstration equipment, and physical facilities)?

RQ3: How accurately can ninth grade students' *value* of their science class be predicted from a linear combination of science teacher indicators about their schools' science classroom facilities (instructional equipment, demonstration equipment, and physical facilities)?

Null Hypotheses

$H_0$1: High school students' *enjoyment* of their science class cannot be predicted from a linear combination of science teachers' perceptions of their available instructional equipment, available demonstration equipment, and condition of physical facilities.

$H_0$2: High school students' *boredom* with their science class cannot be predicted from a linear combination of science teachers' perceptions of their available instructional equipment, available demonstration equipment, and condition of physical facilities.

$H_0$3: High school students' *value* of their science class cannot be predicted from a linear combination of science teachers' perceptions of their available instructional equipment, available demonstration equipment, and condition of physical facilities.

Descriptive Statistics

The data used for this study was extracted from the public use dataset High School

Longitudinal Study of 2009 (HSLS:09). The mean and standard deviation for each of the predictor variables (N = 11,523) of science teachers' perceptions of instructional equipment, demonstration equipment, and physical facilities are displayed in Table 8. The criterion variables (N = 11,523) of ninth grade students' attitudes about science are displayed in Table 9.

Table 8

Mean and Standard Deviation Scores for each Predictor Variable

Variables	Mean	SD
Predictor		
Instructional equipment - N1STUEQUIP	1.88	1.04
Demonstration equipment - N1DEMOEQUIP	1.99	1.06
Physical facilities - N1FACILITIES	1.79	1.11

Table 9

Mean and Standard Deviation Scores for each Criterion Variable

Variables	Mean	SD
Criterion		
Enjoyment of science - S1SENJOYING	2.20	.82
Science is a waste of time - S1SWASTE	3.12	.78
Boredom with science - S1SBORING	2.72	.89

Results

Data Screening

Prior to the actual data analysis, the data was screened for missing data and data inconsistencies using the sort function on SPSS. Data screening was conducted on each of the predictor variables (instructional equipment, demonstration equipment, physical facilities) and criterion variables (enjoyment of science, value of science, and boredom with science).

Box and whisker plots were used to detect outliers on each of the predictor and criterion variables. Outliers were found on the criterion variable of students' value of science for data points 11,241, 11,242, 11,422, and 11,423 (see Figure 2). The researcher then produced standardized z-scores for this variable and found all within normal range (between -3.30 and +3.30) as defined by Warner (2013, p. 153). The lowest z-score was -2.72 and the highest z-score was 1.13.

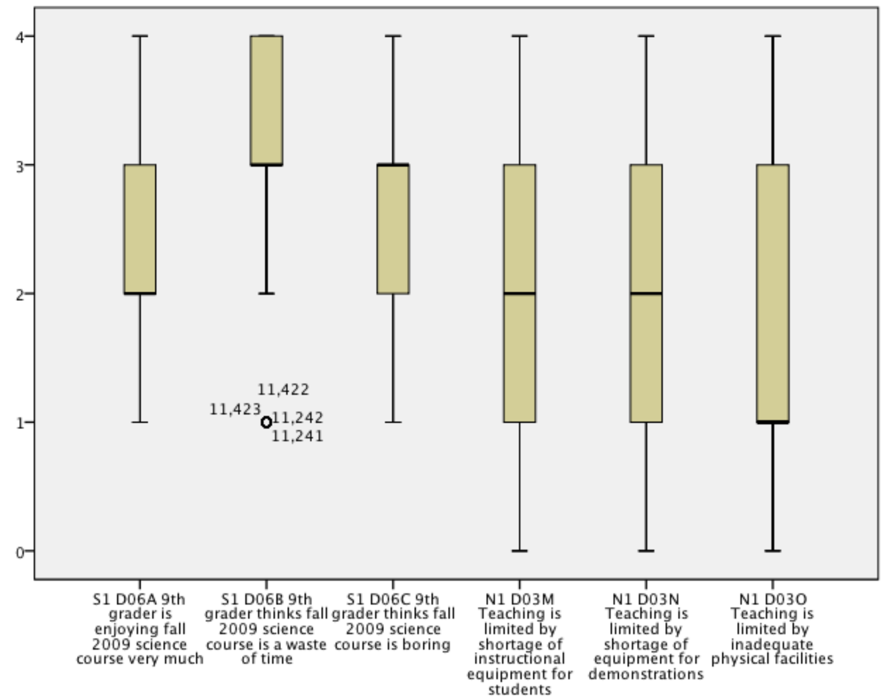

Figure 2. Box and whisker of criterion and predictor variables. This figure shows outliers.

Normality was examined through a series of histograms and found tenable (see figures 3 through 8 for histograms).

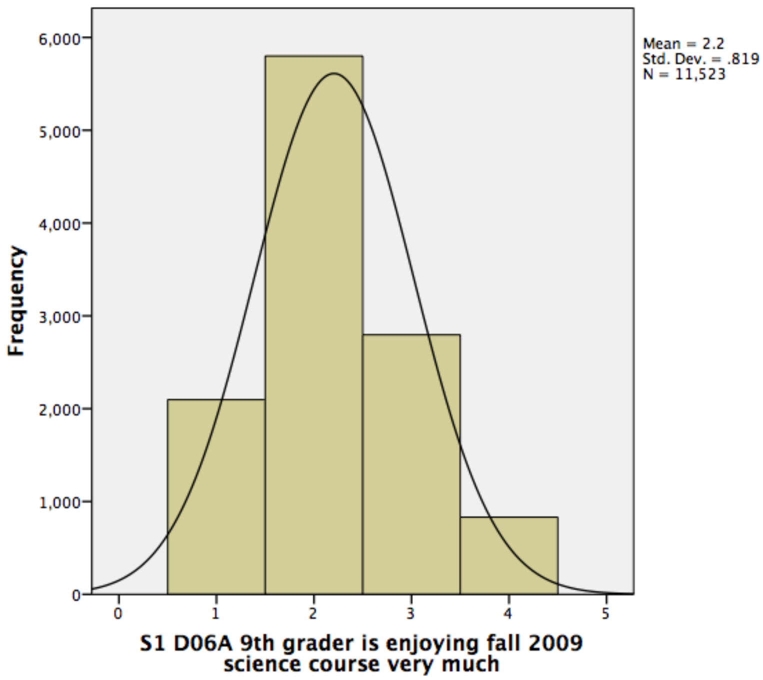

Figure 3. Histogram of criterion variable S1SENJOYING, 9th grade students' enjoyment of science. This figure illustrates acceptable normality.

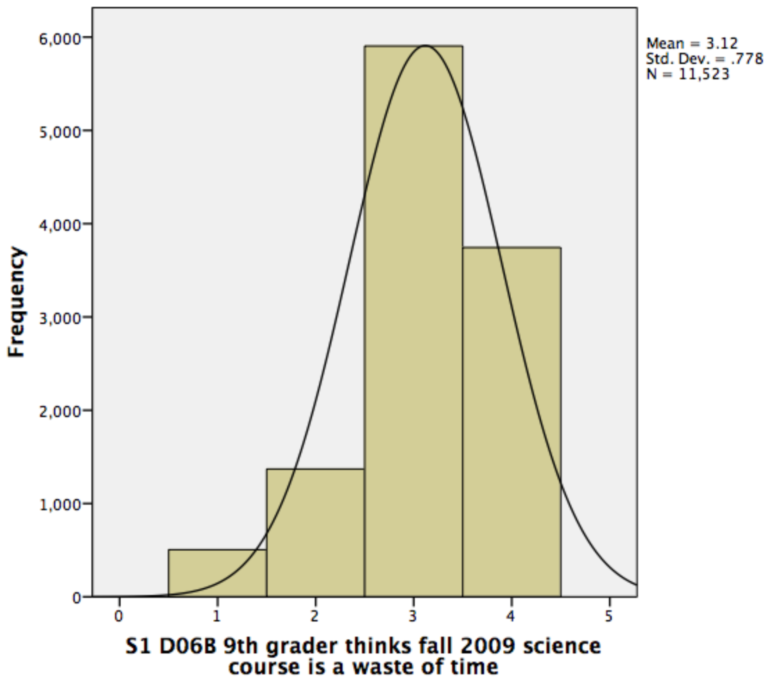

Figure 4. Histogram of criterion variable S1SWASTE, 9th grade students' feelings about science being a waste of time. This figure illustrates acceptable normality.

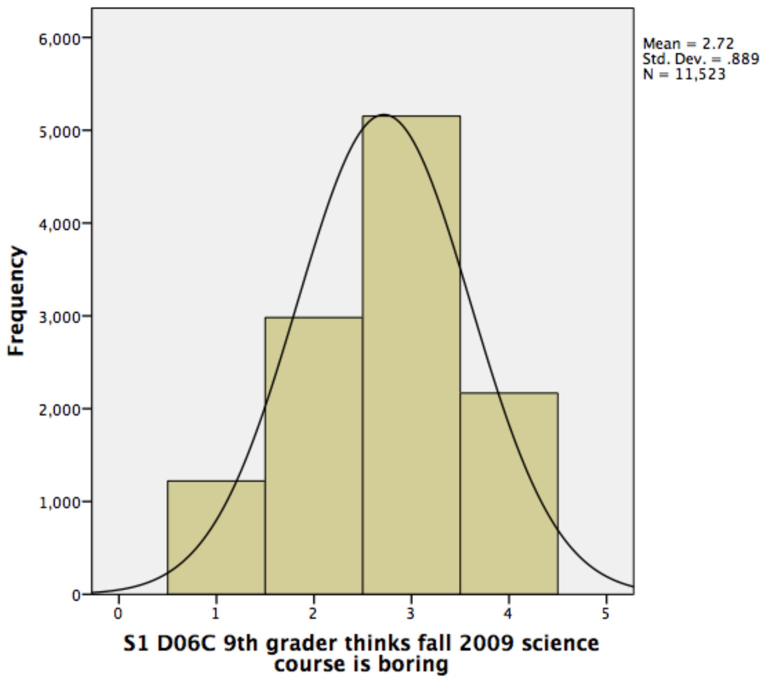

Figure 5. Histogram of criterion variable S1SBORING, 9th grade students' attitudes about whether or not science is boring. This figure illustrates acceptable normality.

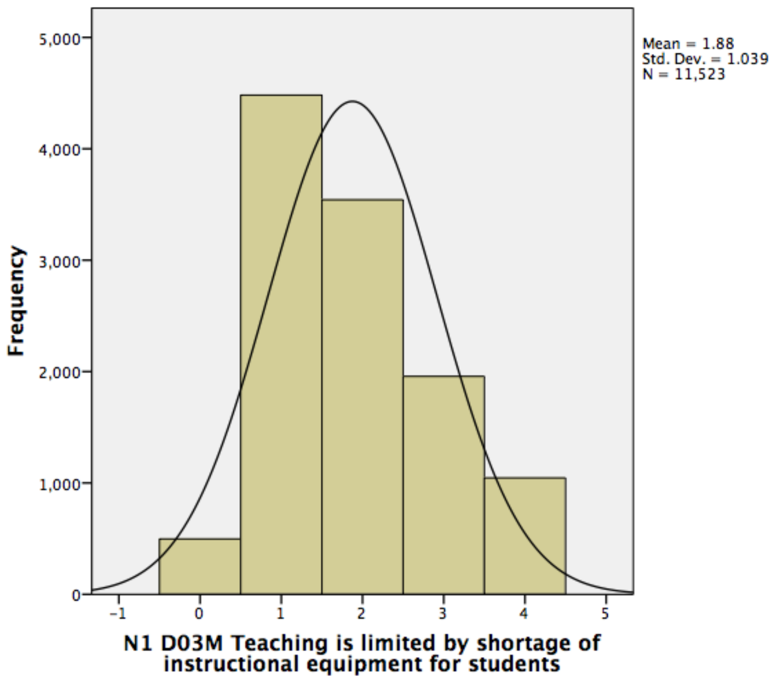

Figure 6. Histogram of predictor variable N1STUEQUIP, science teachers' perceptions of the effects of instructional equipment availability. This figure illustrates acceptable normality.

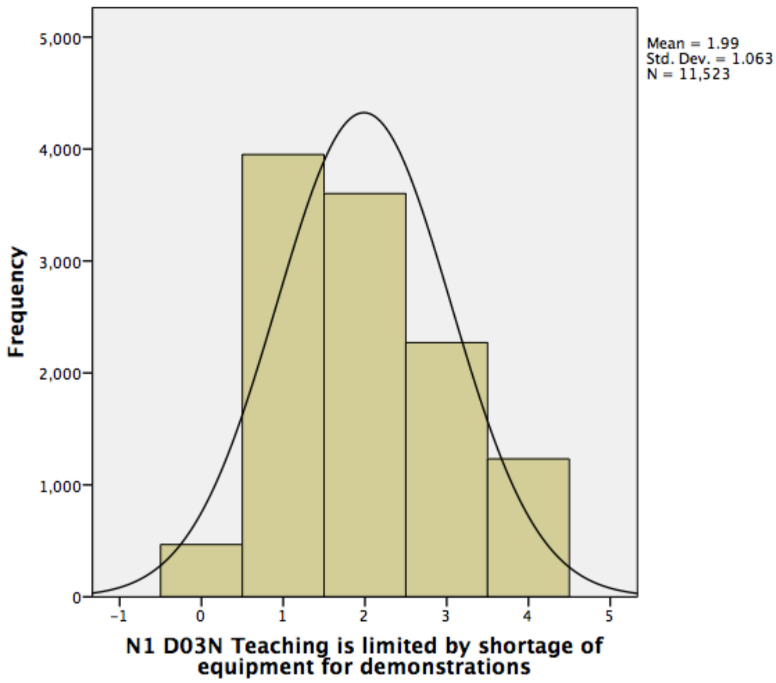

Figure 7. Histogram of predictor variable N1DEMOEQUIP, science teachers' perceptions of the effects of demonstration equipment availability. This figure illustrates acceptable normality.

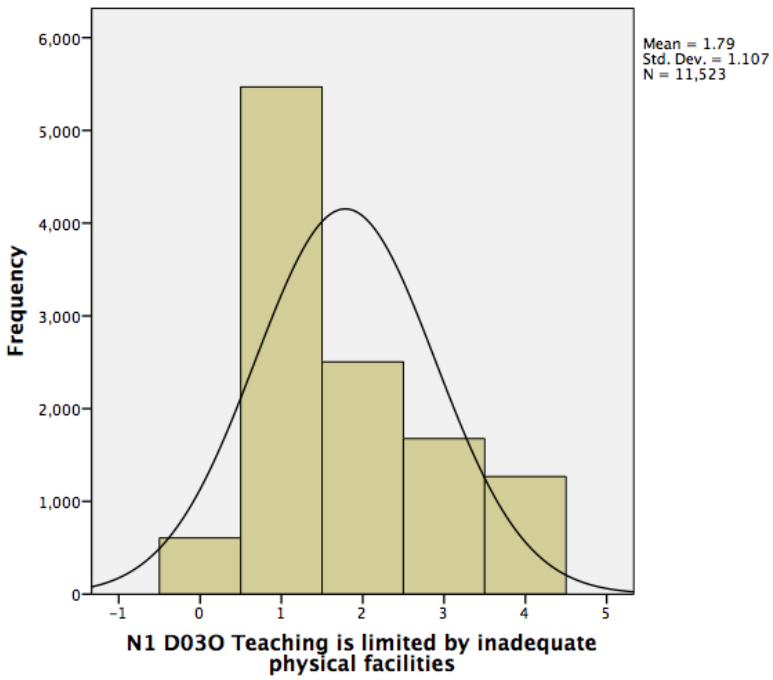

Figure 8. Histogram of predictor variable N1FACILITIES, science teachers' perceptions of the effects of facility conditions. This figure illustrates acceptable normality.

Assumption Testing

Multiple linear regression analysis required that assumptions of bivariate outliers, multivariate normal distribution, and the absence of multicollinearity be met. Scatterplots were used to determine the assumptions of bivariate outliers and multivariate normal distribution and the relationships between the criterion and predictor variables were found tenable. See figures 9 through 11 for scatterplots.

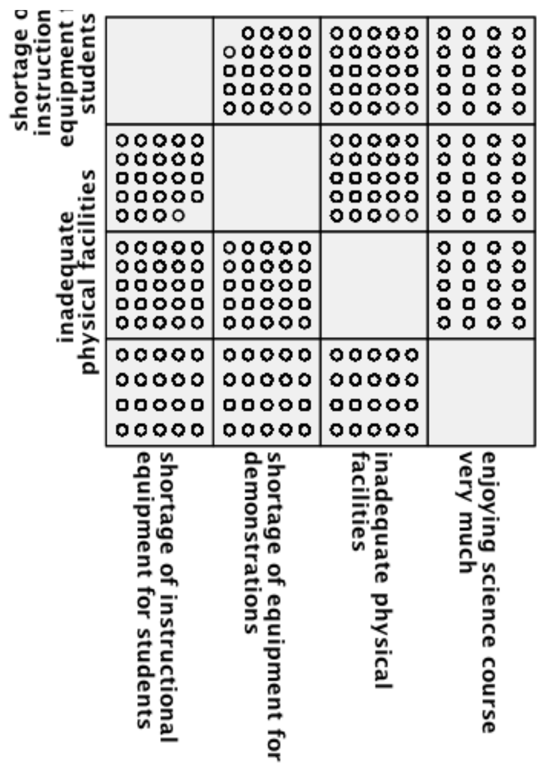

Figure 9. Scatterplots of criterion variable S1SENJOYING, students' enjoyment of science in relation to each predictor variable.

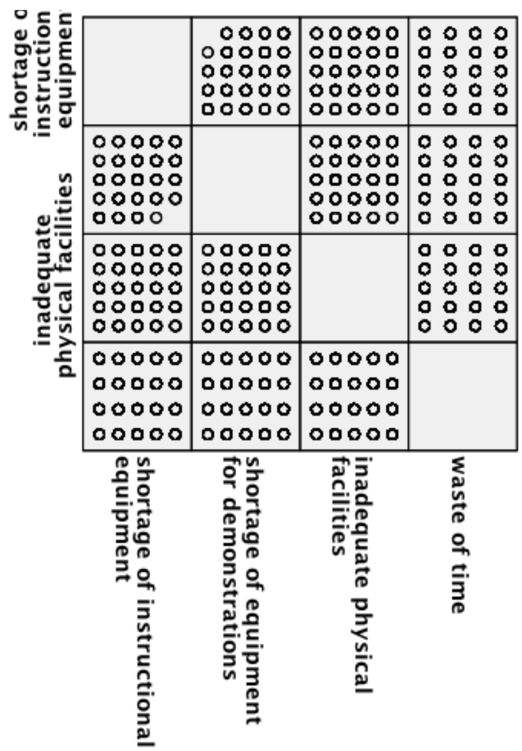

Figure 10. Scatterplots of criterion variable S1SWASTE, students' attitudes about whether science is a waste of time in relation to each predictor.

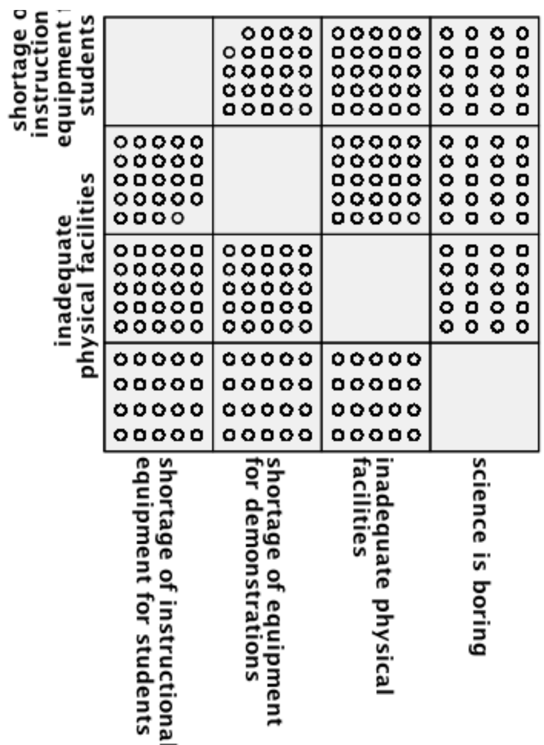

Figure 11. Scatterplots of criterion variable S1SBORING, students' attitudes about whether science is boring in relation to each predictor.

The assumption of the absence of multicollinearity for the predictor variables was then assessed using the variance inflation factors (VIF). They were all within normal range of 1 and 5 indicating the predictor variables were not correlated strongly (Green & Salkind, 2011). See Table 10 for variance inflation factors.

After data screening was conducted and assumptions were tested, three multiple linear regressions were run to analyze each null at the 95% confidence level. A multiple regression analysis was conducted to evaluate how well science teachers' perceptions of their classroom and available resources predicted high school students' attitudes about science. The three predictors were science teachers' perceptions of available instructional equipment, available demonstration equipment, and the condition of the physical educational facilities.

Table 10

Variance Inflation Factors

Variables	VIF
Predictor	
Instructional equipment - N1STUEQUIP	1.42
Demonstration equipment - N1DEMOEQUIP	1.42
Physical facilities - N1FACILITIES	1.42

Null Hypothesis One

The first research question looked at students' *enjoyment* of science class and the teachers' perceptions of the instructional equipment, demonstration equipment, and the condition of the school building. The multiple linear regression, with all three of the predictors, was statistically significant, $R = .05$, $R^2 = .003$, adjusted $R^2 = .002$, $F(3,11519) = 9.68$, $p < .01$. Meaning, approximately .2% of the variance of student *enjoyment* could be predicted from the linear regression of these variables. As the linear combination of predictors indicated an increase in the teacher's perception that their teaching was limited, student *enjoyment* decreased. The null hypothesis was rejected.

The best predictors of high school students' *enjoyment* of their science class were demonstration equipment ($p < .001$) and facilities ($p < .001$). Instructional equipment was not a significant predictor of students' *enjoyment* of their science class ($p = .34$). The strength of each individual predictor was analyzed through partial correlation. The partial correlations showed the relationship between the criterion variable and each predictor variable while controlling for the other predictors. These results showed that demonstration equipment ($r_{partial} = .04$) and the condition of the facilities ($r_{partial}$ = -.03) were statistically significant (p < .001). Demonstration equipment shortage had a weak relationship with students' decreased *enjoyment* of their science classes. The correlation between facilities and students' *enjoyment* of science is significant; however, it is below an extremely small effect size. Instructional equipment ($r_{partial}$ = - .01) did not have a statistically significant relationship with student *enjoyment* (p = .34). See table 11.

Table 11

Correlations of Predictor Variables with Criterion Variable Enjoyment of Science

Variable	B	Sig.	Partial Correlations	Sig.
Instructional Equipment	-.01	.34	-.01	.34
Demonstration Equipment	.05	.00	.04	.00
Facilities	-.03	.00	-.03	.00

Null Hypothesis Two

The second research question examined students' *boredom* of their science classes and the teachers' perceptions of the instructional equipment, demonstration equipment, and the condition of the school building. The multiple linear regression, with all three of the predictors, was statistically significant, $R = .05$, $R^2 = .003$, adjusted $R^2 = .002$, $F(3,11519) = 9.812$, $p < .01$. Meaning, approximately .2% of the variance of student *boredom* could be predicted from the linear regression of these variables. The null hypothesis was rejected. The data could be interpreted as an increase in teachers' perceived limitations indicated a decrease in student *boredom*. The results are contradictory to the first null and should be interpreted with caution as the student question about *boredom* was negatively worded which can cause confusion (Johnson, Bristow, & Schneider, 2011).

The best predictors of high school students' *boredom* of their science class were demonstration equipment ($p < .001$) and facilities ($p < .001$). Instructional equipment was not a significant predictor of students' *boredom* of their science class ($p = .19$). The strength of each individual predictor was analyzed through partial correlation (see Table 12). The partial correlations showed the relationship between the criterion variable and each predictor variable while controlling for the other predictors. These results showed that demonstration equipment ($r_{partial} = -.04$) and the condition of the facilities ($r_{partial} = .02$) were statistically significant ($p < .001$). As demonstration equipment shortages limited teaching the students' *boredom* with science increased. The correlation between facilities and students' *boredom* with science is significant; however, it is below an extremely small effect size. Instructional equipment ($r_{partial} = .01$) did not have a statistically significant relationship with student *boredom* ($p = .19$). See Table 12.

Table 12

Correlations of Predictor Variables with Criterion Variable Science is Boring

Variable	B	Sig.	Partial Correlations	Sig.
Instructional Equipment	.02	.19	.01	.19
Demonstration Equipment	-.06	.00	-.04	.00
Facilities	.04	.00	.02	.00

Null Hypothesis Three

The third research question looked at students' *value* of science class and the teachers' perceptions of the instructional equipment, demonstration equipment, and the condition of the school building. The multiple linear regression, with all three of the predictors, was statistically significant, $R = .05$, $R^2 = .003$, adjusted $R^2 = .003$, $F(3,11519) = 10.818$, $p < .01$. Meaning, approximately .3% of the variance of student *value* could be predicted from the linear regression of these variables. The null hypothesis was rejected. The data could be interpreted as when the linear combination of predictors indicated an increase in teaching hindrances, student *value* of science increased. The results are contradictory to the first null and should be interpreted with caution as the student question about *value* was negatively worded which can cause confusion (Johnson et al., 2011).

The best predictors of high school students' responses to *value* or whether science is a *waste of time* were demonstration equipment ($p < .001$) and facilities ($p < .01$). Instructional equipment was not a significant predictor of students' *value* of their science class ($p = .45$). The strength of each individual predictor was analyzed through a partial correlation (see Table 13).

The partial correlations show the relationship between the criterion variable and each predictor variable while controlling for the other predictors. These results showed that demonstration equipment ($r_{partial}$ = -.04) was statistically significant (p < .001) and the condition of the facilities ($r_{partial}$ = .02) was statistically significant (p < .05). As demonstration equipment shortages increased the limitations on teaching, students *valued* science less. The correlation between facilities and students' *value* of science is significant; however, it is so small that it is not considered even an extremely small effect size. Instructional equipment ($r_{partial}$ = -.01) did not have a statistically significant relationship with student enjoyment (p = .45). See Table 13.

Table 13

Correlations of Predictor Variables with Criterion Variable Science is a Waste of Time

Variable	B	Sig.	Partial Correlations	Sig.
Instructional Equipment	.01	.45	.01	.45
Demonstration Equipment	-.05	.00	-.04	.00
Facilities	.02	.00	.02	.01

CHAPTER FIVE: DISCUSSION, CONCLUSIONS, AND RECOMMENDATIONS

Discussion

The purpose of this correlational study was to examine whether science teachers' perceptions of their physical classroom environment and available resources had any relationship to their ninth grade students' attitudes toward science. Data mining was used in this study to locate a usable nationally representative dataset. The variables used to investigate this possible relationship were gleaned from a National Center for Education Statistics (NCES) database named the High School Longitudinal Study of 2009 (HSLS:09).

Evidence is growing that the physical school environment has effects on learning (Cash, 1993; Earthman & Lemasters, 2011). This study sought to add to the literature by examining a possible relationship between the effects of the physical science classroom and students' attitudes regarding science (enjoyment of science, boredom with science, and value placed on science).

Research Question One

The first research question looked at students' *enjoyment* of their science class and teachers' perceptions of their available instructional equipment, available demonstration equipment, and condition of physical facilities. The variables extracted from the HSLS:09 survey were not based on a theory and therefore, a definition of *enjoyment* was not provided. For the purposes of this study *enjoyment* was defined as a pleasurable and positive emotion or attitude (Tamborini et al., 2010), and/or a characteristic of intrinsic motivation (Deci & Ryan, 1985). Instructional equipment was defined as the equipment the student would use during instruction (NCES, 2012). Demonstration equipment was defined as the equipment used by the teacher during instruction for demonstration of science concepts (NCES, 2012). Physical facilities were defined as the science classroom in which the teacher is teaching the student being interviewed (NCES, 2012).

A significant relationship was found among the linear combination of predictor variables and *enjoyment*. In other words, if the available equipment and facilities were inadequate, the students had a decreased *enjoyment* level of the subject. The best predictors of high school students' *enjoyment* of their science class were demonstration equipment and facilities. However, both these relationships were weak and should be interpreted with caution.

Enjoyment, an indicator of intrinsic motivation based on the self-determination theory (SDT), is one emotion or attitude that can be predictive of student engagement and academic success (Reeve, 2012). Reeve (1989) stated, "Enjoyment contributes to intrinsic motivation by sustaining the willingness to continue and persist in the activity" (p. 87). Evidence suggests that students' attitudes toward science, including *enjoyment*, correlate with their achievement in the subject (Newell et al., 2015). Meaning that a higher level of *enjoyment* will coincide with a higher level of achievement. Therefore, if students have higher enjoyment due to better demonstration equipment and facilities, then they would be more likely to have higher achievement. This logic would support other literature, which suggests a positive relationship between educational facility conditions and achievement (Baker & Bernstein, 2012; Blincoe, 2008; Buckley et al., 2004; Bullock, 2007; Earthman & Lemasters, 2011; Lemasters, 1997; Uline et al., 2010). Cash (1993) specifically stated that science achievement was higher in schools with higher quality science labs.

Research Question Two

The second research question sought to investigate if the students' level of *boredom* with their science class was affected by the predictor variables of available instructional equipment, available demonstration equipment, and condition of physical facilities. The HSLS:09 student survey did not provide a definition for *boredom*; therefore *boredom* was defined as "a state of relatively low arousal and dissatisfaction which is attributed to an inadequately stimulating situation" (Mikulas & Vodanovich, 1993, p. 1), and a lack of intrinsic motivation (Caldwell, Darling, Payne, & Dowdy, 1999). Instructional equipment was defined as the equipment the student would use during instruction (NCES, 2012). Demonstration equipment was defined as the equipment used by the teacher during instruction for demonstration of science concepts (NCES, 2012). Physical facilities were defined as the science classroom in which the teacher is teaching the student being interviewed (NCES, 2012).

A significant relationship was found among these variables. In other words, if the available equipment and facilities were inadequate, the students' *boredom* was affected. The best predictors of high school students' *boredom* of their science class were demonstration equipment and facilities. However, both these relationships were weak and should be interpreted with caution.

Boredom is the lack of interest and/or motivation to engage in an activity. Lack of engagement contributes to lack of achievement (Reeve, 2012), thus an increase in *boredom* could coincide with a decrease in achievement. This logic would support other literature, which suggests a positive relationship between educational facility conditions and achievement (Baker & Bernstein, 2012; Blincoe, 2008; Buckley et al., 2004; Bullock, 2007; Earthman & Lemasters, 2011; Lemasters, 1997; Uline et al., 2010). Just as with *enjoyment*, the results of this study on the variable of *boredom* suggest that facilities have an effect on student boredom.

Research Question Three

The third research question examined whether or not there was a relationship between the predictor variables of available instructional equipment, available demonstration equipment, and condition of physical facilities and the criterion variable of how students *valued* the time they were spending in science class. The survey was not based on a theory and did not provide a definition for *value* or *perceived waste of time*; therefore, *value* was defined as importance, intrinsic importance, and/or usefulness (Eccles et al., 1983). Instructional equipment was defined as the equipment the student would use during instruction (NCES, 2012). Demonstration equipment was defined as the equipment used by the teacher during instruction for demonstration of science concepts (NCES, 2012). Physical facilities were defined as the science classroom in which the teacher is teaching the student being interviewed (NCES, 2012).

A statistically significant relationship was found between the linear combination of predictors and the criterion. In other words, if the conditions were poor students' *value* of science was affected. The best predictors of *value* were demonstration equipment and facilities. However, both these relationships were weak and should be interpreted with caution.

Value, or students' perceived importance or usefulness of science, is important to science achievement (Newell et al., 2015). The higher value students place on science could coincide with their effort and engagement (Newell et al., 2015; Reeve, 2012). Just as with *enjoyment* and *boredom*, the results of this study on the variable of *value* are in support of studies that suggest that facilities have effects on occupants (Baker & Bernstein, 2012; Blincoe, 2008; Buckley et al., 2004; Bullock, 2007; Earthman & Lemasters, 2011; Lemasters, 1997; Uline et al., 2010).

Conclusion

All of the nulls in this study were rejected yet the relationships between the conditions in science classrooms and students' attitudes were extremely weak. These results suggest that available science equipment and science classroom facilities do have a relationship with students' attitudes of *enjoyment*, *boredom* and whether or not students *value* science or perceive it is a waste of time. For the sake of this conclusion the three attitudes of *enjoyment*, *boredom*, and *value* will be combined and discussed as students' attitudes toward science. This is being assumed even though Reeve (1989) suggested a clear difference between enjoyment and interest, which can be seen as a value and/or the opposite of *boredom*, and the VIF scores for these variables also clearly showed that each variable measured a unique aspect of attitude. The relationships between the predictors and each criterion variable were extremely weak, however statistically significant, meaning the conditions of the science facilities and available resources did affect different aspects of students' attitudes.

Extensive research exists on students' attitudes based on self-determination theory (SDT) and for that reason this researcher proposes using this theory to further examine these results in light of what is known about students' attitudes and motivations. SDT proposes that optimal motivation occurs when a person feels competence, autonomy, and relatedness to others (Deci & Ryan, 1985). This researcher proposes that regardless of the physical conditions of the science classroom and adequacy of available resources, the influence of teachers who are able to promote the feelings of competence, autonomy, and relatedness within students outweighs these variables. This does not mean that educational facility conditions should not be considered; however, it suggests that many other variables are influencing classroom outcomes. Studies have shown that the physical environment in which teachers work does affect their attitudes and performance (Buckley et al., 2005; Earthman & Lemasters, 2009; Horng, 2009). Optimally, teachers would not need to accommodate for poor facilities or lack of appropriate equipment.

The student-teacher dialectical framework within SDT explains that the learning environment either supports or thwarts the positive emotions and positive attitudes of students such as those being examined in this study that in turn affect motivation (Reeve, 2012). This framework does not consider the physical facilities; however, evidence is available that shows the physical condition of learning spaces and the available resources contribute to the overall classroom environment and the climate within the school (Uline et al., 2010). Evidence also shows that the overall climate within the school has an effect on the occupants (Uline et al., 2010).

In addition, studies are available on the effects of redesigned science classrooms at the college level. Improvements to college science classrooms have shown to produce increases in interest, engagement, and achievement (Park & Choi, 2014). Studies of college science classrooms have also shown that the more a classroom environment promotes student autonomy both socially and physically, the more likely students are to have positive attitudes about the subject (Ratelle, Guay, Vallerand, Larose, & Senecal, 2007).

With the considerations about the effects of the school climate it could be surmised that although the physical conditions of the learning spaces do have an effect on the students, there are other variables that may have more of an effect. It can be assumed that other variables whether they correlate with the school conditions or not, have a stronger influence over students' attitudes. The climate of the classroom, whether it is in poor physical condition or not, can be more influenced by the attitude of the teacher and the techniques the teacher employs. Science teachers could be utilizing teaching methods that encourage students' feeling of competence, autonomy, and relatedness through maintaining students' attention and engagement.

The fact that demonstration equipment, the equipment used by the teacher, had the most predictive value may mean that if a science teacher has adequate demonstration equipment he is more able to engage the students in learning the subject regardless of whether the classroom conditions are satisfactory or whether there is adequate instructional equipment. The demonstrations led by the teacher, if done effectively, could be successfully promoting all of the positive feelings suggested by SDT. The teaching techniques used during demonstration could involve volunteers (autonomy), could engage the whole class (relatedness), and could help all of the students feel successful (competence).

Instructional equipment used by the students during instruction, did not appear to have a significant relationship with any of the examined attitudes. This appears to be contradictory to studies that demonstrate that hands-on learning is preferred by students (Berk e al., 2014; Gilmore, 2013; Hofstein & Lunetta, 2004); however, there is evidence that experiments can be time consuming and even frustrating to some students (Hofstein & Lunetta, 2004).

Even though the effects of facilities and available resources in this study appear to have only an extremely small effect size on student attitudes, a consistently statistical significance was found with each null. With this as a consideration, and evidence provided from a long list of other studies that facilities affect occupants, it is imperative to continue examining how school facilities and resources affect occupants.

Implications

Studies have shown that school facility conditions affect the occupants (Bowers & Urick, 2011; Cash, 1993; Cleveland & Fisher, 2014; Earthman & Lemasters, 2011; Lemasters, 1997, Tanner, 2015) and that resources available can be correlated with the condition of facilities (Carter & Welner 2013; Kozol, 2012). Most educational facility studies have been conducted at a regional or state level (Tanner, 2015) and few have been conducted that specifically examine science classrooms. This study added to the body of knowledge by examining the relationship of a nationally representative sample of science teachers' perceptions of the physical high school science classroom environment and their ninth grade students' attitudes about science.

Educators are encouraged to increase the interest and achievement of students in science fields; therefore, it is imperative to understand the factors that contribute to students' positive attitudes and success. This study helps to identify variables that appear to have an impact on students. Demonstration equipment, the equipment used by the teacher during instruction, appeared to have the most impact. These findings suggest that different types of science classroom equipment might play different roles in students' enjoyment and value of science. These findings also suggest that the certain types of equipment in the science classroom have more impact than the physical classroom conditions.

Limitations

The threats to internal validity include any and all unknown variables that affected the responses of the teachers and students. There are many variables that studies such as these are unable to control for that would affect the teachers' perceptions of their classrooms and the students' attitudes toward science. The internal threat of subjectivity is also a concern as the survey questions for the teachers and students were about their perceptions. There is also the concern about the unclear definition of the variables chosen for this study as well as the use of the word attitude to encompass those variables.

On the teachers' survey the options available for the teachers to choose about the condition of the facilities and the availability of resources were not based on pre-defined levels. The school buildings could have been considered satisfactory or unsatisfactory with a standardized assessment and the teachers could have indicated the opposite conditions in their classrooms. Two teachers with similar classrooms and available resources could have answered the questions differently. There was no indication about important classroom conditions such as whether the classrooms were overcrowded or whether the classrooms being used for science were indeed designed for science instruction. There was also no indication as to whether or not classrooms were unsafe for any reason. A concern also exists about the reasoning of the high number of teachers who chose not to fill out the surveys.

The student survey was filled out early in the ninth grade year. Students could have been answering the questions based on their previous experiences in science rather than their current classroom experiences. Research also indicates that student attitudes toward science are established before they enter high school (Newell et al., 2015). The students' attitudes toward science have been affected by many variables outside of the school condition and available resources.

Another consideration about the surveys is that both the student and teacher surveys used positively and negatively worded questions. Evidence shows that negatively worded questions can lead the answers to be more negative and they can confuse those taking the survey (Johnson et al., 2011). For the variables used for this study the student had one positively worded question and two negatively worded, and the teacher had three negatively worded. This could have affected the way these questions were completed. Another concern about the results is that the statistical significance could have been due to the sheer number of cases (N = 11,523); however, the consistency with the three research questions suggests this is not likely.

The threats to external validity or whether the study is applicable to other groups include the fact that the dataset used for this study was from 2009 and the responses of students and or teachers being asked the same questions today or in the future might be different.

Recommendations for Future Research

Even though there are many studies that have been conducted on the effects of school facilities and this study contributes to such literature, there are many studies yet to be completed to fill in the gaps and increase understanding. One such area is in school facility assessments. Studies that would help to establish consistent definitions of school conditions such as those in the Commonwealth Assessment of Physical Environments (CAPE) and those used by the National Center for Education Statistics (NCES) would help to clearly define aspects and features and how each affects occupants.

Future studies on the effects of science classroom conditions on student attitudes could be conducted using different grade levels and different ages of students. Also, more recent data could be examined, in order to have a sample that is more representative of the current population of students.

Another suggestion would be to have a nationwide dataset such as the one used for this study; however, one that investigates specific features and elements of school buildings and how they influence both teachers and students. Such a study could be based on a specific theory that pertains to students' attitudes and could offer a clearer understanding of combinations of variables that may have a relationship with occupants' attitudes or success as well as an increased knowledge of individual variables that standout. Such theories that could be helpful include, however, are not limited to expectancy-value theory (EVT; Eccles et al., 1983) or self-determination theory (SDT; Deci, Vallerand, Pelletier, & Ryan, 1991). Examining student attitudes in light of EVT could focus on their beliefs about their own competence on a given task and the value of that given task (Wigfield & Eccles, 2000). Examining students' attitudes in light of SDT could focus on students' interest in learning, value of education and their own competence and abilities (Deci et al., 1991). The use of either of these theories in examining students' attitudes toward science could be helpful as students' attitudes are often predictive of their achievement (Newell et al., 2015).

Baker and Bernstien (2012) as well as Tanner (2015) suggested changing the focus of school facility studies from those focused on whether or not school buildings are adequate or inadequate to those that are functional and high performing. Understanding about individual building elements and combinations of elements may further this research. With a nationwide dataset that focuses on facility questions, it might be easier to control for mediating variables such as school climate, socio-economic variables, community engagement, etc. A national study that was conducted longitudinally such as the one used for this study may be able to investigate relationships between facilities and occupants at different ages and grade-levels.

In addition, studies would be helpful that investigate the specific elements within science classrooms that are most effective. Such studies could provide more understanding about individual elements and also subject specific elements such as those necessary for biology, physics, earth science, or chemistry. With such studies it would be beneficial to include an investigation of technology within the science classroom.

The study of technology within science classrooms could be a whole area of study. Virtual labs are one aspect; integrated technology could be another. The use of technology within classrooms at different developmental ages could also add to the understanding of the influence technology has on learning science. With the continued increase in technology use this will be an ever-changing area in need of analysis.

Another interesting path for studies that would further the understanding of demonstration versus instructional equipment would be to investigate the benefits of group work with less equipment or providing enough equipment for each individual to have his or her own. Studies could examine statistically significant differences with different levels of available equipment.

Additional studies could be conducted that investigate how school building conditions affect teacher retention. Teacher retention is a concern especially with math and science teachers. Understanding how the physical school conditions affect teachers' health, attitudes, performance, and ultimately retention rates could be helpful. If building conditions could be identified that affect teacher turnover, then changes and/or improvements might be performed that would remedy what is becoming an epidemic problem in America. Buckley et al. (2005) examined teachers' reasons for leaving specific schools, or for leaving the profession of teaching entirely, and found the quality of school facilities did influence their decisions. Their study was conducted in Washington, D.C. and they encouraged further research that would add to the evidence of the effects of school building quality or conditions on teacher turnover across the nation.

Synthesis studies could be conducted such as the ones conducted by Lemasters (1997) and Bailey (2009) with a focus on science classroom facilities. There also appears to be enough studies available that a meta-analysis could be conducted on studies that examine the relationship between school facility conditions and student attitudes and/or student achievement. Tanner (2015) conducted a meta-analysis; however, that was limited to six dissertations, and more comprehensive meta-analyses may broaden the understanding of the effects of school facility conditions.

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APPENDIX A: IRB Approval

LIBERTY UNIVERSITY.
INSTITUTIONAL REVIEW BOARD

December 1, 2015

Angela Y. Ford
IRB Application 2372: The Relationship between Science Classroom Facility Conditions and Ninth Grade Students' Attitudes toward Science

Dear Angela,

The Liberty University Institutional Review Board has reviewed your application in accordance with the Office for Human Research Protections (OHRP) and Food and Drug Administration (FDA) regulations and finds your study does not classify as human subjects research. This means you may begin your research with the data safeguarding methods mentioned in your IRB application.

Your study does not classify as human subjects research because it will not involve the collection of identifiable, private information.

Please note that this decision only applies to your current research application, and any changes to your protocol must be reported to the Liberty IRB for verification of continued non-human subjects research status. You may report these changes by submitting a new application to the IRB and referencing the above IRB Application number.

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

Sincerely,

[redacted]

G. Michele Baker, MA, CIP
Administrative Chair of Institutional Research
The Graduate School

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APPENDIX B: Permission to Use Figure of Theoretical Model

On Wed, May 11, 2016 at 9:21 AM, Ford, Angel <[redacted]> wrote:

Greetings!

I am contacting you because I would like to ask permission to **reproduce** your Theoretical Model figure (shown below) in my Dissertation/Thesis. After defending my Dissertation/Thesis, my program requires me to submit it for publication in the Liberty University open-access institutional repository, the Digital Commons, and in the Proquest thesis and dissertation subscription research database. If you allow this, I will provide a citation of your work as follows:

Earthman, G. I., & Lemasters, L. K. (2011). The influence of school building conditions on students and teachers: A theory-based research program (1993-2011). The ACEF Journal, 1(1), 15-36.

Thank you for your consideration in this matter!

Angel

Angel Ford, Ed.D.
Research Associate
Education Facilities Clearinghouse
George Washington University, GSEHD

On Wed, May 11, 2016 at 9:28 AM, Linda Lemasters <[redacted]> wrote:

Good Morning, Angel,

You have my permission.

I am happy to see this model maintaining a place in the world of research.

Best regards,

linda

LINDA K. LEMASTERS, ED.D.
ASSOCIATE PROFESSOR AND DIRECTOR OF EFC
EDUCATIONAL ADMINISTRATION AND POLICY STUDIES, DEL
GSEHD, THE GEORGE WASHINGTON UNIVERSITY
[redacted] (C)

USDOE EDUCATION FACILITIES CLEARINGHOUSE (EFC)
VISIT US at ***WWW.EFC.GWU.EDU***

Glen Earthman 9:53 AM (18 minutes ago)

to me

Angela - Most certainly you have my permission to use the model. I too am glad the model is being used. Glen

APPENDIX C: Student Survey from the High School Longitudinal Study of 2009 (HSLS:09) – Open source from http://nces.ed.gov/surveys/hsls09/

* Questions marked with an asterisk (*) were not asked of all respondents.

SECTION A: Student Background

Next we are going to ask you a few questions about your background.

What is your sex?
Male
Female

Are you Hispanic or [Latino/Latina]?
Yes
No
* Which of the following are you?
Mexican, Mexican-American, Chicano
Cuban
Dominican
Puerto Rican
Central American such as Guatemalan, Salvadoran, Nicaraguan, Costa Rican, Panamanian, or Honduran
South American such as Colombian, Argentine, or Peruvian Other
Hispanic or Latino or Latina

[In addition to learning about your Hispanic background, we would also like to know about your racial background.] Which of the following choices describe your race? You may choose more than one. (Check all that apply.)
White
Black or African American
Asian
Native Hawaiian or other Pacific Islander
American Indian or Alaska Native
* Which one of the following are you?
Chinese
Filipino
Southeast Asian such as Vietnamese or Thai South
Asian such as Indian or Sri Lankan Other Asian such
as Korean or Japanese
What is your birth date?
Month
Day
Year
1991 or earlier
1992
1993
1994
1995
1996 or late
What was the first language you learned to speak when you were a child? Was it...
English
Spanish
Another language
English and Spanish equally or English and
another language equally?

* What is the [other] language you first learned to speak?
A European language, such as French, German, or Russian
A Chinese language
A Filipino language
A Southeast Asian language such as Vietnamese or Thai
A South Asian language such as Hindi or Tamil
Another Asian language such as Japanese or Korean
A Middle Eastern language such as Arabic or Farsi, or
Another language

* How often do you speak [this language] with your mother or female guardian at home?

    Never
    Sometimes
    About half the time
    Most of the time
    Always
    No mother or female guardian in your household

* How often do you speak [this language] with your friends?

    Never
    Sometimes
    About half the time
    Most of the time
    Always

SECTION B: Previous School Experiences

Next we are going to ask you a few questions about your background.
What grade were you in last school year (2008-2009)?

    7th
    Grade
    8th
    Grade
    9th
    Grade

You were in an ungraded program
During the last school year (2008-2009), did you attend [current school] or did you attend a different school?

    [current school]
    Different school
    You were homeschooled

* During the last school year (2008-2009), what school did you attend?

    School Name
    City
    State/Foreign County

Since the beginning of the last school year (2008-2009), which of the following activities have you participated in? (Check all that apply.)

    Math club
    Math competition
    Math camp
    Math study groups or a program where you were tutored in math
    Science club
    Science competition
    Science camp
    Science study groups or a program where you were tutored in science
    None of these

Since the beginning of the last school year (2008-2009), how often have you done the following science activities?

    Read science books and magazines
        Never
        Rarely
        Sometimes
        Often
    Accessed web sites for computer technology information
        Never
        Rarely
        Sometimes
        Often
    Visited a science museum, planetarium or environmental center
        Never
        Rarely
        Sometimes
        Often

* What math course did you take in the 8th grade? If you took more than one math course, please choose your most advanced or most difficult course.

Math 8
Advanced or Honors Math 8 not including Algebra
Pre-algebra
Algebra I including IA and IB
Algebra II or Trigonometry
Geometry
Integrated Math
Other advanced math course such as pre-calculus or calculus
Other math

* What was your final grade in this math course?
(If your school uses numerical grades only, please answer in terms of the letter equivalent. If you don't know the equivalent, assume that

90 to 100 is an "A"
80 to 89 is a "B"
70 to 79 is a "C"
60 to 69 is a "D"
Anything less than 60 is "below D")

A
B
C
D
Below D
Your class was not graded

* What science course did you take in the 8th grade? If you took more than one science course, please choose your most advanced or most difficult course.

Science 8
General Science or General Science 8
Biology
Life science
Pre-AP or pre-IB Biology
Chemistry
Earth Science
Environmental Science
Integrated Science
Principles of Technology
Physical Science Physics
Other science course

* What was your final grade in this science course?
(If your school uses numerical grades only, please answer in terms of the letter equivalent. If you don't know the equivalent, assume that ...

90 to 100 is an "A"
80 to 89 is a "B"
70 to 79 is a "C"
60 to 69 is a "D"
Anything less than 60 is "below D")

A
B
C
D
Below D
Your class was not graded

SECTION C: Math Experiences

Now we are going to ask you a few questions about your experiences with math.
How much do you agree or disagree with the following statements?

You see yourself as a math person

Strongly agree
Agree

Disagree
Strongly disagree

Others see you as a math person
Strongly agree
Agree
Disagree
Strongly disagree

When you are working on a math assignment, how often do you think you really understand the assignment?
Never
Rarely
Sometimes
Often

Are you currently taking a math course this fall?
[Were you taking a math course in the fall of 2009?]
Yes
No

What math course(s) are you currently taking this fall?
[What math course(s) were you taking in the fall (2009)?]
(Check all that apply.)
Algebra I including IA and IB
Geometry
Algebra II
Trigonometry
Review or Remedial Math including Basic, Business, Consumer, Functional or General math
Integrated Math I
Statistics or Probability
Integrated Math II or above
Pre-algebra
Analytic Geometry
Other advanced math course such as pre-calculus or calculus
Other math course

* Why are you taking [fall 2009 math course]?
[If late December or later add: If you are no longer taking this course, think back to the fall when you answer this question and the questions that follow.]
(Check all that apply.)
You really enjoy math
You like to be challenged
You had no choice, it is a school requirement
The school counselor suggested you take it
Your parent(s) encouraged you to take it
A teacher encouraged you to take it
There were no other math courses offered
You will need it to get into college
You will need it to succeed in college
You will need it for your career
It was assigned to you
Some other reason
You don't know why you are taking this course

* How much do you agree or disagree with the following statements about your [fall 2009 math course]?
You are enjoying this class very much
Strongly agree
Agree
Disagree
Strongly
disagree

You think this class is a waste of your time
Strongly agree
Agree
Disagree
Strongly disagree

You think this class is boring
Strongly agree
Agree
Disagree
Strongly disagree

How much do you agree or disagree with the following statements about the usefulness of your [fall 2009 math] course? What students learn in this course.is useful for everyday life.
Strongly agree

Agree
Disagree
Strongly disagree
will be useful for college.
Strongly agree
Agree
Disagree
Strongly disagree
will be useful for a future career.
Strongly agree
Agree
* How much do you agree or disagree with the following statements about your [fall 2009 math] course?
You are confident that you can do an excellent job on tests in this course
Strongly agree
Agree
Disagree
Strongly disagree
You are certain that you can understand the most difficult material presented in the textbook used in this course
Strongly agree
Agree
Disagree
Strongly disagree
You are certain that you can master the skills being taught in this course
Strongly agree
Agree
Disagree
Strongly disagree
You are confident that you can do an excellent job on assignments in this course
Strongly agree
Agree
Disagree
Strongly disagree
How much do you agree or disagree with the following statements about [your math teacher]? Remember, none of your teachers or your principal will see any of the answers you provide.
Your math teacher values and listens to students' ideas.
Strongly agree
Agree
Disagree
Strongly disagree
treats students with respect.
Strongly agree
Agree
Disagree
Strongly disagree
treats every student fairly.
Strongly agree
Agree
Disagree
Strongly disagree
thinks every student can be successful.
Strongly agree
Agree
thinks mistakes are okay as long as all students learn. Strongly agree
Agree
Disagree
Strongly disagree
treats some kids better than other kids.
Strongly agree
Agree
Disagree
Strongly disagree
makes math interesting.
Strongly agree
Agree
Disagree
Strongly disagree
treats males and females differently.
Strongly agree
Agree

Disagree
Strongly disagree
makes math easy to understand.
Strongly agree
Agree
Disagree
Strongly disagree

SECTION D: Science Experiences

Now we are going to ask you a few questions about your experiences with science.
How much do you agree or disagree with the following statements?
You see yourself as a science person
Strongly agree
Agree
Disagree
Strongly disagree
Others see you as a science person
Strongly agree
Agree
Disagree
Strongly disagree
When you are working on a science assignment, how often do you think you really understand the assignment?
Never
Rarely
Sometimes
Often
Are you currently taking a science course this fall?
[Were you taking a science course in the fall of 2009?]
Yes
No
What science course(s) are you currently taking this fall?
[What science course(s) were you taking in the fall (2009)?] (Check all that apply.)
Biology I
Earth Science
Physical Science
Environmental Science
Physics I
Integrated Science I
Chemistry I
Integrated Science II or above
Anatomy or Physiology
Advanced Biology such as Biology II, AP, or IB
Advanced Chemistry such as Chemistry II, AP, or IB
General Science
Principles of Technology
Life Science
Advanced Physics such as Physics II, AP or IB
Other earth or environmental sciences such as ecology, geology, oceanography, or meteorology
Other biological sciences such as botany, marine biology, or zoology
Other physical sciences such as astronomy or electronics
Other science course
* Why are you taking [fall 2009 science course]?
[If late December or later add: If you are no longer taking this course, think back to the fall when you answer this question and the questions that follow.]
(Check all that apply.)
You really enjoy science
You like to be challenged
You had no choice, it is a school requirement
The school counselor suggested you take it
Your parent(s) encouraged you to take it
A teacher encouraged you to take it
There were no other science courses offered
You will need it to get into college
You will need it to succeed in college
You will need it for your career
It was assigned to you
Some other reason

You don't know why you are taking this course

* How much do you agree or disagree with the following statements about your [fall 2009 science] course?

You are enjoying this class very much

Strongly agree
Agree
Disagree
Strongly disagree

You think this class is a waste of your time

Strongly agree
Agree
Disagree
Strongly disagree

You think this class is boring

Strongly agree
Agree
Disagree
Strongly disagree

* How much do you agree or disagree with the following statements about the usefulness of your [fall 2009 science] course?

What students learn in this course...

is useful for everyday life.

Strongly agree
Agree
Disagree
Strongly disagree

will be useful for college.

Strongly agree
Agree
Disagree
Strongly disagree

will be useful for a future career.

Strongly agree
Agree
Disagree
Strongly disagree

* How much do you agree or disagree with the following statements about your [fall 2009 science] course?

You are confident that you can do an excellent job on tests in this course

Strongly agree
Agree
Disagree
Strongly disagree

You are certain you can understand the most difficult material presented in the textbook used in this course

Strongly agree
Agree
Disagree
Strongly disagree

You are certain you can master the skills being taught in this course

Strongly agree
Agree
Disagree
Strongly disagree

You are confident that you can do an excellent job on assignments in this course

Strongly agree
Agree
Disagree
Strongly disagree

~~~~~~

How much do you agree or disagree with the following statements about [your science teacher]? Remember, none of your teachers or your principal will see any of the answers you provide.

Your science teacher...

values and listens to students' ideas.

Strongly agree
Agree
Disagree
~~~~~~

Strongly disagree
treats students with respect. Strongly
agree
Agree
Disagree
Strongly disagree
treats every student fairly.
Strongly agree
Agree
Disagree
Strongly disagree
thinks every student can be successful.
Strongly agree
Agree
Disagree
Strongly disagree
thinks mistakes are okay as long as all students learn.
Strongly agree
Agree
Disagree
Strongly disagree
treats some kids better than other kids.
Strongly agree
Agree
Disagree
Strongly disagree makes science
interesting.
Strongly agree
Agree
Disagree
Strongly disagree
treats males and females differently.
Strongly agree
Agree
Disagree
Strongly disagree
makes science easy to understand.
Strongly agree
Agree
Disagree
Strongly disagree

SECTION E: Home and School

Now we are going to ask you a few questions about your experiences at home and in school.
How much do you agree or disagree with the following statements about your current school?
You feel safe at this school
Strongly agree
Agree
Disagree
Strongly disagree
You feel proud being part of this school
Strongly agree
Agree
Disagree
Strongly disagree
There are always teachers or other adults in your school that you can talk to if you have a problem
Strongly agree
Agree
Disagree
Strongly disagree
School is often a waste of time
Strongly agree
Agree
Disagree
Strongly disagree

Getting good grades in school is important to you
Strongly agree
Agree
Disagree
Strongly disagree
How often do you...
go to class without your homework done?
Never
Rarely
Sometimes
Often
go to class without pencil or paper?
Never
Rarely
Sometimes
Often
go to class without
books?
Never
Rarely
Sometimes
Often
go to class late?
Never
Rarely
Sometimes
Often
Not including lunch or study periods, what is your favorite school subject?
English
Foreign Language
Science
Art
Mu
sic
Mathematics
Physical Education or Gym
Religion
Health Education
Computer Education or Computer Science
Social Studies, History, Government, or Civics
Career preparation class such as health professions, business, or culinary arts
Other
Not including lunch or study periods, what is your least favorite school subject?
English
Foreign Language
Science
Art
Music
Mathematics
Physical Education or Gym
Religion
Health Education
Computer Education or Computer Science Social
Studies, History, Government, or Civics
Career preparation class such as health professions, business, or culinary arts
Other
How much do you agree or disagree with the following statements?
Studying in school rarely pays off later with good jobs
Strongly agree
Agree
Disagree
Strongly disagree
Even if you study, you will not be able to get into college
Strongly agree
Agree
Disagree
Strongly disagree
Even if you study, your family cannot afford to pay for you to attend college

Strongly agree
Agree
Disagree
Strongly disagree

Working is more important for you than attending college
Strongly agree
Agree
Disagree
Strongly disagree

Since the beginning of the last school year (2008-2009), which of the following people have you talked with about which math courses to take this year?
(Check all that apply.)
Your mother or female guardian
Your father or male guardian
Your friends
A favorite teacher
A school counselor
None of these people

Since the beginning of the last school year (2008-2009), which of the following people have you talked with about which science courses to take this year?
(Check all that apply.)
Your mother or female guardian
Your father or male guardian
Your friends
A favorite teacher
A school counselor
None of these people

~~~~~~

Since the beginning of the last school year (2008-2009), which of the following people have you talked with about which courses to take this year other than math and science courses?
(Check all that apply.)
Your mother or female guardian
Your father or male guardian
Your friends
A favorite teacher
A school counselor
None of these people

~~~~~~

Since the beginning of the last school year (2008-2009), which of the following people have you talked with about going to college?
(Check all that apply.)
Your mother or female guardian
Your father or male guardian
Your friends
A favorite teacher
A school counselor
None of these people

~~~~~~

Since the beginning of the last school year (2008-2009), which of the following people have you talked with about possible jobs or careers when you are an adult?
(Check all that apply.)
Your mother or female guardian
Your father or male guardian
Your friends
A favorite teacher
A school counselor
None of these people

Since the beginning of the last school year (2008-2009), which of the following people have you talked with about personal problems?
(Check all that apply.)
Your mother or female guardian
Your father or male guardian
Your friends
A favorite teacher
A school counselor
~~~~~~

None of these people

As far as you know, are the following statements true or false for your closest friend?
Your closest friend...
gets good grades.
True
False
is interested in school.
True
False
attends classes regularly.
True
False
plans to go to college.
True
False
How much do you agree or disagree with each of the following statements?
If you spend a lot of time and effort in your math and science classes...
you won't have enough time for hanging out with your friends.
Strongly agree
Agree
Disagree
Strongly disagree
you won't have enough time for extracurricular activities.
Strongly agree
Agree
Disagree
Strongly disagree
you won't be popular.
Strongly agree
Agree
Disagree
Strongly disagree
people will make fun of you.
Strongly agree
Agree
Disagree
Strongly disagree

In general, how would you compare males and females in each of the following subjects?
English or language arts
Females are much better
Females are somewhat better
Females and males are the same
Males are somewhat better
Males are much better
Math
Females are much better
Females are somewhat better
Females and males are the same
Males are somewhat better
Males are much better
Science
Females are much better
Females are somewhat better
Females and males are the same
Males are somewhat better
Males are much better
During a typical weekday during the school year how many hours do you spend...
working on math homework and studying for math class?
Less than 1 hour
1 to 2 hours
2 to 3 hours
3 to 4 hours
4 to 5 hours
5 or more hours

working on science homework and studying for science class?
Less than 1 hour
1 to 2 hours
2 to 3 hours
3 to 4 hours
4 to 5 hours
5 or more hours

working on homework and studying for the rest of your classes?
Less than 1 hour
1 to 2 hours
2 to 3 hours
3 to 4 hours
4 to 5 hours
5 or more hours

participating in extracurricular activities such as sports teams, clubs, band, student government?
Less than 1 hour
1 to 2 hours
2 to 3 hours
3 to 4 hours
4 to 5 hours
5 or more hours

working for pay not including chores or jobs you do around your house?
Less than 1 hour
1 to 2 hours
2 to 3 hours
3 to 4 hours
4 to 5 hours
5 or more hours

spending time with your family?
Less than 1 hour
1 to 2 hours
2 to 3 hours
3 to 4 hours
4 to 5 hours
5 or more hours

hanging out or socializing with your friends?
Less than 1 hour
1 to 2 hours
2 to 3 hours
3 to 4 hours
4 to 5 hours
5 or more hours

watching television or movies?
Less than 1 hour
1 to 2 hours
2 to 3 hours
3 to 4 hours
4 to 5 hours
5 or more hours

playing video games?
Less than 1 hour
1 to 2 hours
2 to 3 hours
3 to 4 hours
4 to 5 hours
5 or more hours

chatting or surfing online?

Less than 1 hour

1 to 2 hours

2 to 3 hours

3 to 4 hours

4 to 5 hours

5 or more hours

Are you participating in any of the following programs?

Talent Search

Yes

No

Upward Bound

Yes

No

Gear Up

Yes

No

AVID (Advancement in Individual Determination)

Yes

No

MESA (Mathematics, Engineering, Science Achievement)

Yes

No

SECTION F: Plans for Postsecondary Education

Now we are going to ask you a few questions about your plans for school and college as you progress through high school.

Including this year, how many years of math do you expect to take during high school?

One year

Two years

Three years

Four or more years

* What are the reasons you plan to take more math courses during high school? (Check all that apply.)

Taking more math courses is required to graduate

Your parents will want you to

Your teachers will want you to

Your school counselor will want you to

You are good at math

You will need more math courses for the type of career you want

Most students who are like you take a lot of math courses

You enjoy studying math

Taking more math courses will be useful for getting into college

Taking more math courses will be useful in college

Your friends are going to take more math courses

Some other reason

You don’t know why, you just probably will

* Do you plan to enroll in...

an Advanced Placement (AP) calculus course?

Yes

No

You haven't decided yet

You don't know what this is

an International Baccalaureate (IB) calculus course?

Yes

No

You haven't decided yet

You don't know what this is

Including this year, how many years of science do you expect to take during high school?

One year

Two years

Three years

Four or more years

* What are the reasons you plan to take more science courses during high school? (Check all that apply.)

Taking more science courses is required to graduate
Your parents will want you to
Your teachers will want you to
Your school counselor will want you to
You are good at science
You will need more science courses for the type of career you want
Most students who are like you take a lot of science courses
You enjoy studying science
Taking more science courses will be useful for getting into college
Taking more science courses will be useful in college
Your friends are going to take more science courses
Some other reason
You don’t know why, you just probably will

* Do you plan to enroll in...
an Advanced Placement (AP) science course?
Yes
No
You haven't decided yet
You don't know what this is
an International Baccalaureate (IB)
science course?
Yes
No
You haven't decided yet
You don't know what this is

An "education plan" or a "career plan" is a series of activities and courses that you will need to complete in order to get into college or be successful in your future career.

Have you put together...
a combined education and career plan
an education plan only
a career plan only or
none of these?

* Who helped you put your [education and career/education/career] plan together? (Check all that apply.)
A counselor
A teacher
Your parents
Someone else
No one

Have you taken or are you planning to take...
the PSAT?
No
Yes
You haven't decided yet
You don't know what this is
the
SAT?
No
Yes
You haven't decided yet
You don't know what this is
American College Testing Service (ACT) test?
No
Yes
You haven't decided yet
You don't know what this is
an Advanced Placement (AP) test?
No
Yes
You haven't decided yet
You don't know what this is
a test for the International Baccalaureate (IB)?
No
Yes
You haven't decided yet
You don't know what this is

How sure are you that you will graduate from high school?
Very sure you'll graduate
You’ll probably graduate

You probably won't graduate
Very sure you won't graduate

SECTION G: Life After High School

Now we are going to ask you a few questions about your future life after high school.
We understand that you may not have thought a lot about some of these questions or you may not have all of the information right now. If you are unsure about how to answer a question, please make your best guess. Your thoughts are very important to us..
As things stand now, how far in school do you think you will get?

Less than high school High
school diploma or GED
Start but not complete an Associate's degree
Complete an Associate's degree
Start but not complete a Bachelor's degree
Complete a Bachelor's degree
Start but not complete a Master's degree
Complete a Master's degree
Start but not complete a Ph.D., M.D., law degree, or other high level professional degree
Complete a Ph.D., M.D., law degree, or other high level professional degree
Don't know

* How sure are you that you will go on to college to pursue a Bachelor's degree after you leave high school?

Very sure you'll go
You'll probably go
You probably won't go
Very sure you won't go

Whatever your plans, do you think you have the ability to complete a Bachelor's degree?

Definitely
Probably
Probably not
Definitely not

Would you be disappointed if you did not graduate from college with a Bachelor's degree by the time you are 30 years old?

Ye
s
No

What do you plan to do during your first year after high school?
(check all that apply.)

Enroll in an Associate's degree program in a two-year community college or technical institute
Enroll in a Bachelor's degree program in a college or university
Obtain a license or certificate in a career field
Attend a registered apprenticeship program
Join the armed services
Get a job
Start a family
Travel
Do volunteer or missionary work
Not sure what you want to do

* Are you more likely to attend a public or private 4-year college, or have you not thought about this yet?

Public
Private
Haven't
thought
about this

* Are you more likely to attend an in-state or out of state 4-year college, or have you not thought about it yet?

In-state
Out of state
Haven't thought about this

* Have you gotten information about the cost of tuition and mandatory fees at a specific [in-state public/out-of-state public/private] college?

Ye
s
No

* What is the cost of one year's tuition and mandatory fees at that public 4-year college in your state? Include the cost of courses and required fees such as student activity fees and student health fees. Do not include optional expenses such as room and board.

* Is that tuition and mandatory fees only, or does that also include other fees such as room and board?

Tuition and mandatory fees only
Tuition, mandatory fees, and other fees

* What is the cost of one year's tuition and mandatory fees at that private 4-year college?
Include the cost of courses and required fees such as student activity fees and student health fees. Do not include optional expenses such as room and board.

* Is that tuition and mandatory fees only, or does that also include other fees such as room and board?
Tuition and mandatory fees only
Tuition, mandatory fees, and other fees

* What is the cost of one year's tuition and mandatory fees at that out-of-state public 4-year college? Include the cost of courses and required fees such as student activity fees and student health fees. Do not include optional expenses such as room and board.

* Is that tuition and mandatory fees only, or does that also include other fees such as room and board?
Tuition and mandatory fees only
Tuition, mandatory fees, and other fees

* What is your best estimate of the cost of one year's tuition and mandatory fees at a public 4-year college in your state?
Include the cost of courses and required fees such as student activity fees and student health fees.
Do not include optional expenses such as room and board.

* Is that tuition and mandatory fees only, or does that also include other fees such as room and board?
Tuition and mandatory fees only
Tuition, mandatory fees, and other fees

* How confident are you in the accuracy of your estimate of the cost of one year's tuition and mandatory fees at a public 4-year college in your state? Are you...
very confident
somewhat confident or
not at all confident?

As things stand now, what is the job or occupation that you expect or plan to have at age 30?
You don't know
No
Yes

How much have you thought about this choice? Have you thought about it...
not at all
a little
somewhat or a
lot?

When you talk about your plans for the future, would you say you talk...
mostly to your parents
more to your parents than your friends
to your parents and your friends about the same
more to your friends than your parents
mostly to your friends or
you don't talk to your parents or to your friends about your plans for the future?

APPENDIX D: Teacher Survey from the High School Longitudinal Study of 2009 (HSLS:09) Open source from http://nces.ed.gov/surveys/hsls09/

* Questions marked with an asterisk (*) were not asked of all respondents.

SECTION A: Teacher Background

We would like to confirm your sex. Are you male or female?
- Male
- Female

Are you of Hispanic or [Latino/Latina] origin?
- No
- Yes

[In addition to learning about your Hispanic background, we would also like to know about your racial background.] Which of the following choices describe your race? You may choose more than one. (Check all that apply.)
- White
- Black/African American Asian
- Native Hawaiian or Other Pacific Islander
- American Indian or
- Alaska Native

What is the highest degree you have earned?
- Associate's degree
- Bachelor's degree
- Master's degree
- Educational Specialist diploma
- Ph.D., M.D., law degree, or other high level professional degree
- You do not have a degree

* In what year did you receive your [highest degree earned]?

* What is the name of the college or university where you earned your [highest degree earned]?

* Was this [highest degree earned] awarded by [institution name]'s department of education?
- No
- Yes

* What was your major field of study for your [highest degree earned]?
(Please type your major in the space below and click on "Search for major". Do not enter abbreviations. If you had more than one major field of study, please report the major most closely related to your current teaching position.)

* In what year did you receive your Bachelor's degree?

* What is the name of the college or university where you earned your Bachelor's degree?

* Was this Bachelor's degree awarded by [institution name]'s department of education?
- No
- Yes

* What was your major field of study for your Bachelor's degree?
(Please type your major in the space below and click on "Search for Major". Do not enter abbreviations. If you had more than one major field of study, please report the major most closely related to your current teaching position.)

* Have you started, but not completed, any work on a degree beyond [highest degree earned]? (If you have started more than one of the degrees listed below, please select the higher degree.)
- No, have not started any other degree
- Yes, started but not completed an Associate's degree
- Yes, started but not completed a Bachelor's degree
- Yes, started but not completed a Master's degree
- Yes, started but not completed an Education Specialist diploma
- Yes, started but not completed a Ph.D., M.D., law degree, or other high level professional degree

* In which of the following branches of math have you taken one or more college-level courses? (Check all that apply.)

Algebra such as Abstract Algebra,
Linear Algebra, or Groups, Rings, and Fields
Applied mathematics such as Dynamical systems, Game theory, Information theory, Mathematical modeling, or Mathematical physics
Calculus, Analysis, or Differential equations
Discrete mathematics, Combinatorics, or Graph theory
Foundations, Philosophy, History of mathematics, or Logic
Geometry, Trigonometry, or Topology
Number theory
Probability or Statistics
None of these

* Which of the following college-level science courses have you taken? (Check all that apply.)

Any biology or life science course Any
chemistry course
Any earth or space science course Any
physics course
Any engineering course Any
physical science course None
of the these

* Which of the following college-level biology or life science courses have you taken? (Check all that apply.)

Anatomy or physiology
Botany or plant physiology
Cell biology
Ecology
Entomology
Genetics or Evolution
Microbiology
Zoology or animal behavior
None of the these

* Which of the following college-level chemistry courses have you taken? (Check all that apply.)

Analytical chemistry
Biochemistry
Organic chemistry
Physical chemistry
None of these

* Which of the following college-level earth or space science courses have you taken? (Check all that apply.)

Astronomy
Environmental science
Geology
Meteorology
Oceanography
Physical
Geography
None of these

* Which of the following college-level physics courses have you taken? (Check all that apply.)

Electricity and magnetism
Heat and thermodynamics
Mechanics
Modern/quantum physics
Nuclear physics
Optics
None of these

* Did you work in a job in which you used college-level math before becoming a teacher?

No
Yes

* Did you work in a job in which you used college-level science before becoming a teacher?

No
Yes

Did you enter teaching through an alternative certification program?

No

Yes

* Which of the following describes the math teaching certificate you currently hold in [your state]?

Regular or standard state certificate or advanced professional certificate
Certificate issued after satisfying all requirements except the completion of a probationary teaching period
Certificate that requires some additional coursework or passing a test
Certificate issued to persons who must complete a certification program in order to continue teaching
You do not hold any of these certifications in this state

* In which grades does this certificate allow you to teach math in [your state]? (Check all that apply.)

Kindergarten through 5th grade (any or all grades)
6th through 8th grade (any or all grades)
9th through 12th grade (any or all grades)

* Including this school year, how many years have you taught high school (grades 9-12) math at any school?

* Which of the following describes the science teaching certificate you currently hold in [your state]?

Regular or standard state certificate or advanced professional certificate
Certificate issued after satisfying all requirements except the completion of a probationary teaching period
Certificate that requires some additional coursework or passing a test
Certificate issued to persons who must complete a certification program in order to continue teaching
You do not hold any of these certifications in this state

* In which grades does this certificate allow you to teach science in [your state]? (Check all that apply.)

Kindergarten through 5th grade (any or all grades)
6th through 8th grade (any or all grades)
9th through 12th grades for biology or life sciences (any or all grades)
9th through 12th grade for chemistry, physics, or physical science (any or all grades)
9th though 12th grades for earth or space sciences (any or all grades)

* Including this school year, how many years have you taught high school (grades 9-12) science at any school?

The next two questions are about your years teaching [math / science / math, science,] or any other subject. Including this school year, how many years have you taught...

any grade K-8 at any school?
any grade 9-12 at any school?

Including this school year, how many years have you taught any subject at any grade level at [your school]?

Are you currently collecting a pension from a teacher retirement system or drawing money from a school or system sponsored 401(k) or 403(b) plan which includes funds you contributed as a teacher?

N
o

Y
e
s

SECTION B: Math Department and Instruction

* Now we have some questions regarding your math instruction and the math department at [your school].

* Indicate the extent to which you agree or disagree with each of the following statements about high school math teachers at your school. High school math teachers at your school...

set high standards for teaching.
Strongly agree
Agree
Disagree
Strongly disagree

set high standards for students' learning.
Strongly agree
Agree
Disagree
Strongly disagree

believe all students can do well.
Strongly agree
Agree
Disagree
Strongly disagree

make expectations for instructional goals clear to students.
Strongly agree
Agree
Disagree
Strongly disagree

have given up on some students.
Strongly agree
Agree
Disagree
Strongly disagree
care only about smart students.
Strongly agree
Agree
Disagree
Strongly disagree
expect very little from students.
Strongly agree
Agree
Disagree
Strongly disagree
work hard to make sure all students are learning.
Strongly agree
Agree
Disagree
Strongly disagree

* The following questions are about the [fall 2009 math course] you are teaching.
[if web interview: We would like to standardize the various course titles we receive from schools into defined categories. This course may or may not exactly match one of these categories. Regardless, please indicate which of the following best categorizes this course.]
[if phone interview: We would like to standardize the various course titles we receive from schools into defined categories. Please indicate which of the following best categorizes this course.]
Pre-Algebra
Review or Remedial
Math Algebra I, part 1
or part 2 Algebra I
Algebra II
Geometry
Trigonometry
Analytic
Geometry
Statistics or Probability
Pre-calculus
Calculus
Integrated
Math I
Integrated Math II or above
Other math

* Which of the following best describes the achievement level of students in [fall 2009 math course] compared with the average 9th grade student in this school?
Higher achievement levels
Average achievement levels
Lower achievement levels
Widely differing achievement levels

* About what percentage of the students in [fall 2009 math course] are not adequately prepared to tackle the material you cover?
25% or less
26% to 50%
51% to 75%
More than 75%

* Do you have students in your [fall 2009 math course] course work in small groups?
Yes
Not currently, but you plan to at some point during this course
No

* Primarily, how do you [plan to] assign students to groups in [fall 2009 math course]?
Intentionally create groups so students will be of similar ability levels
Intentionally create groups so students will be of different ability levels
Create groups without regard to ability level such as alphabetically or randomly
Groups will be chosen by the students

* Think about the full duration of this [fall 2009 math course]. How much emphasis are you placing on each of the following objectives?

Increasing students’ interest in mathematics

No emphasis

Minimal Emphasis
Moderate Emphasis
Heavy Emphasis
Teaching students mathematical concepts
No emphasis
Minimal Emphasis
Moderate Emphasis
Heavy Emphasis
Teaching students mathematical algorithms or procedures
No emphasis
Minimal Emphasis
Moderate Emphasis
Heavy Emphasis
Developing students' computational skills
No emphasis
Minimal Emphasis
Moderate Emphasis
Heavy Emphasis
Developing students' problem solving skills
No emphasis
Minimal Emphasis
Moderate Emphasis
Heavy Emphasis
Teaching students to reason mathematically
No emphasis
Minimal Emphasis
Moderate Emphasis
Heavy Emphasis
Teaching students how mathematics ideas connect with one another
No emphasis
Minimal Emphasis
Moderate Emphasis
Heavy Emphasis
Preparing students for further study in mathematics
No emphasis
Minimal Emphasis
Moderate Emphasis
Heavy Emphasis
Teaching students the logical structure of mathematics
No emphasis
Minimal Emphasis
Moderate Emphasis
Heavy Emphasis
Teaching students about the history and nature of mathematics
No emphasis
Minimal Emphasis
Moderate Emphasis
Heavy Emphasis
Teaching students to explain ideas in mathematics effectively
No emphasis
Minimal Emphasis
Moderate Emphasis
Heavy Emphasis
Teaching students how to apply mathematics in business and industry
No emphasis
Minimal Emphasis
Moderate Emphasis
Heavy Emphasis
Teaching students to perform computations with speed and accuracy
No emphasis
Minimal Emphasis
Moderate Emphasis
Heavy Emphasis
Preparing students for standardized tests
No emphasis
Minimal Emphasis
Moderate Emphasis
Heavy Emphasis
* To what extent do you agree
or disagree with each

of the following
statements about how
high school math
teaching assignments
are made at [your
school]?

Advanced courses are assigned to teachers with the most seniority
Strongly agree
Agree
Disagree
Strongly disagree

Advanced courses are assigned to teachers with the strongest math background
Strongly agree
Agree
Disagree
Strongly disagree

All or most math teachers are assigned at least one section of advanced courses
Strongly agree
Agree
Disagree
Strongly disagree

Non-college prep courses are assigned to teachers new to the profession
Strongly agree
Agree
Disagree
Strongly disagree

Non-college prep courses are assigned to teachers whose students do not perform well on standardized tests
Strongly agree
Agree Disagree
Strongly disagree

All or most math teachers are assigned at least one section of a non-college prep course
Strongly agree
Agree
Disagree
Strongly disagree

* How would you rate the following aspects of remedial help for students in [your school] who are struggling in Algebra I?

Availability of tutoring or other remedial assistance
Poor
Fair
Good Excellent

Quality of tutoring or other remedial
assistance
Poor
Fair
Good Excellent

~~~~~~

* To what extent do you agree or disagree with each of the following statements about the math department at [your school]?
Math teachers in this department...

share ideas on teaching.
Strongly agree
Agree
Disagree
Strongly
disagree

discuss what was learned at a workshop or conference.
Strongly agree
Agree
Disagree
Strongly
disagree

share and discuss student work.
Strongly agree
Agree Disagree
Strongly disagree

discuss particular lessons that were
not very successful.
Strongly agree
Agree
Disagree
~~~~~~

Strongly disagree
discuss beliefs about teaching and
learning.
Strongly agree
Agree
Disagree
Strongly Disagree
share and discuss research on effective
teaching methods.
Strongly agree
Agree
Disagree
Strongly disagree
share and discuss research on effective instructional practices for English language learners.
Strongly agree
Agree
Disagree
Strongly disagree
explore new teaching approaches for under-performing students.
Strongly agree
Agree
Disagree
Strongly disagree
make a conscious effort to coordinate the content of courses with other teachers in this school.
Strongly agree
Agree
Disagree
Strongly disagree
are effective at teaching students mathematics.
Strongly agree
Agree
Disagree
Strongly disagree
provide support to new mathematics teachers.
Strongly agree
Agree
Disagree
Strongly disagree
are supported and encouraged by the math department's chair or curricular area coordinator.
Strongly agree
Agree
Disagree
Strongly disagree

SECTION C: Science Department and Instruction

~~~~~~

* Now we have some questions regarding your science instruction and the science department at [your school].

~~~~~~

* Indicate the extent to which you agree or disagree with each of the following statements about high school science teachers at your school. High school teachers at your school...
set high standards for teaching.
Strongly agree
Agree
Disagree
Strongly
disagree
set high standards for students' learning.
Strongly agree
Agree
Disagree
Strongly
disagree
believe all students can do well.
Strongly agree
Agree
Disagree
Strongly
disagree

make expectations for instructional goals clear to students.
Strongly agree
Agree
Disagree
Strongly
disagree
have given up on some students.
Strongly agree
Agree
Disagree
Strongly
disagree
care only about smart students.
Strongly agree
Agree
Disagree
Strongly
disagree
expect very little from students.
Strongly agree
Agree
Disagree
Strongly
disagree
work hard to make sure all students are learning.
Strongly agree
Agree
Disagree
Strongly
disagree

* The following questions are about the [fall 2009 science] course you are teaching.
[if web interview: We would like to standardize the various course titles we receive from schools into defined categories. This course may or may not exactly match one of these categories. Regardless, please indicate which of the following best categorizes this course.]
[if telephone interview: We would like to standardize the various course titles we receive from schools into defined categories. Please indicate which of the following best categorizes this course.]
General
Science
Life Science
Environmental Science
Earth Science
Other Earth or Environmental Science such as ecology, geology, oceanography, or meteorology
Physical Science without Earth Science
Physical Science with Earth Science
Other Physical Science such as astronomy or electronics
Principles of Technology
Anatomy or Physiology
Biology I
Advanced Biology such as Biology II, AP, or IB
Other Biological Science such as botany, marine biology, or zoology
Chemistry I
Advanced Chemistry such as Chemistry II, AP, or IB
Physics I
Advanced Physics such as Physics II, AP, or IB
Integrated Science I
Integrated Science II or above
Other science
Physical Science with Earth Science

* Which of the following best describes the achievement level of students in [fall 2009 science course] compared with the average 9th grade student in this school?
Higher achievement levels
Average achievement levels
Lower achievement levels
Widely differing achievement levels

* About what percentage of the students in [fall 2009 science course] are not adequately prepared to tackle the material you cover?
25% or less

26% to 50%
51% to 75%
More than 75%

* Do you have students in your [fall 2009 science] course work in small groups?
Yes
Not currently, but you plan to at some point during this course
No

* Primarily, how do you [plan to] assign students to groups in [fall 2009 science course]?
Intentionally create groups so students will be of similar ability levels
Intentionally create groups so students will be of different ability levels
Create groups without regard to ability level such as alphabetically or randomly
Groups will be chosen by the students

* Think about the full duration of this [fall 2009 science] course. How much emphasis are you placing on each of the following objectives?
Increasing students' interest in science
No emphasis
Minimal Emphasis
Moderate Emphasis
Heavy Emphasis
Teaching students basic science concepts
No emphasis
Minimal Emphasis
Moderate Emphasis
Heavy Emphasis
Teaching students important terms and facts of science
No emphasis
Minimal Emphasis
Moderate Emphasis
Heavy Emphasis
Teaching students science process or inquiry skills
No emphasis
Minimal Emphasis
Moderate Emphasis
Heavy Emphasis
Preparing students for further study in science
No emphasis
Minimal Emphasis
Moderate Emphasis
Heavy Emphasis
Teaching students to evaluate arguments based on scientific evidence
No emphasis
Minimal Emphasis
Moderate Emphasis
Heavy Emphasis
Teaching students how to communicate ideas in science effectively
No emphasis
Minimal Emphasis
Moderate Emphasis
Heavy Emphasis
Teaching students about the applications of science in business and industry
No emphasis
Minimal Emphasis
Moderate Emphasis
Heavy Emphasis
Teaching students about the relationship between science, technology, and society
No emphasis
Minimal Emphasis
Moderate Emphasis
Heavy Emphasis
Teaching students about the history and nature of science
No emphasis
Minimal Emphasis
Moderate Emphasis
Heavy Emphasis
Preparing students for standardized tests
No emphasis
Minimal Emphasis

Moderate Emphasis
Heavy Emphasis
* To what extent do you agree or disagree with each of the following statements about how high school science teaching assignments are made at [your school]?
Advanced courses are assigned to teachers with the most seniority
Strongly agree
Agree
Disagree
Strongly disagree
Advanced courses are assigned to teachers with the strongest science background
Strongly agree
Agree
Disagree
Strongly disagree
All or most science teachers are assigned at least one section of advanced courses
Strongly agree
Agree
Disagree
Strongly disagree
Non-college prep courses are assigned to teachers new to the profession
Strongly agree
Agree
Disagree
Strongly disagree
Non-college prep courses are assigned to teachers whose students do not perform well on standardized tests
Strongly agree
Agree
Disagree
Strongly disagree
All or most science teachers are assigned at least one section of a non-college prep course
Strongly agree
Agree
Disagree
Strongly disagree
* To what extent do you agree or disagree with each of the following statements about the science department at [your school]? Science teachers in this department...
share ideas on teaching.
Strongly agree
Agree
Disagree
Strongly disagree
discuss what was learned at a workshop or conference.
Strongly agree
Agree
Disagree
Strongly disagree
share and discuss student work.
Strongly agree
Agree
Disagree
Strongly disagree
discuss particular lessons that were not very successful.
Strongly agree
Agree
Disagree
Strongly disagree
discuss beliefs about teaching and learning.
Strongly agree
Agree
Disagree
Strongly disagree
share and discuss research on effective teaching methods.
Strongly agree
Agree
Disagree
Strongly disagree
share and discuss research on effective instructional practices for English language learners.
Strongly agree
Agree

Disagree
Strongly disagree
explore new teaching approaches for under-performing students.
Strongly agree
Agree
Disagree
Strongly disagree
make a conscious effort to coordinate the content of courses with other teachers in this school.
Strongly agree
Agree
Disagree
Strongly disagree
are effective at teaching students in science.
Strongly agree
Agree
Disagree
Strongly disagree
provide support to new science teachers.
Strongly agree
Agree
Disagree
Strongly disagree
are supported and encouraged by the science department's chair or curricular area coordinator.
Strongly agree
Agree
Disagree
Strongly disagree

SECTION D: Beliefs About Teaching and Current School

The questions in the final section are related to your beliefs about teaching and your opinions about [your school].

In general, how would you compare males and females in each of the following subjects?
English or Language Arts
Females are much better
Females are somewhat better
Females and males are the same
Males are somewhat better
Males are much better

Math
Females are much better
Females are somewhat better
Females and males are the same
Males are somewhat better
Males are much better

Science
Females are much better
Females are somewhat better
Females and males are the same
Males are somewhat better
Males are much better
To what degree is each of the following matters a problem at [your school]?
Student tardiness
Not a problem
Minor problem
Moderate problem
Serious problem
Student absenteeism
Not a problem
Minor problem
Moderate problem
Serious problem
Student class cutting
Not a problem
Minor problem
Moderate problem
Serious problem
Teacher absenteeism
Not a problem

Minor problem
Moderate problem
Serious problem
Students dropping out
Not a problem
Minor problem
Moderate problem
Serious problem
Student apathy
Not a problem
Minor problem
Moderate problem
Serious problem
Lack of parental involvement
Not a problem
Minor problem
Moderate problem
Serious problem
Students come to school unprepared to learn
Not a problem
Minor problem
Moderate problem
Serious problem
Poor student health
Not a problem
Minor problem
Moderate problem
Serious problem
Lack of resources and materials for teachers
Not a problem
Minor problem
Moderate problem
Serious problem
Student tardiness
Not a problem
Minor problem
Moderate problem
Serious problem
Student absenteeism
Not a problem
Minor problem
Moderate problem
Serious problem
Student class cutting
Not a problem
Minor problem
Moderate problem
Serious problem
Teacher absenteeism
Not a problem
Minor problem
Moderate problem
Serious problem
Students dropping out
Not a problem
Minor problem
Moderate problem
Serious problem
Student apathy
Not a problem
Minor problem
Moderate problem
Serious problem
Lack of parental involvement
Not a problem
Minor problem
Moderate problem
Serious problem
Students come to school unprepared to learn
Not a problem

Minor problem
Moderate problem
Serious problem
Poor student health
Not a problem
Minor problem
Moderate problem
Serious problem
Lack of resources and materials for teachers
Not a problem
Minor problem
Moderate problem
Serious problem
In your view, to what extent do the following limit how you teach?
Students with different academic abilities in the same class
Not applicable
Not at all
A little
Some
A lot
Students who come from a wide range of socio-economic backgrounds
Not applicable
Not at all
A little
Some
A lot
Students who come from a wide range of language backgrounds
Not applicable
Not at all
A little
Some
A lot
Students with special needs such as hearing, vision, or speech impairments, physical disabilities, or mental, emotional, or psychological impairments
Not applicable
Not at all
A little
Some
A lot
Uninterested students
Not applicable
Not at all
A little
Some
A lot
Low morale among students
Not applicable
Not at all
A little
Some
A lot
Disruptive students
Not applicable
Not at all
A little
Some
A lot
Inadequate opportunities for professional learning
Not applicable
Not at all
A little
Some
A lot
Inadequate administrative support
Not applicable
Not at all
A little
Some
A lot
Students with different academic abilities in the same class

Not applicable
Not at all
A little
Some
A lot
Students who come from a wide range of socio-economic backgrounds
Not applicable
Not at all
A little
Some
A lot
Students who come from a wide range of language backgrounds
Not applicable
Not at all
A little
Some
A lot
Students with special needs such as hearing, vision, or speech impairments, physical disabilities, or mental, emotional, or psychological impairments
Not applicable
Not at all
A little
Some
A lot
Uninterested students
Not applicable
Not at all
A little
Some
A lot
Low morale among students
Not applicable
Not at all
A little
Some
A lot
Disruptive students
Not applicable
Not at all
A little
Some
A lot
Inadequate opportunities for professional learning
Not applicable
Not at all
A little
Some
A lot
Inadequate administrative support
Not applicable
Not at all
A little
Some
A lot
Shortage of computer hardware or software
Not applicable
Not at all
A little
Some
A lot
Shortage of support for using computers
Not applicable
Not at all
A little
Some
A lot
Shortage of textbooks for student use
Not applicable
Not at all
A little

Some
A lot
Shortage of other instructional equipment for students' use
Not applicable
Not at all
A little
Some
A lot
Shortage of equipment for your use in demonstrations and other exercises
Not applicable
Not at all
A little
Some
A lot
Inadequate physical facilities
Not applicable
Not at all
A little
Some
A lot
High student to teacher ratio
Not applicable
Not at all
A little
Some
A lot
Lack of planning time
Not applicable
Not at all
A little
Some
A lot
Lack of autonomy in instructional decisions
Not applicable
Not at all
A little
Some
A lot
Lack of parent or family support
Not applicable
Not at all
A little
Some
A lot
Shortage of computer hardware or software
Not applicable
Not at all
A little
Some
A lot
Shortage of support for using computers
Not applicable
Not at all
A little
Some
A lot
Shortage of textbooks for student use
Not applicable
Not at all
A little
Some
A lot
Shortage of other instructional equipment for students' use
Not applicable
Not at all
A little
Some
A lot
Shortage of equipment for your use in demonstrations and other exercises
Not applicable

Not at all
A little
Some
A lot
Inadequate physical facilities
Not applicable
Not at all
A little
Some
A lot
High student to teacher ratio
Not applicable
Not at all
A little
Some
A lot
Lack of planning time
Not applicable
Not at all
A little
Some
A lot
Lack of autonomy in instructional decisions
Not applicable
Not at all
A little
Some
A lot
Lack of parent or family support
Not applicable
Not at all
A little
Some
A lot
To what extent do you agree or disagree with each of the following statements as it applies to your instruction?
The amount a student can learn is primarily related to family background
Strongly agree
Agree
Disagree
Strongly disagree
If students are not disciplined at home, they are not likely to accept any discipline at school
Strongly agree
Agree
Disagree
Strongly disagree
You are very limited in what you can achieve because a student's home environment is a large influence on their achievement
Strongly agree
Agree
Disagree
Strongly disagree
If parents would do more for their children, you could do more for your students
Strongly agree
Agree
Disagree
Strongly disagree
If a student did not remember information you gave in a previous lesson, you would know how to increase their retention in the next lesson
Strongly agree
Agree
Disagree
Strongly disagree
If a student in your class becomes disruptive and noisy, you feel assured that you know some techniques to redirect them quickly
Strongly agree

Agree
Disagree
Strongly disagree

If you really try hard, you can get through to even the most difficult or unmotivated students

Strongly agree
Agree
Disagree
Strongly disagree

When it comes right down to it, you really cannot do much because most of a student's motivation and performance depends on their home environment

Strongly agree
Agree
Disagree
Strongly disagree

The amount a student can learn is primarily related to family background

Strongly agree
Agree
Disagree
Strongly disagree

If students are not disciplined at home, they are not likely to accept any discipline at school

Strongly agree
Agree
Disagree
Strongly disagree

You are very limited in what you can achieve because a student's home environment is a large influence on their achievement

Strongly agree
Agree
Disagree
Strongly disagree

If parents would do more for their children, you could do more for your students

Strongly agree
Agree
Disagree
Strongly disagree

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Strongly agree
Agree
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Strongly disagree

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Strongly agree
Agree
Disagree
Strongly disagree

If you really try hard, you can get through to even the most difficult or unmotivated students

Strongly agree
Agree
Disagree
Strongly disagree

When it comes right down to it, you really can not do much because most of a student's motivation and performance depends on their home environment

Strongly agree
Agree
Disagree
Strongly disagree

To what extent do you agree or disagree with each of the following statements about [your school]'s principal? The principal...

deals effectively with pressures from outside the school that might interfere with my teaching.

Strongly agree
Agree
Disagree
Strongly disagree

does a poor job of getting resources for this school.

Strongly agree
Agree
Disagree
Strongly disagree

sets priorities, makes plans, and sees that they are carried out.

Strongly agree
Agree
Disagree
Strongly disagree
knows what kind of school he or she wants and has communicated it to the staff.
Strongly agree
Agree
Disagree
Strongly disagree
lets staff members know what is expected of them.
Strongly agree
Agree
Disagree
Strongly disagree
is interested in innovation and new ideas.
Strongly agree
Agree
Disagree
Strongly disagree
usually consults with staff members before he or she makes decisions that affect them.
Strongly agree
Agree
Disagree
Strongly disagree
deals effectively with pressures from outside the school that might interfere with my teaching.
Strongly agree
Agree
Disagree
Strongly disagree
does a poor job of getting resources for this school.
Strongly agree
Agree
Disagree
Strongly disagree
sets priorities, makes plans, and sees that they are carried out.
Strongly agree
Agree
Disagree
Strongly disagree
knows what kind of school he or she wants and has communicated it to the staff.
Strongly agree
Agree
Disagree
Strongly disagree
lets staff members know what is expected of them.
Strongly agree
Agree
Disagree
Strongly disagree
is interested in innovation and new ideas.
Strongly agree
Agree
Disagree
Strongly disagree
usually consults with staff members before he or
she makes decisions that affect them.
Strongly agree
Agree
Disagree
Strongly disagree

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To what extent do you agree or disagree with each of the following statements about teachers at [your school]? Teachers at this school...
help maintain discipline in the entire school, not just in their classroom.
Strongly agree
Agree
Disagree
Strongly disagree
take responsibility for improving the school.
Strongly agree
~~~~~~

Agree
Disagree
Strongly disagree
set high standards for themselves.
Strongly agree
Agree
Disagree
Strongly disagree
feel responsible for helping students develop self-control.
Strongly agree
Agree
Disagree
Strongly disagree
feel responsible for helping each other do their best.
Strongly agree
Agree
Disagree
Strongly disagree
feel responsible that all students learn.
Strongly agree
Agree
Disagree
Strongly disagree
feel responsible when students in this school fail.
Strongly agree
Agree
Disagree
Strongly disagree
help maintain discipline in the entire school, not just in their classroom.
Strongly agree
Agree
Disagree
Strongly disagree
take responsibility for improving the school.
Strongly agree
Agree
Disagree
Strongly disagree
set high standards for themselves.
Strongly agree
Agree
Disagree
Strongly disagree
feel responsible for helping students develop self-control.
Strongly agree
Agree
Disagree
Strongly disagree
feel responsible for helping each other do their best.
Strongly agree
Agree
Disagree
Strongly disagree
feel responsible that all students learn.
Strongly agree
Agree
Disagree
Strongly disagree
feel responsible when students in this school fail.
Strongly agree
Agree
Disagree
Strongly disagree