2013

REFLECTIONS OF MIDDLE SCHOOL STUDENTS BY GENDER AND RACE/ETHNICITY ON OBTAINING A SUCCESSFUL SCIENCE EDUCATION

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THESIS

Submitted to
Northern Michigan University
In partial fulfillment of the requirements
For the degree of

MASTER OF SCIENCE IN SCIENCE EDUCATION

Graduate Studies Office

2013

SIGNATURE APPROVAL FORM

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ABSTRACT

REFLECTIONS OF MIDDLE SCHOOL STUDENTS BY GENDER AND RACE/ETHNICITY ON OBTAINING A SUCCESSFUL SCIENCE EDUCATION

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Sixty-five eighth grade students responded to a science beliefs survey during a science-inquiry lab unit in an action research project to assess whether gender has an effect on how the students perceive their science classes. The survey was given to eighth grade students during the first week of school. Student results were categorized by gender and by race/ethnicity. The middle school where the study took place is fairly diverse with 540 total students of which 48% of them are White, 42% are Black, and 10% are Hispanic. Six female science teachers are employed at the middle school, two per grade. The first unit that is taught in science is inquiry skills, the basics of all science such as graphing, laboratory tools, safety, etc. This unit is taught in 6^{th}, 7^{th}, and 8^{th} grades, as a part of our standards. Inquiry test results for 8^{th} graders are also given in this thesis, and are categorized again by gender and race/ethnicity. The results of the surveys and the assessment show a gap in the way students think about and complete activities in science. It was exciting to see that the female students scored better overall than male students on an inquiry-based summative assessment, while white students overall scored better than Black and Hispanic students. White males tended to rank science as the class they enjoyed the most of all core classes and thought science was easier than all the other data demographics. The conclusion found was stunning, in that the true gap in student's beliefs about science lies within the different races/ethnicities, rather than just gender alone.

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CHAPTER 1: INTRODUCTION

Gender roles seem to be pushed upon us from birth, possibly through socialization influences, personality, genetics, and role models. The results from Egan and Perry (2001) support the thesis that gender identity is multidimensional. Apparently, middle childhood children have developed fairly stable conceptions of the degree to which they typify their gender category and their contentedness with their gender assignment. Individuals even “learn the values and skills of their disciplinary cultures that are implicitly and explicitly gendered over time” (De Welde & Laursen, 2011, p.572). Think about walking into the baby section of a store, girl’s clothes are pink and boy’s clothes are blue. A little later on in life, boys play with trucks and girls play with dolls. Then we go to school, where gender issues, specifically in science education, are still a major factor. Males have had a dominating influence over science, and the male perspective has influenced many of the theories that are taught in schools (Gondek, 2005). Many different attempts and strategies have tried to close the gender gap, but are the attempts really working? The 2002 No Child Left Behind (NCLB) program included a provision for public school districts to apply for innovative program grant money available for more focused research and experimentation with single-gender education. However, most studies of single-sex schools have been undertaken either in private schools or overseas, which is a problem because of the many different characteristics in these schools (Friend, 2006). Schools in the Unites States have used data from these completely different schools, which have their own curriculum, different tests, and even different cultural standards to help narrow the gender gap. What is still left to be done?

Although the gender gap has dramatically narrowed in recent decades, women remain underrepresented in many science, technology, engineering, and mathematics (STEM) fields (Leaper, Farkas, & Brown, 2012). How can women be better represented in the STEM careers? Can the way we teach in middle school help to narrow the gaps? With the adaptation of the new common core standards for all teachers across the United States, the focus for teaching math and language arts has been stressed to other content areas. Not seeing a focus on science as an important subject seems to be an attitude that exists. As a country, we need to start with eliminating these stereotypes. Stereotype elimination throughout school could even stretch into the college bound years. Removing stereotype threat could eliminate two-thirds of the gender gap on the SAT math exam (Hill, Corbett, & Rose, 2010). Then more women might study and pursue STEM careers. Then again, gender issues might be blown out of proportion. Boys and girls are both earning higher grade point averages in high school than in years before, with girls even slightly outperforming boys (Corbett, Hill, & Rose, 2008). Whatever the case may be, teachers must hold academic expectations equal for all students and especially stress science and math programs for girls (Gondek, 2005). Stressing importance in all subject areas eliminates the stereotypes and prepares students for the STEM careers of the future. This chapter will focus on the problem, purpose, and framework of gender gaps, and lead into research questions and hypotheses.

Background of Problem

Middle school is a time when science curriculum moves from the concrete to the abstract and is also when the achievement gap begins to increase between boys and girls. Boys generally have more concrete experiences in observing phenomena than girls have

(Gondek, 2005). From playing outside, to building with Legos, young boys have many hands- on experiences. Finding a way to close this achievement gap is crucial for the future of all students, promoting gender equality and race/ethnic equality for all.

Purpose of Study

This study was conducted in a very small, rural public middle school using only eighth grade students. The school has a strong focus on all students reading, writing, and discussing, but the STEM (science, technology, engineering, and mathematics) fields are not a top priority, especially for female students. No all-girls clubs, activities, or study groups exist. I believe the situations need to change. School age girls who participated in engineering activities were six times more likely to consider engineering as a career (Gondek, 2005). If the girls at the middle school are not receiving these opportunities, then they are not prepared for a successful future in a STEM career, giving way to the stereotypes in these fields. Increasing pursuit of STEM-related careers in both genders is crucial for any nation to remain competitive in the global economy (Leaper et al., 2012). By comparing the results of the survey on how middle school students' perceive their science classes to scores on their inquiry tests, results could reveal relationships between science achievement and attitudes about inquiry activities by gender.

Theoretical Framework

Constructivism relates to the inquiry-based learning that STEM skills require. Generally, boys perform better on tasks using spatial orientation and visualization and on certain quantitative tasks that rely on those skills (Hill et al., 2010). Girls outperform boys on tests relying on verbal skills, especially writing, as well as some tests involving memory and perceptual speed (2010). In constructivism, students must construct knowledge that makes sense by using current understandings and real-world scenarios. Social interactions using constructivist ideals are necessary for closing the gender gaps. Due to the K-12 teaching methods, many students enter college having learned ways of navigating course material that promotes collection and memorization of information. Little may have been demanded of students by way of inquiry, independent reflection, or application of knowledge (Seymour, De Welde, & Fry, 2010). This study uses a survey to see if eighth graders in a gender-mixed public science classroom show differences in thinking, and then compares the results to students' grades on the inquiry test. The research questions can be answered with the survey results, and lead to further studies and changes and improvements to the school and how to close any gaps (whether in gender or in race/ethnicity) in the STEM fields. The importance of STEM fields in the United States is vital for a competitive future. Unless the serious problems evident in STEM education are to be addressed, the U.S. will lose its world leadership in science and technology. Constructivist theories suggest a close association between inquiry-based STEM science and closing gender gaps, which proposes several research questions.

Research Questions

Boys tend to score higher than girls in their ability and beliefs and value regarding math and science (Leaper et al., 2012), leading to the first research question: Do boys at the middle school where the study took place have more highly articulated beliefs in their values and beliefs in science than girls do? Also, females tend to focus more on the purpose of knowledge, whereas males generally are more willing to explore a subject for its own sake (Gondek, 2005). Leading to the second research question: Are males generally more inquisitive in science than females are? I also plan to see if race/ethnicity has an effect, since I have the opportunity to compare White, Black, and Hispanic students. Since I do not have twenty-five students in each racial grouping, the results from race/ethnicity are a moderate sub-category in the research. The focus of this action-research project, survey, and study is to see the actual gender or racial/ethnicity gaps at this middle school.

Key Terms

The following are terms that will be used throughout the study.

Inquiry-based science. "Inquiry-based teaching is a pedagogical approach that invites students to explore academic content by posing, investigating, and answering questions. Also known as problem-based teaching or simply as 'inquiry,' this approach puts students' questions at the center of the curriculum, and places just as much value on the component skills of research as knowledge and understanding of content" (Towns & Sweetlans, 2008, p.1).

Science Inquiry Fundamentals. "Gathering and evaluating evidence, drawing conclusions, building and communicating arguments" (Laursen, Liston, Thiry, & Graf, 2007, p.62).

STEM. An acronym for science, technology, engineering, and mathematics

Race/Ethnicity. White, Black, and Hispanic students (Corbett et al., 2008).

Hypothesis

While researching gender differences in science education, a wide variety of conclusions were presented. Some studies showed huge gaps and other studies showed no gender affects at all. The popular media have even sensationalized findings of sex differences, often presenting the latest finding without assessing the quality of the research used (Halpern, Benbow, Geary, Gur, Hyde, & Gernsbacher, 2007). By giving the survey and test to students at a public middle school, I hypothesized it truly demonstrated what the everyday students feel. I supposed that some gender gaps would persist and that males indeed would feel more confident and more inquisitive in science. However, I thought that race/ethnicity would have more of a factor than gender on perception of science at this middle school.

Summary

In summary, the introduction has defined inquiry based science, and showed how a survey and a test given to eighth grade students in a public school will give real data on if a gender gap truly exists in science education. A background, purpose, and framework provided data leading to a hypothesis for this study. The literature review will provide the rationale, current research on gender gaps, and researched strategies on how to promote gender equality and racial/ethnic equality.

CHAPTER 2: LITERATURE REVIEW

Researching gender gaps in science education leads to many questions. In a study of middle school teachers who used an inquiry approach, the achievement scores of Black students increased, the achievement gap between male and female students narrowed, and their students were more interested in the lessons (Kahle, Meece, & Scantlebury, 2000). Another study using hands-on inquiry lessons from Laursen, Liston, Thiry, and Graf (2007) reported enhanced interest and engagement by 88% of teachers and 92% of program leaders. As evidence for these benefits, teachers reported student behaviors such as concentrating on the activities, asking questions, and stating their interest. No teachers reported lack of engagement or interest. Many faculty, institutions, and funders continue to promote and support research and inquiry-based learning in STEM (Thiry, Laursen, & Hunter, 2011). So teaching inquiry-based science according to these studies helps reduce gender gaps in education, but is the timing too late? In a study by Foley and McPhee in 2008, only one in five measurements shows significant difference between the hands-on and textbook students. So teaching hands-on alone does not seem to bridge the STEM gaps. Women make up less than a quarter of U.S. doctoral recipients in most physical science and engineering fields, with Black, Hispanic, and Native American women being especially poorly represented (De Welde & Laursen, 2011). Although females make up one-half of the workforce, only about 15% of U.S. mathematicians, scientists and engineers are females (Friend, 2006). To promote STEM careers, teachers, parents, and adults should teach children that intellectual skills can be acquired. Adults should praise children for effort, show that gifted and talented programs value growth and learning, highlight struggles, and encourage students to have a more flexible or growth mindset about intelligence. Just as important, leaders must expose girls to successful female role models in math and science, and teach students and teachers about stereotype threat (Hill et al., 2010). The literature review will focus on the rationale of my study, the role of males in science, research that shows that girls are actually outperforming boys in some areas, characteristics of girls who do well in science, what can be done in schools to create a true equality, and opponents of the gender gap issues.

Rationale of researching gender gaps in science

From a very early age, research shows that boys outperform girls on hands-on learning. Sex differences in favor of boys are present on spatial tasks by age four and a half. In grade school, boys and girls take roughly the same amount of science and math classes, leaving both equally prepared for STEM type fields of study. According to one study, however, girls tend to get less attention.

Visuospatial ability is not routinely taught or assessed by schools and is not often developed and assessed in ways that influence students' educational and career plans. Linkage of mathematical and visuospatial skills has important consequences, because high levels of both of these skills are required for careers in fields such as physics and engineering in which women are typically underrepresented (Halpern et al., 2007). To improve spatial skills, a huge factor in the gender gap in STEM careers, some suggestions are to explain that spatial skills are developed over time. Students should be encouraged to work with their hands, completing activities such as taking apart and putting together, and using handheld models instead of computers whenever possible (Hill et al., 2010). In order to achieve success in science, learners need good mathematical abilities, but students also need verbal and visuospatial abilities, so science achievement cannot be explained by math scores alone (Halpern et al., 2007).

Not teaching these spatial task skills in school could be adding to the gender gap in science. In a 2009 survey of age 8 to 17 year old students, 24% of boys but only 5% of girls were interested in an engineering career (Hill et al., 2010). The standardized tests right before college led to even more proof of the gaps. Boys have outperformed girls on both the math and verbal portions of the SAT (Corbett et al., 2008). Later on in college, women only earn 20% of STEM field bachelor's degrees, and the numbers decrease for doctoral degrees and careers (Hill et al., 2010). In 2006, 29% of males but only 15% of females planned to study a major in the STEM fields (Hill et al., 2010). In doctoral degrees awarded in the U.S., women accounted for 27% in mathematics, 15% in physics, 20% in computer science, and 18% in engineering (Leaper et al., 2012). Women earn 46% of undergraduate math degrees in this country but only represent 8% of math professors (Trei, 2006). Women earning degrees in computer science is actually dropping from 36% in 1980 to 20% in 2006 (Hillet al., 2010).

If boys and girls are taking the same amount of STEM based classes in middle and high school, what is happening later on? Why are women not continuing in science in higher education? The beliefs from a very early age on who a scientist is and is not could lead to the dropping numbers later on in life.

The Role of Males in Science

One activity that is done in many science classrooms is to have students draw a picture of who a scientist is. Most of the scientist pictures portray males, often with "nerdy" characteristics such as a pocket full of writing utensils or oversized eyeglasses

(Friend, 2006). These simple drawings add to the stereotyping that goes on in STEM careers. “Girls and young women have been found to be aware of, and negatively affected by, the stereotypical image of a scientist as a man” (Hill et al., 2010, p.38). Males in the United States typically perform better than females on achievement measures such as standardized tests in science and enroll in more advanced science classes, therefore a higher percentage of males pursue careers in the field of science (Friend, 2006). However, the number of males who completed an undergraduate science degree and then furthered their education with doctoral degrees in science and engineering dropped from 15.5% in 1970 to 8.7% in 1990 (Friend, 2006). This drop might contribute to the changes in the male and female ratios in STEM doctoral programs and careers.

Because of this male dominant perception, women who persist in STEM fields must have the ability to withstand persistent negative cultural and social attitudes regarding scientific careers. Women in STEM fields are often seen as outsiders, experience sexism, and even other forms of exclusion. The lack of role models and conflicts between careers and families offer other hardships for women looking into STEM careers. Experiences in the workplace affect women’s attitudes towards pursuing STEM careers as well. “Women reported stereotyping: being treated unfairly, seen as incompetent, or not taken seriously. Over a third of the women in this study reported being stereotyped” (De Welde & Laursen, 2011, p.582). Women who pursue graduate education and take faculty positions in STEM fields face continuing challenges. The work field climate is often experienced as chilly or unwelcoming, subtle harassment is experienced, exclusion from opportunities to collaborate and to take leadership roles are often felt, and expectations of a single-minded focus on work exist. Great pressure to meet significant tenure expectations that often coincide with childbearing years and prejudice against scholars who delay entering the academic workplace are sometimes present. “In more recent years, however, awareness has increased of systemic and organizational factors that thwart the success of women in STEM fields” (Austin, Laursen, Hunter, Soto, & Martinez, 2011, p.3). While stereotypes of males as scientists still exist, gender gaps in science careers are actually declining. Is the drop happening fast enough? Are the efforts being made actually working?

Girls are Outperforming Boys

Girls tend to get less attention in schools, and Black girls especially receive much less attention in middle school than any other group of students, Black or White, male or female (Gondek, 2005). However, in the past few decades the gender gap has narrowed. Girls are earning high school math and science credits at the same rate as boys and are earning slightly higher grades in these classes. In fact, a difference in average math performance between girls and boys no longer exists in the general school population (Hill et al., 2010). Girls even earn more credits than boys earn in high school math and science and have a higher combined GPA in these courses. According to the U.S. Census Bureau, in 2006, 88.5% of women ages 25 to 29 had graduated from high school, compared to 84.4% of males. On average, girls even performed better on the English and reading sections of the ACT (Corbett et al., 2008).

In college, the trends are changing as well. Women have earned 57% more bachelors’ degrees than men since 1982. Women also earned the majority of associate’s and master’s degrees, and about half of first professional and doctoral degrees in 2004 to

2005. Across races and ethnicities, women are more likely than men to earn a bachelor's degree. Women also make up a majority of undergraduates on college campuses (Corbett et al., 2008). In 2009, 52.9% of all biological scientists were women (Hill et al., 2010). Girls are making great strides to outperform boys.

Characteristics of Girls who are High Achievers in Science

Since some studies show that girls are outperforming boys in science, how do we continue this trend? Do girls who are good in science have certain characteristics? According to a study from the Girl Scout Research Institute (GSRI) 74% of high school girls across the country are interested in the fields and subjects of STEM. Girls are interested in the process of learning, asking questions, and problem solving. Girls want to help people and make a difference in the world. Girls who are interested in STEM are high achievers who have supportive adult networks and are exposed to STEM fields. Girls who are interested in STEM fields are actually interested in many subjects and career opportunities—STEM is just one area of interest among many (Modi, Schoenberg, & Salmond, 2012).

What to do in Schools for Improvement

Over 200 public schools across the country have reformed structures to provide single-sex academies or single-sex classes. Most single-sex schools have other attributes that correlate with higher academic achievement, such as a smaller student body, stronger emphasis on academics, and higher level of commitment to the school's mission, which again, will have a large impact on the true data of gender classes. However, some data suggest that parents and students who choose single-sex schools are more motivated and achievement-oriented than average, which will skew the overall perception on the question if gender classes are better (Friend, 2006). Single-gender classes might not be the best option. Opponents to the concept of same-gender education, such as the American Civil Liberties Union and the National Organization for Women, have filed lawsuits aimed at ending public school experiments with same-gender grouping (Friend, 2006). Single-gender classes have not proven to be the solution.

Workforce projections for 2018 completed by the U.S. Department of Labor show that nine of the ten fastest-growing occupations will require significant scientific or mathematical training (Hill et al, 2010). Something clearly has to be done to close any kind of gender gap. STEM fields are so important to the future of our country. Students recognize patterns of treatment and quickly realize what is acceptable for males and what is acceptable for females in terms of behavior, appearance, attitudes, interests, social relations, roles, and occupations. Teachers must minimize differences in acceptance of types of behavior based on gender to the greatest extent possible (Gondek, 2005). Margot Gerritsen, who is a math professor, does not believe in any ability differences between male and female students. She thinks the gender gap problems are because of differences in attitude and perception. Even simple examples such as thinking how will I fit in, or I got a poor test grade are thought of very differently by male and female students. Gerritsen believes that these thought processes begin at a very early age (Trei, 2006). By thinking more like Gerritsen and getting rid of stereotypes and having support from parents and peers for cross-gender-typed domains, we may strengthen girls' motivation in STEM careers (Leaper et al., 2012). Short duration intervention strategies intend for students to develop interest and enthusiasm around science, have positive experiences with science, meet science role models, and learn about science careers. These experiences will translate down the road to more students pursuing advanced science education and careers in high school, college, and beyond. Students having positive attitudes and experiences with science has been shown to correlate with positive STEM outcomes in choices of classes taken in high school, college majors, and careers. The positive “link has been shown largely for longer-duration, school-based experiences” (Laursen, Liston, Thiry, & Graf, 2007, p. 50). Some other strategies to promote gender equality are to make use of the Internet, set up mentoring programs, give examples and relevancy of the content, and make connections between science and other subject areas such as in cross-curricular projects. Other suggestions including showing career connections, using a reward system like stars on a bulletin board to recognize improvement and achievement, and giving students ample practice time.

Getting girls excited about science, and feeling as equals with other classmates is crucial. In one study, gender had no significant effect on the use of computers, but the use of computers in teaching improved the academic performance of the students. Continued use of computers in schools, and government with other stakeholders should provide more computers and train teachers to enhance further the integration of computers in classrooms. While the mean score of the males was higher than that of the females showing that the males performed better than the females, the difference in performance was not significant (Achuonye, 2011). The equality in science by using computers could be a step in the right direction for bridging the gender gap.

Educational theory supports the role of experiential learning in STEM education. Activities such as research and internships provide the opportunity to learn through engaging in authentic tasks within a social context. While these theories place emphasis on learning through experience and apply to contexts outside of the classroom, the theory does not simply advocate learning by doing. Instead, the strategies emphasize learning by doing and learning from doing within a specific social context with a support group. Learning and development are deeply embedded in social and cultural practices, taking place through a group of people engaged in collective learning through a joint enterprise—such as a group of scientists working together on an experiment. Out-of-class experiences complement classroom learning and may enhance students' learning and development in multiple domains. Guiding students toward tasks challenging their intellectual abilities and skills is important. Students gain most when extending their capabilities and when not relegated to non-educational, routine tasks (Thiry et al., 2011). A study showed that having students attend special days and visits to science centers increases their own internal views on their science knowledge. Students' mean ratings (out of 4) of their familiarity with presenting science to non-science audiences before the workshops were 2.3, after the program were 3.3, and even 1 year later were 3.4. The importance in students relating to science is astounding. Students being comfortable with presenting science could lead to many STEM opportunities in their futures (Webb et al., 2012).

The Significant Opportunities in Atmospheric Research and Science (SOARS) program intends to promote careers in atmospheric science research for students from underrepresented groups. Protégés, participants in the program, were interviewed, attended conferences, participated in activities, were mentored, completed writing portions, had computer training, were offered a compensation salary, and were a part of the four-year program. In the completion of the program, almost all of the protégés (94%)

aspired to or were already working in a STEM career (Melton, Pedersen-Gallegos, Donohue, & Hunter, 2005). The success of this program could give valuable resources on how to promote STEM across all races/ethnicities and genders. The gender gap might not be the biggest problem in STEM education.

Opponents of the Gender Gap

Like any good debatable issue, two sides to the story exist. Does a true gender gap in science education exist? No single factor by itself has been shown to determine sex differences in science and math. Early experience, biological constraints, educational policy, and cultural context each have effects, and these effects add and interact in complex and sometimes unpredictable ways. Developing innate abilities depends on environment and learning experiences. Abilities are developed in supportive environments. Abilities may in fact just be different for different people. Males and females actually solve complex problems, such as items on IQ tests, differently. Females show a greater use of language-related brain regions and males show a greater use of spatial-related brain regions (Halpern et al., 2007). In one study's conclusions, which had one class of all males taught by a male teacher and the same teacher with a co-ed class, and then one class of all females taught by a female teacher and the same teacher with a co-ed class, the same-gender grouping did not produce significant differences in student science academic achievement. Same-gender classes did not create a more positive classroom climate. The means of the scores for females and males in the same-gender class were higher than the means of the scores for females and males in the mixed-gender classes, though not statistically significant at the .05 level due to the small sample size. For the middle school involved in the study, policy recommendations include limiting same-gender grouping until further research indicates that this structure is effective in countering gender stereotypes and improving achievement and attitudes toward science (Friend, 2006). Grouping students by gender had no effect, actually indicating that a gender gap did not exist here. The data regarding brain structure or function do not suggest that girls and boys learn differently or that either sex would benefit from single-sex schools (Halpern et al., 2007).

Maybe the true issue is not gender at all. Gender differences are small relative to gaps by race, ethnicity, and family income level. Girls and boys are not unilaterally succeeding or failing. The true crisis is that American school children are deeply divided across race, ethnicity, and family income level, and improvements in closing the gaps has been too slow and unsteady (Corbett et al., 2008).

Summary

The literature review has shown that the gender gap problems start at a very young age, and continue through college and into the workplace. STEM careers are the future of our nation, so something has to be done to get more women into the field. While opponents do not all agree on what that solution is, issues with our education system exist. When we look at race/ethnicity and family income level as well, the problems of gaps increase significantly.

Chapter 3 will focus on the methodology used to collect the data from the student surveys given at this middle school. The research questions, designs, participants, procedures, survey, test, and discrepancies will all be discussed.

CHAPTER 3: METHODOLOGY

Throughout the literature review, many varied opinions on gaps in science existed. Some studies show gender and race/ethnicity gaps and other studies that do not show any at all. Students' interest in science, their understanding of the nature of science, and their attitude about science interact with the content test and survey scores (Foley & McPhee, 2008). This study was designed to show if any gaps actually exist in an eighth grade rural science classroom. Having the inquiry skills unit at the beginning of the year, giving students the survey at the beginning of the unit, teaching the unit, and then administering a summative assessment were all parts in gathering data for this study.

Research Questions

The study addresses these research questions: (1) Do boys at this middle school have higher beliefs in their values and beliefs in science than girls do (does race/ethnicity play a role as well)? (2) Are males generally more inquisitive in science than females are (does race/ethnicity play a role as well)?

Research Design

This study achieved to learn of any gender or race/ethnicity gaps in the students' beliefs and test scores in science. The independent variables are the different genders, male and female, and the different races/ethnicities: White, Black, and Hispanic. The dependent variables are the different outcomes of the survey questions (qualitative), and the scores on the inquiry skills test (quantitative). This study is controlled because all 65 students have the same science teacher, all students attend the same school, all students are in the eighth grade, and all students were taught the inquiry skills unit at the very beginning of the year.

Participants

The students participating in this survey are all enrolled in the same teacher's eighth grade science class at the middle school. The school is in a rural district in the midlands of South Carolina, and is fairly diverse with 540 total students of which 261 are Caucasian, 226 are Black, and 52 are Hispanic. The school employs six total science teachers, two per grade, and all are female. The average student to teacher ratio is 15.88. The middle school in the study is a Title 1 school, with 292 students on free lunch, and 50 students on reduced lunch. Out of the 65 eighth grade students that participated in this survey, 33 were males and 32 were females. Out of the 33 males, 18 were white, 8 were Black, and 7 were Hispanic. Out of the 32 females, 13 were white, 13 were Black, and 6 were Hispanic.

Research Procedure

The teacher conducting this study was in her sixth year of teaching in the same school and at the same grade level. She was completing her Master's degree in Science Education at the time of this research. Because the middle school in the study has a diverse population, and a computer program did grouping for science classes, the results are randomized and hand-picked, gender, or race/ethnicity specific classrooms are not present.

The inquiry skills unit is the very first unit during the school year. Students were given a survey about their attitudes and beliefs towards science at the beginning of the school year. The students were given about 15 minutes to complete the questions, although it was not technically a timed scenario. The survey included a variety of questions, with the focus being on science. Then, the teacher taught the inquiry skills unit. Students focused on reading, writing, and discussing, and after a 12-day unit, were tested over the material. The test included a range of question types including multiple choice, fill in the blank, matching, and short answer. The test occurred on the last day of the unit and took one period, about 65 minutes, for the students to complete.

The Survey

The survey was taken and adapted from Foley and McPhee (2008). The survey starts with students identifying themselves as male or female and then identifying their race/ethnicity as White, Black, Hispanic, or other. The reason for adding the race/ethnicity was for the students to be completely honest with their answers, and keeping the survey anonymous, without names but still being able to categorize the data, was one way to help insure the categorization of results. Next, students ranked their likes and dislikes (using a 5-point scale) in science, social studies, math, and English/Language Arts (ELA). The subjects from the Foley and McPhee (2008) study were adapted to fit the subjects that the eighth grade students are required to take. Then students had to rank (again using a 5-point scale) how difficult science is. The next part was to rate questions on their perceptions and feelings towards science. A couple of statements about boys being better at hands-on inquiry and girls being better at writing lab reports were added in, so that the results would connect directly to this thesis. Finally, a last part was added onto this survey about what the eighth grade students thought their score on their end of the year-standardized test would be. Asking students to think about their final score was an assessment of their metacognition. The scoring section was added for correlation to this study and also for a continuation of this study.

The Test

Each year in this middle school's science classes, students begin with an inquiry skills unit. The standards and support documents from the state of South Carolina are what the teachers at this middle school follow when planning units of study, and inquiry skills are a part of science for all three grades, 6^{th},7^{th}, and 8th. Throughout this unit, students learn about process skills, the scientific method, and lab safety. Students read, write, discuss, and complete hands-on inquiry labs. After the unit is taught, students take their first summative assessment for the year. All of the questions on the test are standards based, following the South Carolina State Standards of Assessment.

The test was created before the unit was even planned, because backwards design is used at this middle school. The test starts with multiple-choice questions. Most of these questions are a basic recall on Bloom's taxonomy levels (a scale used by educators to rate question and knowledge levels), but when using the support documents that tell what students are responsible for knowing, the standards use words included in the Bloom's recall level. Some questions require students to think deeper and apply their knowledge to answer correctly. Next, students have a couple of fill in the blank and completion questions. Eliminating choices on these questions shows if students really know the content or not. The next section is matching. The answer bank contains more choices than the number of questions. The reason for choosing matching on this part was because these laboratory tools are new for eighth grade students, and the students have not been required to work with these tools before. The final part of the test is a short answer. Students were required to use a teacher created rubric when completing this part. The rubric was reviewed and explained to the students with a formative practice writing assignment, and this same rubric will be used for all writing portions on summative tests.

Discrepancies

Some discrepancies might affect the results taken from the 65 eighth grade students in this study. Every student completed the survey and the inquiry skills test. However, not every student was present every day during the 12-day inquiry unit. Absent students might have missed reading, notes, discussion, and labs. A copy of the assignments was given to an absent student, but not being present for the lesson was a downfall.

The student population varies in other ways than just gender and race/ethnicity. Included in the participants were some students with an IEP (Individualized Education Plan) and some were ESOL (English as Second Language Learners). These students did not require any modifications to the assignments except for reading the questions if asked. However, any student that asked to have the questions read would have that opportunity.

One more fact to consider is that most studies on gender and race/ethnicity issues are not completed just for South Carolina. Other states might not require in their standards that inquiry skills be taught in each grade in middle school. The focus on math and language arts as part of the common core standards could have implications for the newer students. Just as in the Foley and McPhee study, students' ratings of their feelings on science is not strongly correlated with scores on the written or performance assessments (2008).

Summary

The methodology used for this study is precise and clear. This study could be easily repeated in any classroom for any subject or grade level. Gaps in gender and race/ethnicity are sometimes present in the science classroom, and this study strives to see what holds true for the rural school in South Carolina and what can be done to fix any problems. Chapter Four will discuss the results of this study and specifically focus on the students' answers to the surveys and inquiry skills summative assessment.

CHAPTER 4: RESULTS

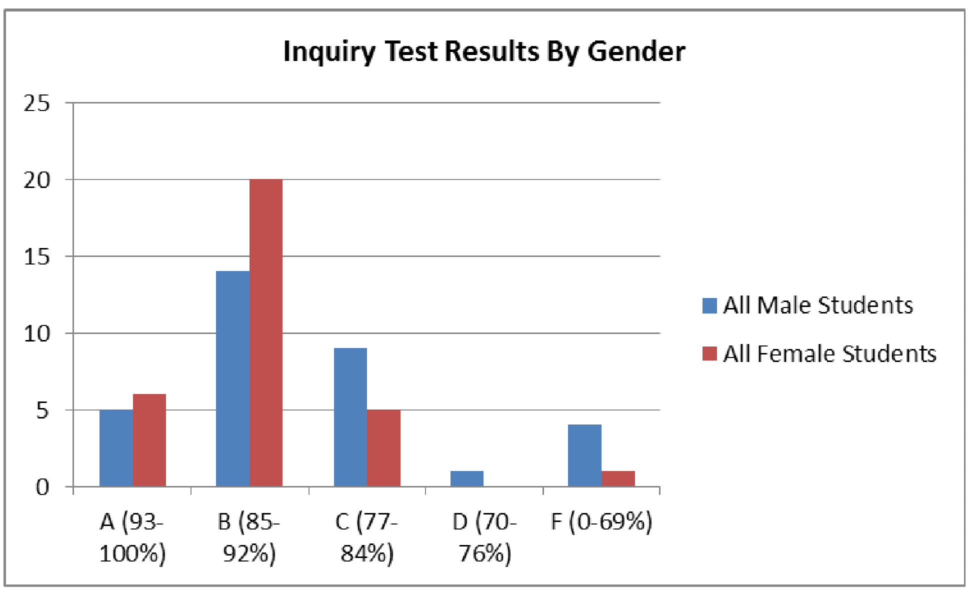
The study looked at eighth grade students' beliefs about science through the use of a survey and their actual inquiry skills test scores to compare gender and race/ethnicity gaps. The participants as well as data tables, graphs, and written results will be discussed throughout this section.

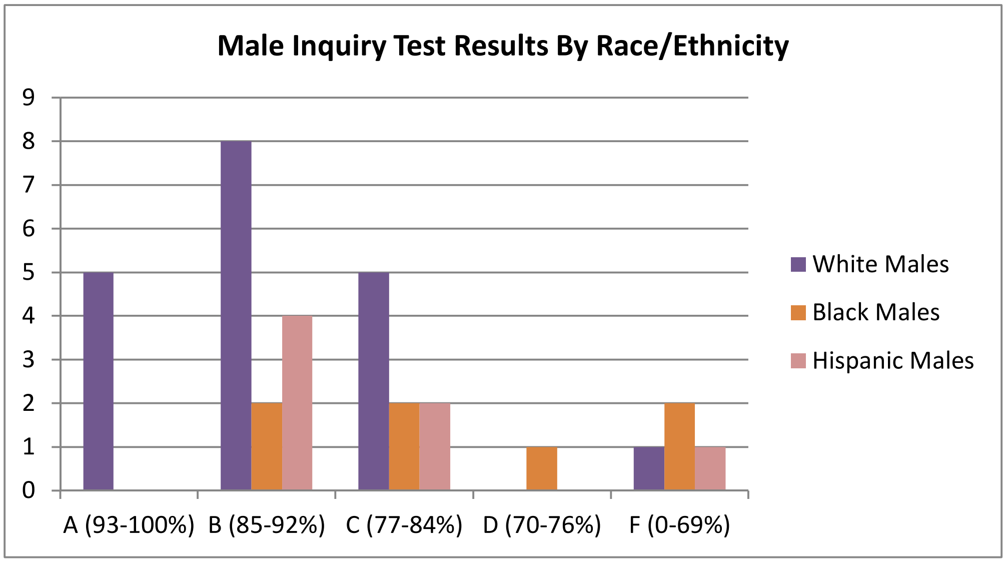
Participants

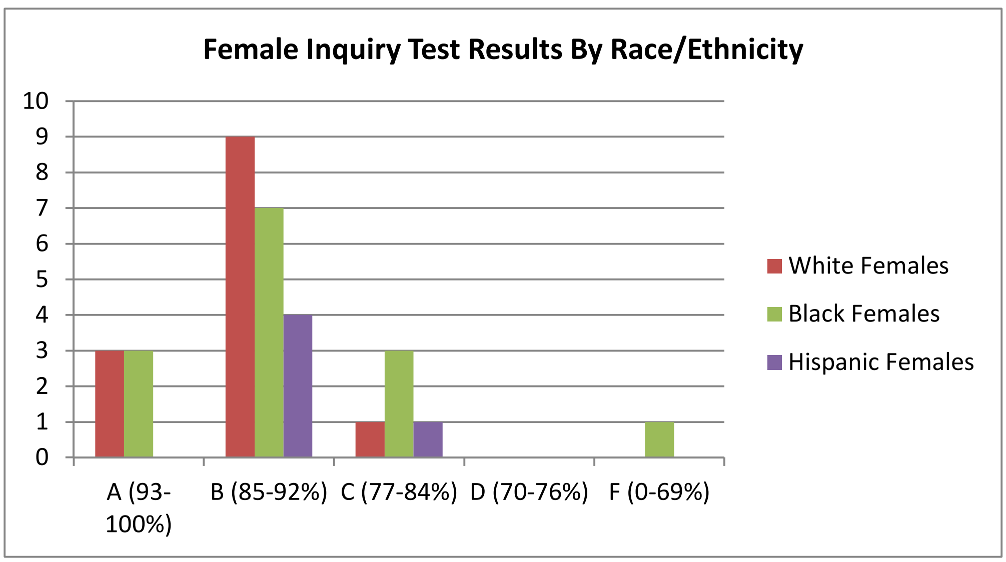
The total number of survey and test takers was 65 eighth grade students. The students range across four periods throughout the school day and are all taught by the same teacher. Students all attend a rural school in the midlands of South Carolina. The students range in age from 13 to 15 years old and include males, females, Whites, Blacks, and Hispanics.

Inquiry Test Results

As the figures represent, the inquiry test results are as follows:

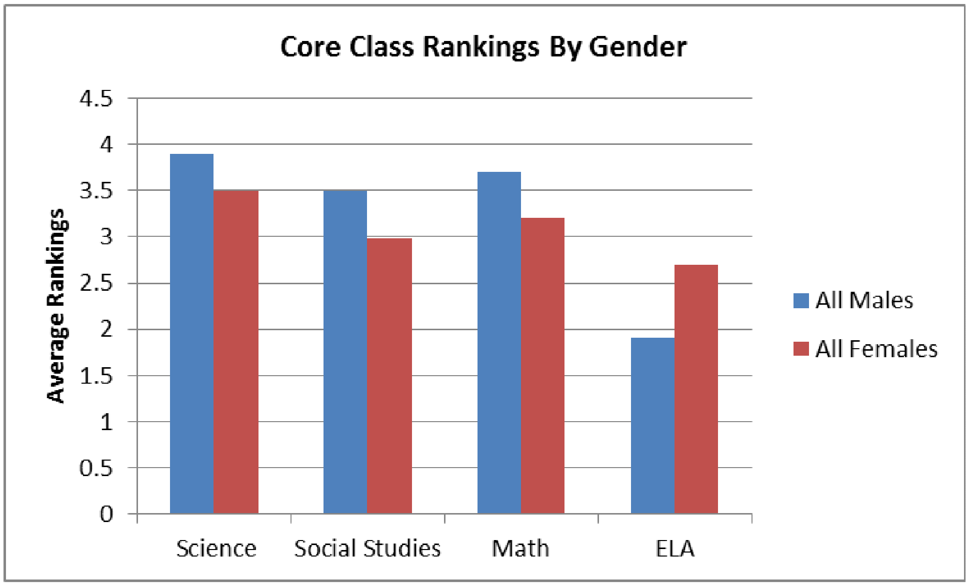


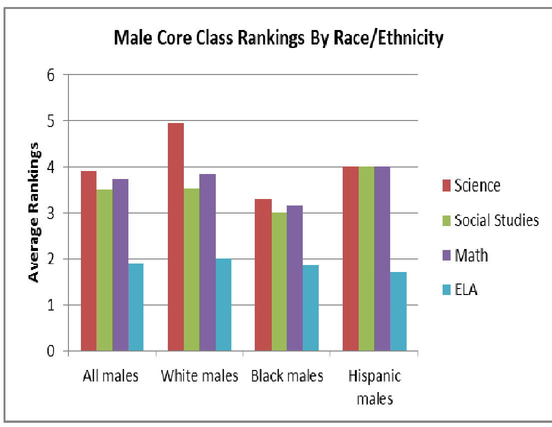

Male Inquiry Test Results By Race/Ethnicity
9
8
7
6
5
4
3
2
1
0
A (93-100%)
B (85-92%)
C (77-84%)
D (70-76%)
F (0-69%)
White Males
Black Males
Hispanic Males

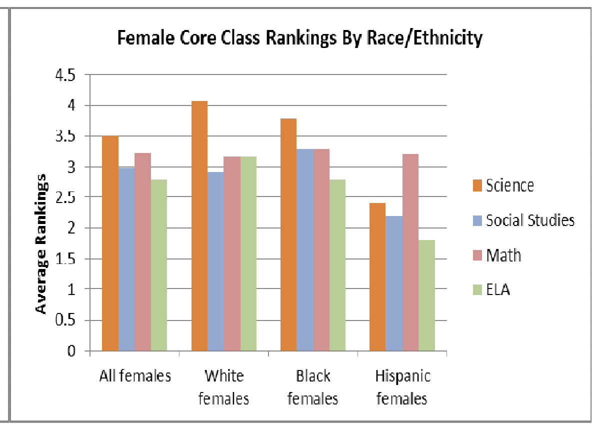

Female Inquiry Test Results By Race/Ethnicity
10
9
8
7
6
5
4
3
2
1
0
A (93-100%)
B (85-92%)
C (77-84%)
D (70-76%)
F (0-69%)
White Females
Black Females
Hispanic Females

Student Survey Results

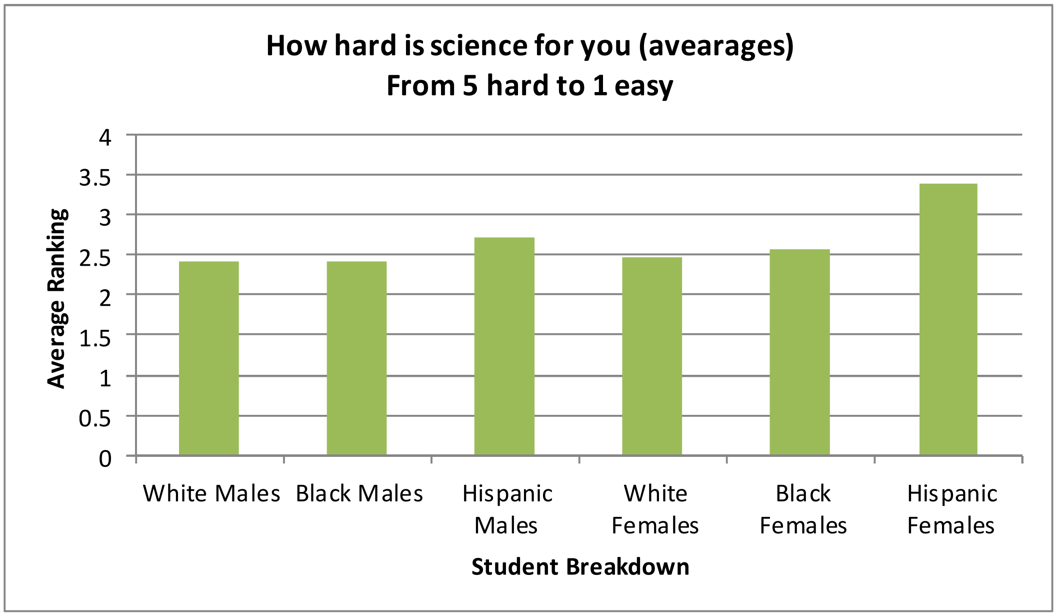
As the figures represent, the survey test results are as follows:



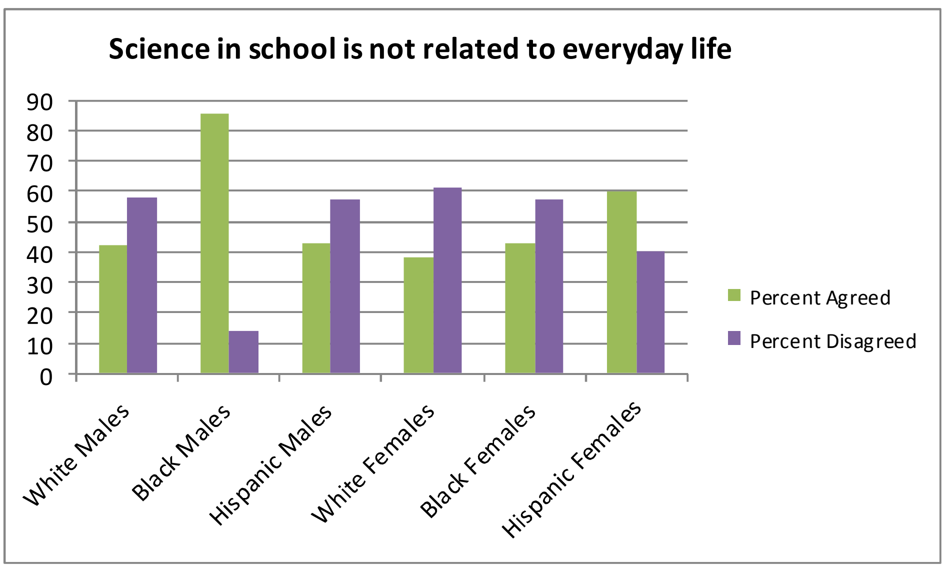




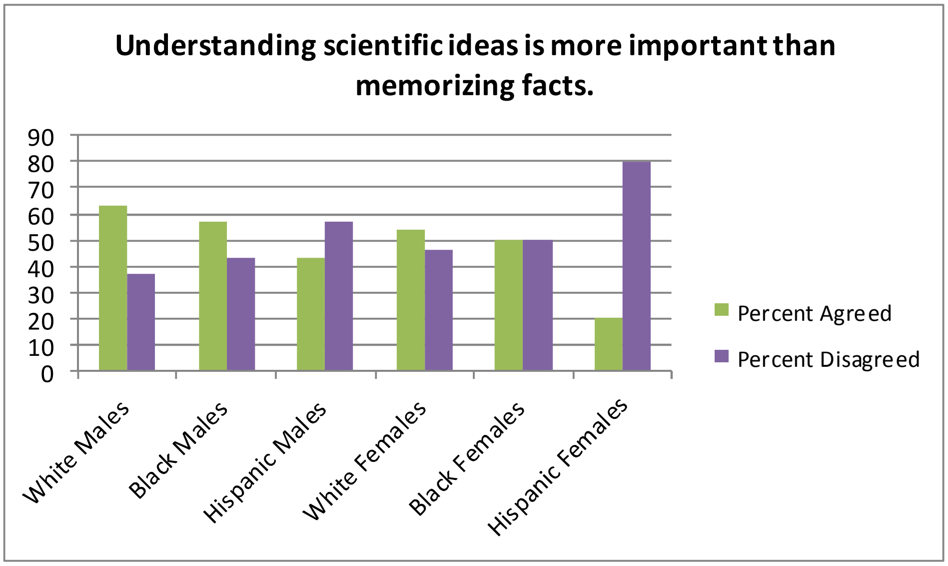
Most students actually like science the most, and ELA the least.



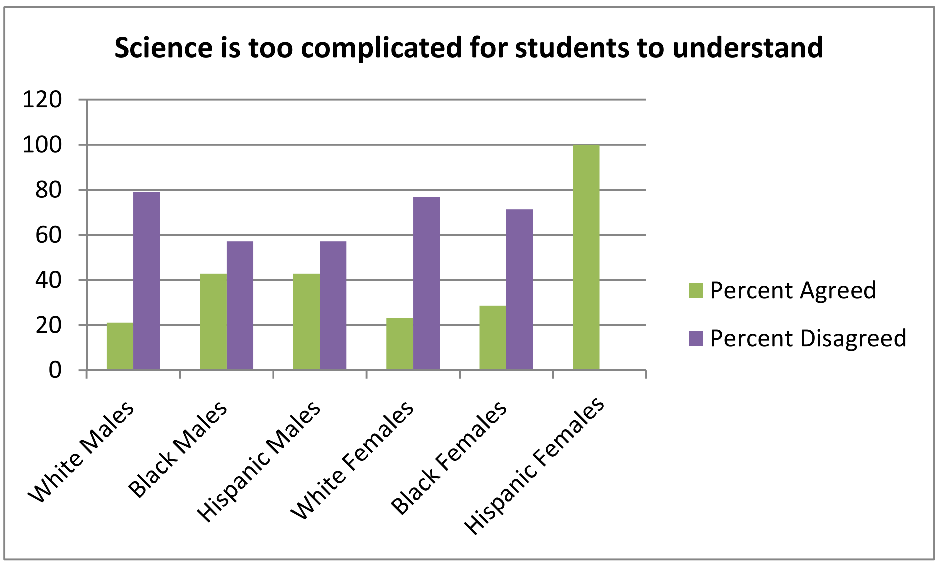
Males and females feel the same about science, but Hispanic females find science the hardest, followed by Hispanic males.



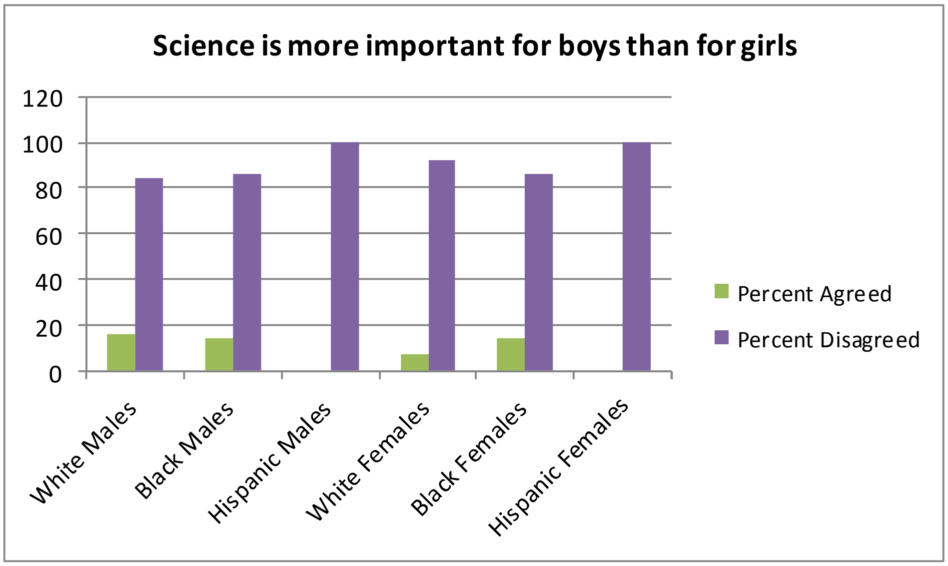
A gender gap in how students see science as related to school and everyday life exists, but race/ethnicity, specifically in Black Males seems to have the largest gap.



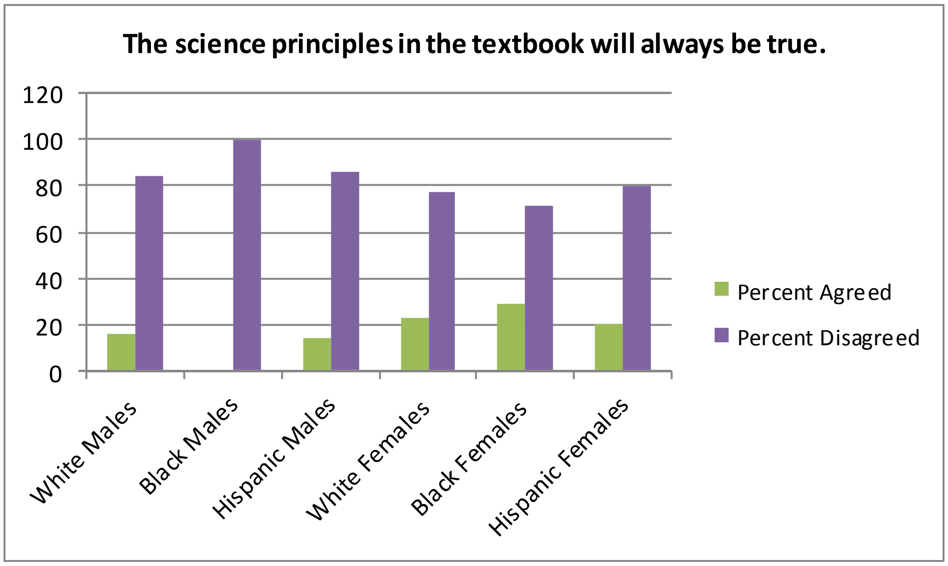
A slight gender gap in understanding scientific ideas rather than just memorizing facts exists, but again, race/ethnicity has a bigger gap; Hispanic females have the largest differences from the norm.



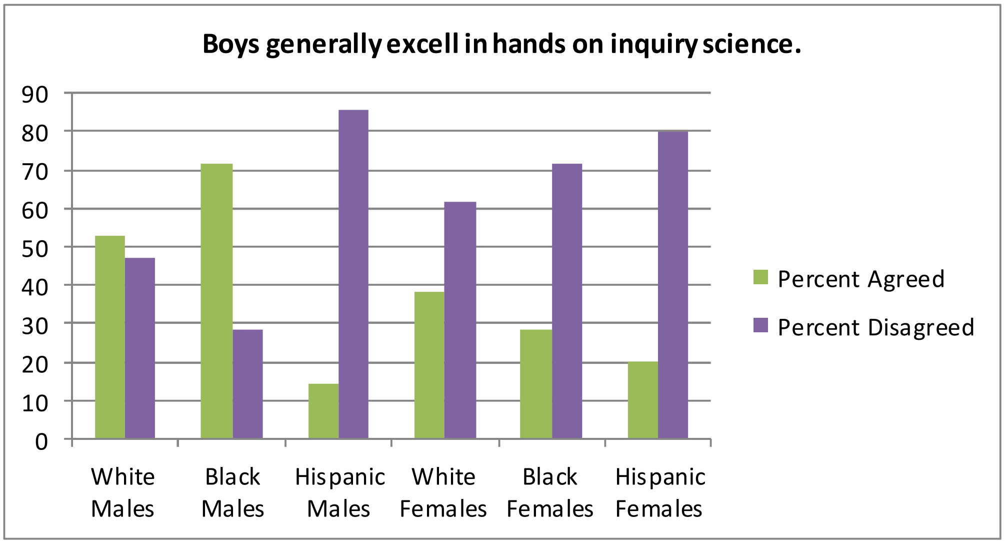
Gender does not prove too different in understanding science; however, Hispanic females have staggering results on not being able to understand.



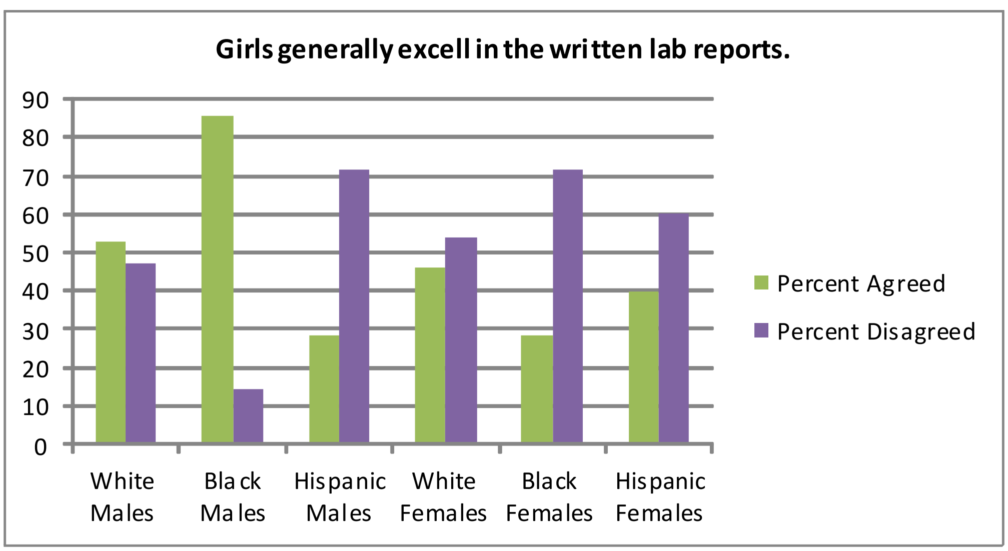
Again, gender does not play a huge role in determining if science is more important for boys than girls, but race/ethnicity, specifically Hispanic completely disagreed, because all believed science was equally important for both genders.



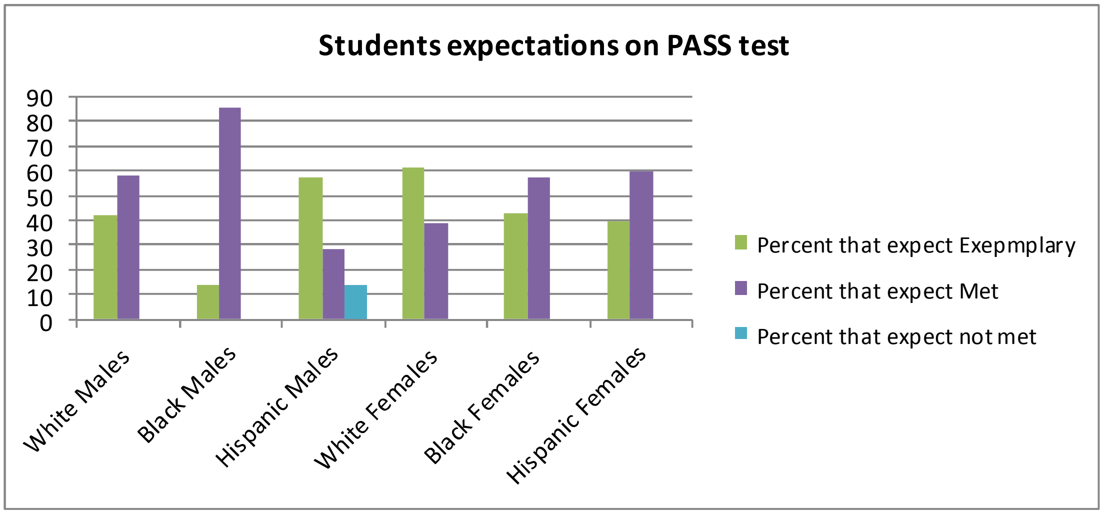
More females than males agreed that science principles would not changes, but Black males specifically all disagreed with the statement.



Gender and race/ethnicity played an issued on boys excelling in inquiry based science. For the most part, males were about half-and-half and females had more disagree. When looking at gender, Hispanic's disagreed the most, and Black males agreed the most.



Gender and race/ethnicity played a role on how students thought that girls excelled in science. More males agreed, and more females disagreed. Black males agreed the most, and Black females disagreed the most.



Gender did not have a huge affect on how students ranked their scores, but race/ethnicity, specifically Black males, had a huge result on their thoughts of their PASS scores.

Summary

On the inquiry skills summative assessment, gender was a factor, because females actually outperformed males overall. Race/ethnicity was an issue because White students outperformed Black and Hispanic. In general, gender did not have a huge affect on the students' beliefs on science. Race/ethnicity had the biggest effect on student beliefs in science throughout most of the questions. The Hispanic students had the most different beliefs than the group norms, followed by Black males. The next chapter will focus on the conclusions of this study.

CHAPTER 5: SUMMARY AND CONCLUSIONS

The focus of this action-research thesis was to conduct research through the use of a survey and inquiry based assessment to see if any gender or race/ethnicity gaps existed in the middle school science classroom. The results of this study showed that differences in race/ethnicity had more of an affect in student's beliefs and scores in science than differences in gender did.

Strengths and Weaknesses

Strengths of the study include having a good diversity of White, Black, and Hispanic students to get a diverse sampling. Teaching a standards based inquiry unit was also a strength because of the high number of researchers who promote inquiry in science. Some weaknesses included that the researcher used her own students. Her students may have been trying to please her, ranking science higher than other subjects, stating higher scores on the end of year test, etc. The fact that the inquiry skills unit is taught all throughout middle school in South Carolina might also be considered a weakness, because other states and studies might not have the same background as these students.

Gender-Based Results

Female students actually outperformed male students on the inquiry summative assessment. The students' beliefs of science seemed to be about equal overall for both genders. The real issue was the differences in race/ethnicity. Both Black and Hispanic students scored lower overall on the summative assessment. The Hispanic students overall had some of the lowest beliefs in science, followed by Black males. The results of this study brought up a completely new set of questions, shifting focus slightly away from just gender alone as the only issue with science education.

Action-Research

Very similar to the standards based inquiry unit that the students were assessed over for this research, the thesis followed many of the same procedures, from the initial question, to the hypothesis, to research, data collection, and conclusions. The thesis and action research topic of this size is the first that the researcher has completed. The process and results have had profound effects. Completing action-research is something that the researcher can use repeatedly with students for the benefit of excellence for all. The results of this study can have an effect on the way students view science if the researcher and other teachers and administrators work together to help solve the issued. Beliefs in science can really be changed from students to adults with the incorporation of positive attitudes, programs, and role models.

Participants

The 65 students in this study were all part of the same science teachers' class. Out of the 65 eighth grade students that participated in this survey, 33 were males and 32 were females. Out of the 33 males, 18 were white, 8 were Black, and 7 were Hispanic. Out of the 32 females, 13 were white, 13 were Black, and 6 were Hispanic. The average class size was 15 students with about equal gender and race/ethnicity mixes each period. Students completed the same standards based inquiry unit, completed a summative assessment at the end, and completed a survey on their beliefs in science.

Future Research

The implications of the study were astounding. Several of the data points were very surprising based on research and the data. Hispanic students' thoughts on science and their scores seemed to stand out the most to me. Both male and female Hispanics believed that science was important for every gender. Hispanic students even disagreed the most on questions that implied one gender was better than another on certain parts of science such as writing a lab report or completing a hands-on experiment. On the summative assessment, both Hispanic genders scored about equally, in the middle B to C range. These data have very real-world applications. Hispanics are the fastest growing race/ethnicity in the United States. In the small town in which the study took place in South Carolina the Hispanic population is continually growing as well. Due to the small sample size of Hispanic students, but the stunning results, this is worth more study. The new common core standards with an emphasis on math and language arts might have altered some of the current students' perceptions towards science. As schools such as this one revamp their science programs and align to common core standards, changes being made have to rely on current studies and data and eliminating stereotypes.

Race/ethnicity was a factor on how students felt about science and how students scored on their summative assessment; room for growth in science education is necessary. At the middle school, exploring the possibility of offering extra opportunities for Black and Hispanic races/ethnicities to help with science might be worthwhile. Incorporating an after school program, a different way of teaching, or even some kind of speaker or assembly might help these races/ethnicities close the gap in scores and beliefs in science. Giving the survey to students later in the year after the special activities would be beneficial to see the potential gains in students' thoughts about science. They many possibilities for further action-research are an exciting possibility.

Summary

This thesis focused on the results of an assessment and a survey and looked for gender or race/ethnicity gaps. In a small, rural, public middle school, race/ethnicity seemed to have more of an affect than gender on science beliefs and grades. Future experimentation with ways to improve the gaps between races/ethnicities at this middle school is recommended.

Reflections

Completing this thesis has changed the way the researcher will focus on certain issues in science. When beginning, gender gaps were the key focus of the research. After finding journals and studies, the issue of gaps in different races/ethnicities became more apparent and more related to the school where the research was taking place.

My goal is to share these data with my principal and science team at a future professional learning community meeting and brainstorm ways to help the close these gaps in race/ethnicity. I am envisioning having Black and Hispanic speakers come to the school for assemblies, having groups or after school science clubs and programs, and continuing to survey our students. The survey results were so clear and so easy to use to get quick data.

I am confident that this research will be useful for middle school science teachers, and I encourage other schools and teachers to conduct similar research to help ensure the success of all students, regardless of gender or race/ethnicity.

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Appendix A: Student Survey

I am: (Circle 1) male female

I am: (Circle 1) White Black Hispanic Other

1. **Which subjects do you like and not like?**
   Rank each core subject from 5 (I like it a lot) to 1 (I don't like it).

Science	I like it a lot	5	4	3	2	1	I don't like it
Social Studies	I like it a lot	5	4	3	2	1	I don't like it
Math	I like it a lot	5	4	3	2	1	I don't like it
ELA	I like it a lot	5	4	3	2	1	I don't like it

2. **How hard is science for you?**
   Rank from 5 (very hard) to 1 (super easy).
   5 4 3 2 1

3. **Do you agree or disagree with the following sentences:**
   Circle 1 for each statement.

   a) "The science in school is not related to my everyday life."
   agree disagree

   b) "Understanding scientific ideas is more important than memorizing facts."
   agree disagree

   c) "Science is too complicated for most students to understand."
   agree disagree

   d) "Science is more important for boys than for girls."
   agree disagree

   e) "The science principles in textbooks will always be true."
   agree disagree

   f) "Boys generally excel in hands-on inquiry based science."
   agree disagree

   g) "Girls generally excel in the writing portion of science lab reports."
   agree disagree

4. **This year on the science PASS test, I expect my scores to be**: (circle 1)
   Exemplary Met Not Met

Appendix B: Inquiry Test

8-1 Demonstrate an understanding of Inquiry Skills **36 Total Points**

Multiple Choice (1 point each) **22 total points**

Identify the choice that best completes the statement or answers the question.

____ 1. What would a scientist most likely make a model for?

a. an apple
b. the layers of Earth
c. a skeleton
d. the 3 types of rocks

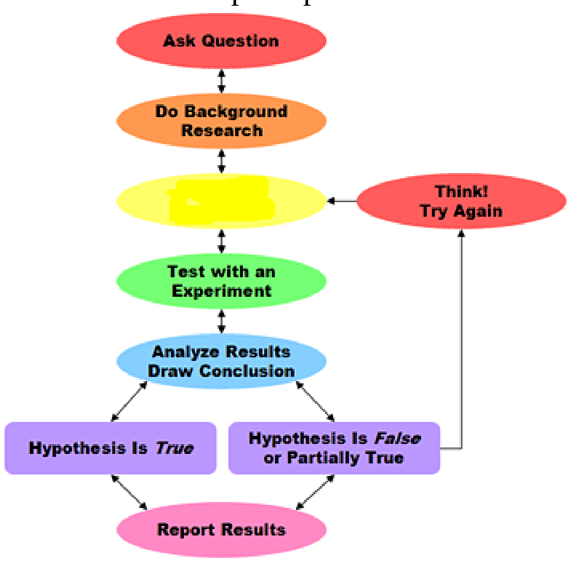
____ 2. Which of the following should be done first in a scientific investigation?

a. write procedure steps
b. develop a hypothesis
c. analyze the results
d. draw conclusions

____ 3. The procedural steps in a scientific investigation must have which of the following characteristics?

a. written in a paragraph form and never in steps
b. detailed so that someone else can repeat them
c. written before forming a hypothesis or doing research
d. written in all capital letters to emphasis their importance

____ 4. Observe the concept map of the scientific method below.



Which step of the scientific method is missing from the empty circle?

a. data
b. hypothesis
c. procedure
d. problem

____5. Jonas is doing a lab report for his physics class. Trish is finishing a lab report for her chemistry class. Why will their lab reports look similar even though they are working in different areas of science?

a. Physics and chemistry use the same tools.
b. Physics and chemistry have similar lab investigations.
c. Physics and chemistry lab investigations collect similar data.
d. The design of lab reports follows the same principles.

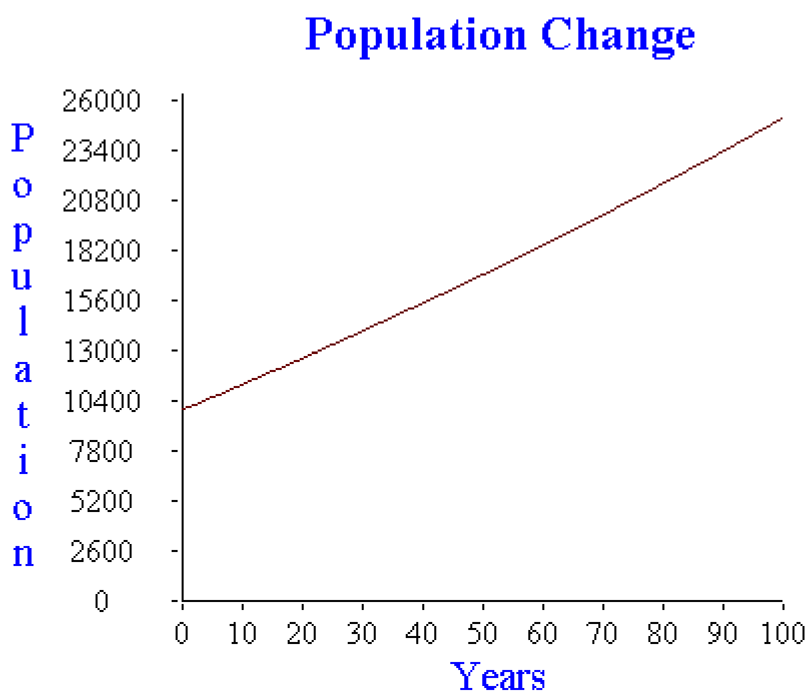
____ 6. A scientist plants pea plant seeds in three identical pots. Each pot contains three seeds. The first pot contains soil, the second pot contains clay, and the third pot contains sand. The seeds are given the same amount of water and sunlight for 3 weeks. What would be the independent variable in this experiment?

a. the number of pea plant seeds
b. the different types of soil in which the seeds are planted
c. the amount of water and sunlight
d. the height that the plants grow

____ 7. A student conducts an experiment to find out which substance will keep iron nails from rusting. He coats the first iron nail with oil-based paint, the second iron nail with acrylic paint, and the third iron nail with water-based paint. He leaves all three nails outside for three weeks. After analyzing his data, he discovers that the nail covered with acrylic paint had the least amount of rust. What is missing from his experiment?

a. independent variable
b. dependent variable
c. a manipulated variable
d. a constant variable

____ 8. This graph represents population growth over time.



Which statement is the most accurate interpretation of the data given in the graph?

a. The population growth is being limited because of decreasing resources.
b. The population growth is steadily increasing over time.
c. The population growth has reached maximum capacity and no longer increases in size.
d. The population growth is rapidly increasing due to a decrease in limiting factors.

____ 9. Two scientists are investigating the growth of flower plants using various pH levels of soil. They perform the same steps. One scientist's results indicate that a higher pH level increases growth. The other scientist's results indicate that a lower pH level increases growth. What should happen next in order to determine whose results were more accurate?

a. Testing should continue until data are collected that verify which scientist's results are accurate.
b. The scientist with a higher education should have his or her results published.
c. The experiment should be considered invalid and not be performed again.
d. Research should be found that supports one of the scientist's data, and those results should be published.

____ 10. Barbara McClintock was a biologist who spent her life studying corn in order to learn about genes. In 1940, she discovered that genes move around on chromosomes. Which statement explains why she repeated her experiment many times?

a. Repeating the experiment allowed her to make changes to the procedural steps.
b. Repeating the experiment allowed her to test various safety measures when dealing with corn.
c. Repeating the experiment is the most important step of the scientific method.
d. Repeating the experiment can build strong support for the development of scientific theories.

____ 11. What scientific tool would most likely be used to boil water?

a. hot plate
b. match
c. stove
d. bunsen burner

____ 12. Which scientific tool would be used to find the volume of a liquid?

a. balance
b. ruler
c. spring scale
d. graduated cylinder

____ 13. Which of the following science tools would **least likely** be used when studying the characteristics of light?

a. prism
b. lenses
c. tuning fork
d. color filters

____ 14. Which of the following would a balance be used to measure?

a. volume in millimeters
b. mass in grams
c. length in meters
d. temperature in degrees Celsius

____ 15. The annual gardening contest is approaching, and Bob is sure he has the winning tomato. He calls a local science lab because he wants the most accurate measurement of the tomato's mass. Which tool would he use to find out the mass of his prized beefsteak tomato?

a. triple-beam balance
b. graduated cylinder
c. metric ruler
d. thermometer

____ 16. Which science resource would **least likely** contain recent information on global warming?

a. Internet
b. science journals
c. encyclopedia
d. newspapers

____ 17. Which safety precaution would **best** help prevent injury to your eyes?

a. Tilt the test tube away from your face when heating substances.
b. Tie back your hair and loose clothing during lab investigations.
c. Wave vapors away from your mouth when observing chemicals.
d. Wear goggles only when using fire.

____ 18. The skull and crossbones symbol identifies which of the following safety precautions?

a. flammable chemicals
b. poisonous chemicals
c. location of sharp objects
d. fire alarm

____ 19. Which is the best explanation for why food and drink should not be eaten during a lab investigation?

a. The chemicals/substances used in the investigation could contaminate the food and drink.
b. The food and drink could be a potential fire hazard.
c. Vapors from the food and drink could make a student sick.
d. The caffeine in the drink could cause a headache.

____ 20. Which statement describes an unsafe lab safety guideline?

a. The lab area is clear of debris and clean at the start of lab.
b. The opening of the test tube is pointed toward the student.
c. The student is wearing goggles and close-toed shoes.
d. The test tube does not have a stopper in it but is not bubbling.

____ 21. Look at the safety symbol below.

Which statement correctly describes the safety symbol?

a. indicated the presence of flammable chemicals
b. indicated the presences of poisonous chemicals
c. indicated the presence of a fire alarm
d. indicated the presence of a safety shower

____ 22. Which of the following statements explains how to work with chemicals safely in a lab investigation?

a. Always smell the chemical if you are not sure what it is.
b. Never use a chemical with an unlabeled container.
c. Gloves are not necessary when you work with chemicals.
d. Goggles are necessary only if the chemical says “toxic” on it.

Completion (1 point each) **3 Points total**

Spelling does not count but write clearly and neatly

23. ____________________ observations use numbers, amounts, or measurements to make comparisons such as more than, all, less than, few, or none.

24.____________________ observations are made using only the senses and refer to specific properties.

25.Observe the data in the time and temperature chart below.

Time (hours)	Temperature (C)
2	30
4	33
6	37
8	42
10	?

What will the temperature reading **most likely** be at 10 hours?

Matching (1 Point each) 6 Points total

a. Concave Lens
b. Color Filter
c. Slinky Spring
d. Convex Lens
e. Spring Scale
f. Prism
g. Triple Beam Balance
h. Plane Mirror

____ 26. What tool is used to bend or refract light causing objects to be magnified?
____ 27. What tool is used to reflect light?
____ 28. What tool blocks certain wavelengths of light and transmits others?
____ 29. What tool breaks light into the colors of the spectrum?
____ 30. What tool is used to model waves?
____ 31. What tool measures the pulling force of gravity?

Short Answer 5 points total
Use your own paper to record your response to this question. Your responses must be in paragraph form; at least five sentences long, include relevant information, and must be grammatically correct.

Your explanation will be scored using the rubric provided. This rubric must be attached to your lined paper.

32. Explain the relationship between the independent and dependent variable. Compare and contrast similarities and differences.

8-1 Demonstrate an understanding of Inquiry Skills 36 Total Points

Answer Section

MULTIPLE CHOICE

1. ANS: B PTS: 1
2. ANS: B PTS: 1
3. ANS: B PTS: 1
4. ANS: B PTS: 1
5. ANS: D PTS: 1
6. ANS: B PTS: 1
7. ANS: D PTS: 1
8. ANS: B PTS: 1
9. ANS: A PTS: 1
10. ANS: D PTS: 1
11. ANS: A PTS: 1
12. ANS: D PTS: 1
13. ANS: C PTS: 1
14. ANS: B PTS: 1
15. ANS: A PTS: 1
16. ANS: C PTS: 1
17. ANS: A PTS: 1
18. ANS: B PTS: 1
19. ANS: A PTS: 1
20. ANS: B PTS: 1
21. ANS: A PTS: 1
22. ANS: B PTS: 1

COMPLETION

23. ANS: quaNtatative

    PTS: 1
24. ANS: qualitative

    PTS: 1
25. ANS: 48 C

    PTS: 1

MATCHING

26. ANS: D PTS: 1
27. ANS: H PTS: 1
28. ANS: B PTS: 1
29. ANS: F PTS: 1
30. ANS: C PTS: 1
31. ANS: E PTS: 1

ESSAY

32. Use this rubric to score:

	1 Point	.75 Points	.50 Points	.25 Points	0 Points
Sentences	Included all 5 sentences in response.	Included 4 sentences in response.	Included 3 sentences in response.	Included 1-2 sentences in response.	Did not include a response.
Terms of the Discipline	Included at least 3 key terms to support response.	Included at least 2 key terms to support response.	Included at least 1 key term to support response.	Included key terms but did not correctly use them to support response.	Did not include any key terms to support response.
Supporting evidence	Included at least 3 facts to support response.	Included at least 2 facts to support response.	Included at least 1 fact to support the response.	Included facts but did not correctly use them to support response.	Did not include any facts to support response.
Introduction and Conclusion	Included an effective introduction and conclusion statement.	Included an introduction and conclusion, but not as effective as possible.	Only included either an introduction or a conclusion, but not both.	Only included either an introduction or a conclusion, but not both, and not as effective as possible.	Did not include any introduction or conclusion statement.
Grammar, Mechanics, and Punctuation	Did not have any grammatical issues.	Had 1-2 grammatical issues.	Had 3-4 grammatical issues.	Had 5-6 grammatical issues.	Had 7+ grammatical issues.

Appendix C: Inquiry Test Results Data Table of Raw Data

	A (93-100%)	B (85-92%)	C (77-84%)	D (70-76%)	F (0-69%)
All Students	11	34	14	1	5
All Male Students	5	14	9	1	4
White Males	5	8	5	0	1
Black Males	0	2	2	1	2
Hispanic Males	0	4	2	0	1
All Female Students	6	20	5	0	1
White Females	3	9	1	0	0
Black Females	3	7	3	0	1
Hispanic Females	0	4	1	0	0

Appendix D: Student Survey Results Data Tables of Raw Data

Question Number 1: Which subjects do you like and not like?

All Males Subject Rankings- Total 33

	5 I like it a lot	4	3	2	1 I don't like it	Average
Science	9	14	8	2	0	3.909
Social Studies	11	5	10	4	3	3.515
Math	12	8	6	6	1	3.727
ELA	0	2	8	8	15	1.909

White Males Subject Rankings- Total 19

	5 I like it a lot	4	3	2	1 I don't like it	Average
Science	6	7	6	0	0	4.947
Social Studies	6	4	6	0	3	3.526
Math	8	3	5	3	0	3.842
ELA	0	2	5	3	9	2.000

Black Males Subject Rankings- Total 7

	5 I like it a lot	4	3	2	1 I don't like it	Average
Science	2	2	1	2	0	3.286
Social Studies	1	1	2	3	0	3.000
Math	1	2	1	3	0	3.143
ELA	0	0	1	4	2	1.857

Hispanic Males Subject Rankings- Total 7

	5 I like it a lot	4	3	2	1 I don't like it	Average
Science	1	5	1	0	0	4.000
Social Studies	4	0	2	1	0	4.000
Math	3	3	0	0	1	4.000
ELA	0	0	2	1	4	1.714

All Females Subject Rankings- Total 32

	5 I like it a lot	4	3	2	1 I don't like it	Average
Science	6	11	10	3	2	3.500
Social Studies	4	10	7	3	8	2.969
Math	7	5	12	4	4	3.219
ELA	7	5	4	6	10	2.781

White Females Subject Rankings- Total 13

	5 I like it a lot	4	3	2	1 I don't like it	Average
Science	2	6	3	2	0	4.077
Social Studies	2	3	4	0	4	2.923
Math	1	3	6	3	0	3.154
ELA	5	1	2	1	4	3.154

Black Females Subject Rankings- Total 14

	5 I like it a lot	4	3	2	1 I don't like it	Average
Science	3	5	6	0	0	3.786
Social Studies	2	6	2	2	2	3.286
Math	4	2	5	0	3	3.286
ELA	2	3	2	4	3	2.786

Hispanic Females Subject Rankings- Total 5

	5 I like it a lot	4	3	2	1 I don't like it	Average
Science	1	0	1	1	2	2.400
Social Studies	0	1	1	1	2	2.200
Math	2	0	1	1	1	3.200
ELA	0	1	0	1	3	1.800

All students- Total 65

	5 I like it a lot	4	3	2	1 I don't like it	Average
Science	15	25	18	5	2	3.708
Social Studies	15	15	17	7	11	3.246
Math	19	13	18	10	5	3.477
ELA	7	7	12	14	25	2.338

Question Number 2: How hard is science for you?

	5 Very Hard	4	3	2	1 Super Easy	Average
All Students (65)	2	7	26	21	9	2.569
All Males (33)	0	4	13	11	5	2.485
White Males (19)	0	2	8	5	4	2.421
Black Males (7)	0	1	1	5	0	2.429
Hispanic Males (7)	0	1	4	1	1	2.714
All Females (32)	2	3	13	10	4	2.656
White Females (13)	0	1	5	6	1	2.462
Black Females (14)	1	1	6	3	3	2.571
Hispanic Females (5)	1	1	2	1	0	3.400

Question Number 3a) The science in school is not related to my everyday life.

	Agree	Agree Average %	Disagree	Disagree Average %
All Students (65)	31	47.69	34	52.31
All Males (33)	17	51.52	16	48.48
White Males (19)	8	42.11	11	57.89
Black Males (7)	6	85.71	1	14.29
Hispanic Males (7)	3	42.86	4	57.14
All Females (32)	14	43.75	18	56.25
White Females (13)	5	38.46	8	61.54
Black Females (14)	6	42.86	8	57.14
Hispanic Females (5)	3	60.00	2	40.00

Question Number 3b) Understanding scientific ideas is more important than memorizing facts.

	Agree	Agree Average	Disagree	Disagree Average
All Students (65)	34	52.31	31	47.69
All Males (33)	19	57.58	14	42.42
White Males (19)	12	63.16	7	36.84
Black Males (7)	4	57.14	3	42.86
Hispanic Males (7)	3	42.86	4	57.14
All Females (32)	15	46.88	17	53.12
White Females (13)	7	53.85	6	46.15
Black Females (14)	7	50.00	7	50.00
Hispanic Females (5)	1	20.00	4	80.00

Question Number 3c) Science is too complicated for most students to understand.

	Agree	Agree Average	Disagree	Disagree Average
All Students (65)	22	33.85	43	66.15
All Males (33)	10	30.30	23	69.70
White Males (19)	4	21.05	15	78.95
Black Males (7)	3	42.86	4	57.14
Hispanic Males (7)	3	42.86	4	57.14
All Females (32)	12	37.50	20	62.50
White Females (13)	3	23.08	10	76.92
Black Females (14)	4	28.58	10	71.42
Hispanic Females (5)	5	100.00	0	0

Question Number 3d) Science is more important for boys than for girls.

	Agree	Agree Average	Disagree	Disagree Average
All Students (65)	7	10.77	58	89.23
All Males (33)	4	12.12	29	87.88
White Males (19)	3	15.79	16	84.21
Black Males (7)	1	14.29	6	85.71
Hispanic Males (7)	0	0	7	100.00
All Females (32)	3	9.38	29	90.62
White Females (13)	1	7.69	12	92.31
Black Females (14)	2	14.29	12	85.71
Hispanic Females (5)	0	0	5	100.00

Question Number 3e) The science principles in textbooks will always be true.

	Agree	Agree Average	Disagree	Disagree Average
All Students (65)	12	18.46	53	81.54
All Males (33)	4	12.12	29	87.88
White Males (19)	3	15.79	16	84.21
Black Males (7)	0	0	7	100.00
Hispanic Males (7)	1	14.29	6	85.71
All Females (32)	8	25.00	24	75.00
White Females (13)	3	23.08	10	76.92
Black Females (14)	4	28.57	10	71.43
Hispanic Females (5)	1	20.00	4	80.00

Question Number 3f) Boys generally excel in hands-on inquiry based science.

	Agree	Agree Average	Disagree	Disagree Average
All Students (65)	26	40.00	39	60.00
All Males (33)	16	48.48	17	51.52
White Males (19)	10	52.63	9	47.37
Black Males (7)	5	71.43	2	28.57
Hispanic Males (7)	1	14.29	6	85.71
All Females (32)	10	31.25	22	68.75
White Females (13)	5	38.46	8	61.54
Black Females (14)	4	28.57	10	71.43
Hispanic Females (5)	1	20.00	4	80.00

Question Number 3g) Girls generally excel in the writing portion of science lab reports.

	Agree	Agree Average	Disagree	Disagree Average
All Students (65)	30	46.15	35	53.85
All Males (33)	18	54.55	15	45.45
White Males (19)	10	52.63	9	47.37
Black Males (7)	6	85.71	1	14.29
Hispanic Males (7)	2	28.57	5	71.43
All Females (32)	12	37.50	20	62.50
White Females (13)	6	46.15	7	53.85
Black Females (14)	4	28.57	10	71.43
Hispanic Females (5)	2	40.00	3	60.00

Question number 4: This year on the science PASS test, I expect my scores to be:

	Exemplary	Exemplary Average	Met	Met Average	Not Met	Not Met Average
All Students (65)	29	44.62	35	53.85	1	1.53
All Males (33)	14	42.42	19	57.58	0	0
White Males (19)	8	42.11	11	57.89	0	0
Black Males (7)	1	14.29	6	85.71	0	0
Hispanic Males (7)	4	57.14	2	28.57	1	14.29
All Females (32)	16	50.00	16	50.00	0	0
White Females (13)	8	61.54	5	38.46	0	0
Black Females (14)	6	42.86	8	57.14	0	0
Hispanic Females (5)	2	40.00	3	60.00	0	0

Appendix E: IRB Approval Letter

Northern Michigan University

Office of Graduate Education and Research
1401 Presque Isle Avenue
Marquette, MI 49855-5301
906-227-2300
FAX: 906-227-2315
Web site: www.nmu.edu

Memorandum

TO: Bethany Mihalik
Education Department

CC: Carolyn Lowe
Education Department

DATE: November 14, 2012

FROM: Brian Cherry, Ph.D.
Assistant Provost/IRB Administrator

SUBJECT: IRB Proposal HS12-489
"Graduate Thesis: How Important do Student's View Science?"

The Internal Review Board (IRB) has reviewed your proposal and has given it final approval. To maintain permission from the Federal government to use human subjects in research, certain reporting processes are required.

A. You must include the statement "Approved by IRB: Project # HS12-489" on all research materials you distribute, as well as on any correspondence concerning this project.

B. If a subject suffers an injury during research, or if there is an incident of non-compliance with IRB policies and procedures, you must take immediate action to assist the subject and notify the IRB chair (dereande@nmu.edu) and NMU's IRB administrator (bcherry@nmu.edu) within 48 hours. Additionally, you must complete an Unanticipated Problem or Adverse Event Form for Research Involving Human Subjects

C. If you find that modifications of methods or procedures are necessary, you must submit a Project Modification Form for Research Involving Human Subjects before collecting data.

D. If you complete your project within 12 months from the date of your approval notification, you must submit a Project Completion Form for Research Involving Human Subjects.

E. If you do not complete your project within 12 months from the date of your approval notification, you must submit a Project Renewal Form for Research Involving Human Subjects. You may apply for a one-year project renewal up to four times.

All forms can be found at the NMU Grants and Research website:
http://www.nmu.edu/grantsandresearch/node/102

ljc