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Science Self-efficacy In Tenth Grade Hispanic Female High School Students

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SCIENCE SELF-EFFICACY IN TENTH GRADE HISPANIC FEMALE HIGH SCHOOL STUDENTS

by

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ABSTRACT

Historical data have demonstrated an underrepresentation of females and minorities in science, technology, engineering, and mathematics (STEM) professions. The purpose of the study considered the variables of gender and ethnicity collectively in relationship to tenth grade Hispanic females' perception of their self-efficacy in science. The correlation of science self-efficacy to science academic achievement was also studied. Possible interventions for use with female Hispanic minority populations might help increase participation in STEM field preparation during the high school career.

A population of 272 students was chosen through convenience sampling methods, including 80 Hispanic females. Students were administered a 27-item questionnaire taken directly from the Smist (1993) Science Self-efficacy Questionnaire (SSEQ). Three science self-efficacy factors were successfully extracted and included Academic Engagement Self-efficacy (M=42.57), Laboratory Self-efficacy (M=25.44), and Biology Self-efficacy (M=19.35). Each factor showed a significant positive correlation (p<.01) to each of the other two factors.

ANOVA procedures compared all female subgroups in their science self-efficacy perceptions. Asian/Pacific and Native American females had higher self-efficacy mean scores as compared to White, Black and Hispanic females on all three extracted science self-efficacy factors. Asian/Pacific females had the highest mean scores. No statistically significant correlations were found between science-self-efficacy and a measure of science achievement.

Two high-ability and two low-ability Hispanic females were randomly chosen to participate in a brief structured interview. Three general themes emerged. Classroom Variables, Outside School Variables, and Personal Variables were subsequently divided into sub themes influenced by participants' views of science,

It was concluded that Hispanic female science self-efficacy was among the subgroups which self-scored the lowest. Asian/Pacific and Native American females fared better than White, Black, and Hispanic female counterparts respectively. Triangulation of interview and quantitative data showed that classroom factors, specifically academic engagement, influenced participant perceptions of science self efficacy the greatest.

Suggested further studies on the impact of science self-efficacy and science achievement are discussed. Information gleaned from the continued study of science self-efficacy may influence the ability of traditionally underrepresented racial/ethnic females to persist in their science preparation and training in an effort to prevent leaving the STEM pipeline at this crucial juncture.

I dedicate my research to both my parents: To my deceased father, Salvatore Michael DeCanio, who believed I could accomplish anything and was proud of my achievements despite adversities that I encountered in my life. It is his inspiration and common sense approach to life that helped me through the dissertation process. To my mother, Leticia Miranda DeCanio, whose love for children inspired my own and has caused me to expand my knowledge in the field of underrepresented populations in the field of science education.

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LIST OF ACRONYMS/ABBREVIATIONS

AAAS	American Association for the Advancement of Science.
AYP	Adequate Yearly Progress as defined by the *No Child Left Behind* legislation.
FCAT	Florida Comprehensive Achievement Test
ICEQ	Individualized Classroom Environment Questionnaire
NAEP	National Assessment of Educational Progress
NCES	National Council of Education Statistics
NCLB	No Child Left Behind Act of 2001
NRC	National Research Council
NSES	National Science Education Standards
NSB	National Science Board
NSF	National Science Foundation
OCPS	Orange County Public Schools
SAT-9	Ninth Edition of the Stanford Achievement Test
SSEQ	Science Self-efficacy Questionnaire
STEM	Science, Technology, Engineering, Mathematics

CHAPTER ONE: INTRODUCTION

Background and Significance

The strength of the science and technology talent pool is of great importance to America's economy, health care, and national security (NSES, 2003c). Strong performance in science and engineering in the United States (US) has become the international benchmark for measuring Science and Engineering activities and knowledge-driven economic growth world-wide (National Science Board (NSB), 2004) However, in international comparisons, US student performance becomes increasingly weaker than its international counterparts at the higher grade levels in secondary education (NSB, 2004, 1-5). Further, the existing US talent pool is a national concern as evidenced by numerous research references (Blickenstaff, 2005; Kahle, 2004; NSB, 2004; Bordogna, 2003; Baker, 2002; National Research Council (NRC), 2000; Hanson, Schaub, & Baker, 1996;) and initiatives to increase Mathematics and Science achievement through the *No Child Left Behind Act* (NCLB, 2001). There are not enough professionals to meet the current demands in Science, Technology, Engineering, and Mathematics (STEM) fields. Locally, Mathematics and Science achievement is a concern to central Florida businesses, government, and educational leaders as well. Constituents from each of these groups have formed a consortium known as PRISM (Promoting Regional Improvement in Science and Math) to address economic and educational Mathematics and Science issues within the region where the research study will take place (MyRegion.com, 2005).

Currently, the majority of individuals receiving advanced degrees in computers, information sciences, and engineering are men (Freeman, 2004; Bordogna, 2003; Hanson, Schaub, & Baker, 1996;van Langen & Dekkers, 2005). Women remain underrepresented in mathematics, the physical sciences, and engineering fields (Baker, 2002; Hanson, 1996; and Kahle, 2004). Bordogna (2003) made reference to this group as the "underrepresented majority" (p.23) because minorities, or people of color, and women, when added together, actually represent a majority. In doing so, he hoped to highlight the gravity of addressing the issues of underrepresentation.

Metaphorically referred to as the "leaky pipeline" in much of the literature (Berryman, 1983; Blickenstaff, 2005; van Langen & Dekkers, 2005, Bordogna, 2003; Hanson, Schaub, & Baker, 1996,), women and minorities leave science, technology, engineering, and mathematics (STEM) preparation at several key points as they progress through educational training in school toward future professions. Muller, Stage, and Kinzie (2001) believe low science achievement scores caused by poor science preparation to be a primary cause of attrition of women and minorities from STEM fields. Tindall and Hamil (2004) believe the attrition to be caused by gender discrimination in science education. Clewell (2002) believe girls "opt out" of higher level mathematics and science courses due to ongoing and pervasive social stereotyping by media, teachers, parents, and classmates. This general lack of interest in science as boring, masculine, and remote from everyday life may be an important factor (van Langden & Dekker, 2005). As far back as 1994 however, Simpson, Koballa, Oliver, and Crawley argued that high school academic tracking choices offered the first opportunity for the pipeline leak to emerge. Lack of participation in high school mathematics and science is that portion of the pipeline where girls fall behind (Hanson, Schaub, & Baker, 1996). Bordogna (2003) agrees that there exist key points along the pipeline that need to be developed with targeted recruitment to avoid attrition. International research (Hanson, Schaub, & Baker, 1996; van Langden & Dekkers, 2005) notes that one of two crucial moments in a student's career that contributes to this same trend internationally: the choosing of mathematics and science subjects in upper secondary education. Failure to enter the pipeline at this juncture can serve to eliminate potential STEM candidates from the field, despite their academic qualifications. Course-taking choices therefore play a significant role in the attrition and shortages as a result. Without specific insight into the influencing factors for women and minorities to enter STEM fields, these underrepresented populations will continue to fail to be retained in STEM field preparation in high school. Adequate precollege science preparation is necessary for continuance of STEM study that eventually leads to STEM professions. The high school years represent a critical period for encouraging students to continue their science studies and enter or remain in the science pipeline (Muller, Stage, & Kinzie, 2001). This study lends insight in curtailing the leaky pipeline early enough in the process to evoke a difference in practice. Through specific and targeted STEM profession marketing and culturally sensitive science education instruction, perhaps the population of underutilized Hispanic females, over time, can become a viable source of potential talent in the science pool.

Addressing Current Data

Current data focuses on student achievement or physiologic differences in ability. Race and ethnicity remain largely unstudied within gender differences research (Hanson, 1996). Even the NCES statistical research,through the National Assessment of Educational Progress (NAEP) known as the Nation's Report Card, failed to disaggregate the data beyond general analysis (Kahle, 2004). In both 1996 and 2000 science assessments, the National Center for Education Statistics (NCES, 2003c) showed Hispanic students scoring consistently behind their White, Asian, and American Indian counterparts. Blacks, Hispanics, and American Indians constituted 6 % of the total science and engineering labor force, and were disproportionately more likely to earn degrees in the social sciences rather than in the natural sciences or engineering. This data is particularly true for Hispanic women (2%) (NSF, 1996)

Hispanic Females

In the state of Florida, where this study was conducted, White eighth grade students had average science scales scores that were higher than Black and Hispanic students on the 1990 National Assessment for Educational Progress (NAEP) state science assessment (O'Sullivan, Jerry, Ballator, & Herr, 1997). Additionally, Figure 1 indicates that male performance on the NAEP 2000 science assessments improves significantly in grade eight between 1996 and 2000 while female scores remained stagnant. Both males and females demonstrated a significant decline in scores by grade twelve indicating a decrease in science achievement between grades eight and twelve for both genders

(NCES, 2001). This study combined these demonstrated concerns in both female and racial/ethnic performance by centering its analysis on the science self-efficacy attitudes of Hispanic females in early high school, specifically tenth grade. Since performance data are rarely disaggregated as a combination of gender and race/ethnicity, the information gleaned from the research adds to the body of knowledge in science education literature geared toward secondary science education.

Hispanic Underrepresentation in the Sciences

Simpson, et al. (1994) argued that high school academic tracking choices offered the first opportunity for the pipeline leak to emerge. They found that 42% of Hispanic students entered the general education track and 31% of Hispanic students entered the vocational education track. With only 27% of Hispanics choosing the academic track in high school, it is therefore understandable that the NSF (1996) reported only 10% of Hispanic students choosing to enter science and engineering professions. Based on the fact that 22% of scientists and engineers are women (NSF, 1996), and only 10% of that population are Hispanic as noted in the 1996 NSF report, it can be estimated that only 2% of those who enter STEM related careers in the United States are Hispanic women. Despite these staggering figures, race and ethnicity remain largely unexamined within gender research literature in science education (Baker, 2002; Kahle, 2004; Tindall & Hamil, 2004) even though race and ethnicity explains more variance in science achievement scores than does gender alone (Clewell & Ginorio, 1996).

Thus, efforts to increase the science performance of Hispanic female students were explored. A logical step in accomplishing this goal was to identify discrepancies between female subgroups and extend disaggregation of the data beyond current general treatment of either gender or race/ethnicity by combining these factors.

A New Research Focal Point

Baker (2002) and Kahle (2004) also caution that new research foci should not focus on physiologic differences, as these cannot be controlled or manipulated. Rather, research should be response-oriented, studying variables in the learning environment that might decrease achievement discrepancies and increase persistence of women to study science. In short, qualitative studies that delve beyond the scores and grades need to be included as a component of any future research. Only through concurrent behavioral study of affective factors within classroom environments can we more fully understand variables that influence science persistence and subsequent achievement across gender and ethnicity. This study incorporated the use of both quantitative and qualitative methods to achieve this goal.

Theoretical Framework

Self-Efficacy

The social cognitive theory and its self-efficacy construct infer that if science self-efficacy can be improved, females and racial/ethnic minorities might find science a more attractive option as a possible profession (Bandura, Barbaranelli, Caprara, & Pastorelli, 1996). Self-efficacy beliefs are one of many interacting independent variables that create learning environments which serve to inadvertently exclude or include students. Low self-efficacy in the science classroom may sway females and ethnic minorities away from higher level high school science coursework and college science preparation. Studies note the importance of achievement in science during high school for determining later persistence in the science pipeline (Maple & Stage, 1991). Since science self-efficacy may possibly be related to an increase or decrease in science achievement outcomes, the study investigated this theoretical construct and its relationship in specifically Hispanic female populations.

Science self-efficacy may indirectly be influenced by numerous other variables in the learning environment. Both the difficult lexile reading levels of science texts as well as prior mathematics achievement are often cited as gatekeepers to science achievement. School administrators and counselors often use student reading and mathematics achievement scores and prior science course grades as a filter to render appropriate course selection decisions.

Standardized Reading and Mathematics Achievement Scores

Reading achievement. Science grades used alone in the regression analysis might not be an accurate measure since science text is known to be the hard to read and comprehend due to vocabulary and sentence length (Chavkin, 1997). Otero & Campanario (1990) believe that difficulties in science comprehension stem from difficulties in reading comprehension in general Chiang-Soong and Yager (1993) found that at least one third of secondary science textbooks had readability levels that extended into the college level. Chemistry texts are the worst offender showing only 20% of texts written for the appropriate grade level; with Biology texts showing only 50% written at the appropriate level (Chavkin, 1997).

Research findings show diverse opinion regarding why difficulties in science reading comprehension exist. Comprehension of science text requires task-specific cognitive strategies that involve forming a coherent representation of the text (Taraban, 2003). Sovik, Samuelstuen, and Flem (2000) found that good readers differed little from poor readers regarding experience and task-specific strategies when encountering familiar concepts. However, good readers significantly exceeded poor readers in comprehending unfamiliar text. Good readers that have learned to use syntactic and semantic cues to reconstruct meaning would have an easier time comprehending difficult science text. However, Guzzetti (1984) found that prior knowledge and interest in content material, rather than the difficulty of the material itself, influences comprehension. Everson (2003) agrees that science readers rely on background knowledge and experiences to retrieve textual information. Stylianou (2004) found that general reading comprehension, accompanied by strategic decision-making which occurs during navigation through the text, and prior domain knowledge significantly predicts students' individual understanding of science. Termed metacognitive self-management by Spence, Yore, and Williams (1999), these researchers found a significant correlation between such awareness and comprehension task success. Lower ability readers had significant differential learning effects.

In the absence of explicit instruction in navigating unfamiliar science context through metacognitive awareness and self-management within texts (i.e. think alouds, structured interview protocols, concept maps, etc), students who are good readers are more likely to create meaningful constructions and have implicit comprehension (Rivard & Yore, 1992). These skills must also be explicitly taught through what Chyu (1991) calls the Nested Spiral Approach which encompasses the five steps of preview, exploration, discussion, exercise, and review. Since the study involves both Exceptional Student Education students and Limited English Proficient students, it is important to note that Carlisle (1993) found that learning disabled students were less proficient in their skills for understanding science, while Chung and Berry (2000) found that second language proficiency and background knowledge were good predictors of reading comprehension. By including reading achievement in the Hispanic Female Achievement Matrix, a student's reading ability level can be ruled out as a nonvariable.

Mathematics achievement. Is mathematics the language of science as some say? Both domains need measurement as part of their curricula as evidenced by the national standards in both mathematics and science (Hurley & Normandia, 2005). The American Association for the Advancement of Science (AAAS, 1998) recommends integration of between science and other disciplines. Mathematics ability, along with language and cognitive reasoning ability, has been found to have a positive correlation to science achievement and attitudes toward science (DeBaz, 1994). Ma & Ma (2005, 2004) found a correlation between the average rates of growth in mathematics and science achievement was strong among the schools tested and was influenced by student and school characteristics. However, the same correlation did not exist at the student level. Benbow and Minor (1986) did not find gender differences in equally talented mathematics students. High ability females, however, did show negative differences to the physical sciences which tend to involve more mathematical reasoning.

Young & Fraser (1992) found that different schools (school effect) were statistically significant in influencing student achievement in science, as well as verbal and quantitative ability. Wang (2003) wanted to assess the benefit of mathematics and science curriculum integration and found that round 36% to %60 of mathematics or science performance can be accounted for by the relationship between these two subjects. The relationship between mathematics and science can also be determined by negative correlation. Gabel and Sherwood (1983) found that mathematics anxiety was negatively correlated with science achievement. Students that are anxious about performing the mathematical problems often associated in science tended to perform less successfully in science. Quinn and Spencer (2001) found that women were less able to formulate the problem solving strategies in mathematics when the threat of stereotype threat that men were better at mathematics was high. If the threat creates a condition of mathematics anxiety as described by Gabel, then ultimately science achievement would additionally be negatively affected.

Other factors can influence the relationship between mathematics and science achievement. Tappenden (2001) argues the importance of mathematical reasoning in scientific reasoning while Nutall & Hell (2001) demonstrated that prior coursework taken in mathematics and science were strong predictors in achievement in both areas. Interesting to note is the additional finding that race, socioeconomic status, and gender explained very little of the variance in both science and mathematics scores. Sadler and Tai (2001) also found that students who had taken higher level coursework in high school, including high school physics and calculus, predicted higher grades in introductory college physics classes.

Nordstrom (1989) found SAT/ACT mathematics test scores to be good predictors of performance in chemistry. Georgakakos (1997) found that earning a grade of B or better in high school algebra, geometry, and biology were good predictors of student success in college freshmen chemistry. Results by Sanchez and Betkouski (1986) also indicate that students with higher algebra grades were more successful in chemistry than those having lower algebra grades. Following this argument, O'Connor (2003) recommends an integrated approach to mathematics and science instruction.

Conversely, however, Fisher (1996) believes the ability to process numerical data bears no relationship to chemistry achievement. Silberman (1983) had found earlier that students did not perceive their mathematics ability to be a major contributor to their science achievement. Among numerous reasons given by the students for difficulties in problem solving in science, poor math skills was ranked tenth out of twelve and was not important to them. The student perception runs counter to the predominant body of research and knowledge which states that mathematics ability is an important variable in science achievement. Since the possibility of Mathematic ability as an influencing variable exists, it was therefore added to the Hispanic Female Science Achievement matrix to nullify its effect.

Lastly, phenomenological analysis was conducted on the qualitative data collected through brief structured interviews with randomly chosen Hispanic females from both high and low performing achievement groups

The SAT 9 achievement test. The SAT-9, having been administered to all Florida students the spring prior to implementation of the study, was used. In the state of Florida, the SAT-9 is administered separately as part of the Florida Comprehensive Achievement Test (FCAT) batteries. This norm referenced portion of the FCAT assessment is known as the FCAT NRT (norm-referenced test). The SAT-9 provides national percentile ranks (NPR) and was used in developing the Hispanic Female Science Achievement matrix as a component of the science achievement score.

Prior year Final Science Grade

Drew (1996) and Oakes (1990) found that previous science grades was a factor that was positively related ($p < .001$) to eighth grade science achievement, supporting inclusion in this study. The tenth grade science students in this study have an earned final science grade for their ninth grade year. The grade was calculated in conjunction with SAT-9 reading and mathematics achievement to determine overall science achievement scores in the Hispanic Female Achievement Matrix (see Appendix P). While it is recognized that science grades are subjective measurements and difficult to compare for this reason, it was the only measurement available that was directly related to performance in science education. Even though the state of Florida has recently begun to administer standardized testing in science, the test administrations have been exploratory in nature, providing data to the testing service on future standardized science tests. Results have only been reported at the school and district level, with no specific student data available.

Statement of Purpose

This study was a two-phase, sequential, mixed methods study to explore the relationship of science self-efficacy and science achievement of Hispanic female tenth grade students. Research in the area of science self-efficacy is sparse and research connecting science self-efficacy to Hispanic female populations does not exist. Past research has studied these constructs separately. By studying the constructs of science self-efficacy and Hispanic female populations collectively, the researcher assists educators in comprehending the relationship between science self-efficacy beliefs and science academic achievement in this drastically underrepresented group within STEM professions.

Additionally, this research design focuses primarily at the tenth grade high school level. It is at or during the tenth grade year where decision-making regarding future careers and preparation for course selection for the latter years of high school are informed. Van Langen, Rekers-Mombarg, and Dekkers (2006a, 2006b) found that the more science and mathematics subjects that pupils in pre-university education include in their high school career, the more future academic routes are available to them. Further, the research focuses on the construct of science self-efficacy. If science self-efficacy was correlated to student achievement in science, students with higher self-efficacy may choose to take the higher level science coursework necessary for STEM field preparation beyond high school. Information gleaned might influence future decision-making processes regarding science instruction, coursework preparation, and ultimately the achievement of Hispanic female science students.

Research Questions

Bandura's (1977, 1986, 1993, 1994, 1997) construct of self-efficacy was used to determine if there were differences between tenth grade Hispanic females and other subgroups of tenth grade female science students. Science self-efficacy was further used to identify if a significant correlation existed between science self-efficacy and science achievement. The specific research questions studied were:

1. What is the difference in science self-efficacy perceptions between tenth grade Hispanic females and other tenth grade female subgroups, based on race/ethnicity, as measured by the Smist (1993) Science Self-Efficacy Questionnaire (SSEQ)?
2. Is there a significant correlation of science achievement as measured by (a) prior year reading achievement as measured by the SAT 9 standardized test; (b) prior year mathematics achievement as measured by the SAT 9

standardized test, and (c) prior year final science grades on the science self-efficacy in Hispanic females as measured by the Smist (1993) SSEQ?

3. What factors may influence science self-efficacy in tenth grade Hispanic female science students as measured through phenomenological study?

Definition of Terms

In an effort to provide clarity and assist the reader in understanding terms used throughout this study, the following definitions are presented.

Beliefs. Beliefs are a general cognitive acceptance or rejection of basic ideas that are intricately tied to the desire to act or not to act as a major component to motivation (Simpson, Koballa, Oliver, & Crawley, 1994).

Culture. Culture is described by Aikenhead (2001) as a student's world view and social context (p. 181).

Ethnic. The label, "ethnic" is used as referenced in original sources of work. It is a sociological and historical distinction that refers to specific country of origin groups (e.g. White, African-American, Hispanic, and Asian). The groups are differentiated by shared cultural contexts and shared social values, attitudes, and economic and political considerations (Koss-Chiono and Vargas, 1999, p. 7)

Ethnic minority. An ethnic minority is a group of people viewed by society as being in a lower status as compared to White people, based on cultural/racial/ethnic factors (Helms and Carter, 1995).

Hispanic. Florida Department of Education (2005) defines Hispanic as a person of Mexican, Puerto Rican, Cuban, or South or Central American origin or other Spanish culture or origin regardless of race (FL DOE, 2005). This is the definition used by Florida schools when registering students. The label, "Hispanic" will be used as referenced in original sources of work. The term is also defined by the U. S. Census to identify those of Spanish European descent. Hispanic females in the study were self-reported by the parents/guardians as Hispanic upon registration into the school system and were directly derived from the school district database.

Lexile reading level. A lexile reading level is a framework for objectively measuring reading comprehension within text (Stenner, 1996).

Minority. A minority is a group of people viewed by society as being in a lower status based on gender, disability, sexuality, religion, and other "non-mainstream" factors (Helms and Carter, 1995).

Motivation._ Motivation is a construct considered to be goal-directed behavior and thinking (Pintrich, 2003)

Persistence. Persistence is a construct that can be understood as continued choice in the face of obstacles or options over extended periods of time (Betz, 2004).

Self-efficacy. Self-efficacy is a belief in one's own capability to organize and execute the courses of action needed to manage prospective situations (Bandura, 1977, p. 2).

Science self-efficacy. Science self-efficacy is the belief in one's own capability to do science; organize and execute the skills and knowledge needed to manage science content and processes.

Science achievement. For purposes of this study, science achievement was measured using a compiled score derived from data, specifically, prior year's SAT 9 standardized reading score, prior year's SAT 9 standardized mathematics score, and the prior year's final science grade.

Scientific literacy. NRC (1996) describes scientific literacy as an understanding of science and science processes, to include the ability to learn, reason, think creatively, make decisions, and solve problems.

Structured interview. A structured interview is one that incorporates questions, guided and directed by the researcher for responses which build needed understandings in specific topic areas and allows research control over the line of questioning (Creswell, 2003).

Triangulation. Triangulation is a method to interpret a combination of both quantitative and qualitative results wherein the interpretation of one dataset is used to corroborate the interpretation of the second dataset (Brannen, 2004, p. 314).

Delimitations of the Study

This study confined itself to the study of science self-efficacy as an affective variable in the learning environment. Other affective variables (i.e. motivation, attitude, persistence) will be left for future research.

This study also limited its scope by studying tenth grade Hispanic female science students. Students from other backgrounds or grade levels, or Hispanic female high school students in other academic areas or grade levels were not studied. Hispanic females historically demonstrate the lowest participating in STEM fields. However, results may generalize to other minority females.

The tenth grade Hispanic females selected for this study have completed a year's prior experience with high school science coursework, but have not yet made the course selections that begin to diverge from upper level science coursework needed for STEM field preparation in college. Therefore, only tenth grade Hispanic females were studied.

Limitations of the Study

Convenience sampling procedures implemented to identify potential teacher participants and classrooms usually serves to decrease the generalization of findings due to sample size and inescapable omission of potential responders. However, in this study this limitation was counteracted by the inclusion of an inordinate number of Hispanic female high school students. The percentage of participation by Hispanic females in the study was larger than the district, and state, and national averages. Any percentage of Hispanic females greater than the district-wide average of 29.30% of the population seen in Table 1 (OCPS, 2005), and the state representation of 21.7% seen in Table 2 (FL DOE, 2004) is defined as inordinate. Figure 2 (NCES, 2004) additionally shows the Hispanic average percentage distribution of public school students in the South region at 19%. These benchmark percentages render the findings able to be generalized to similar samples in larger populations and counteracted the limitation of employing convenience sampling procedures.

A second limitation of the study was the use of a final science grade as the measure of science achievement to be measured against science self-efficacy. Grading practices vary from teacher to teacher and is nonstandardized, even though grade definitions are universal among educational practitioners. A standardized science test score was unavailable for the population of students that were included in the study. The Florida Comprehensive Assessment Test (FCAT) in science has been administered as a pilot to all fourth, eighth, and twelfth graders in the state of Florida. However, individual scores have not yet been reported, with results being reported solely at the school level.

A third limitation of the study was the self-reporting of ethnicity done by parents upon registration of their children when they entered the school district. This ethnicity designation of “Hispanic” from the school district database identified which Hispanic females were identified for inclusion in the study.

A fourth limitation of the study was the information gathered in the interview component. The information provided by the Hispanic female interviewees was filtered through their views and perceptions and potentially subjected to bias as a result of the researcher’s presence. Comprehension of the interview questions and articulation ability of the interviewees may have affected constructed meaning as individuals are not equally adept at understanding ideas and communicating thoughts to others. Prior reflection on the topic may also have influenced the quality of responses.

A final limitation of the study was that researcher bias may have entered into the phenomenological interpretation and construction of meaning within the structured interview component. Even with researcher bias removed, the information yielded can potentially be subjected to a wide variety of interpretations by various readers.

Assumptions

This study assumed that males and females are equal in intellectual ability and opportunity. Additionally, it was assumed that female students, regardless of race or ethnicity, were intellectually equal. Finally, this study assumed that all respondents answered truthfully.

Design of the Study

The associations between science self-efficacy and a measure of science achievement were studied through survey research methods. Science achievement scores were derived through the calculation of standardized reading and mathematics scores and prior year final science grades in a matrix table used to derive a final science achievement score for each student. Science self-efficacy quantitative results were then analyzed using factor analysis and ANOVA. Science self-efficacy results were correlated to the science achievement matrix scores using multiple linear regression analysis to determine if a significant correlation existed.

The second phase of the sequential, mixed methods (Creswell, 2003) design served to obtain qualitative information and provided an opportunity to probe or explore student beliefs and support mechanisms. This objective was achieved through the use of brief structured interviews with randomly selected high and low performing Hispanic females from the general sample as determined by their science achievement matrix scores. It was hoped that more salient factors would begin to emerge and be identified. The information serves to inform teacher preparation and teacher professional development as interventions to increase participation in higher level science coursework necessary for STEM field preparation. The purpose and the approach was original, going a step beyond simply reporting gender differences in science by isolating self-efficacy as a variable in the affective domain which may have influenced science achievement. Results provide insights into factors influencing Hispanic females' self-efficacy beliefs as well as science achievement and persistence. The project begins to build a strong empirical research base in this area, yielding more valuable and comprehensive information that could inform long-term effective science instruction and effectively motivate students to explore available science career opportunities.

Population and Sample

A convenience sampling method was utilized to determine teacher participants, and eventually the student sample. School district approval did not mandate participation by teachers. This project relied upon teachers to voluntarily participate in the study through participation in a teacher survey followed by a series of contacts using the Dillman (2000) five-contact method to increase response rate.

With the assistance of district personnel, a list of all science department chairpersons at each of the sixteen high schools was generated. In March 2005, pre-notice letters were sent out to schools whose department chairpersons had responded to the initial email contact. At these high schools, ninety-one science teachers were asked to complete a classroom environment questionnaire (see Appendix E), including a question that either granted or denied consent to participate in the study.

Ten teacher participants were selected from the first ten teachers who responded to the questionnaire and indicated a willingness to participate in the comprehensive fall 2005 study. All ninety-two of the teachers who were sent a survey had an equal chance of being one of the first ten teachers selected. Of the ten teachers initially selected, two teachers were then randomly selected to participate in the pilot study conducted in May of 2005. Of the remaining eight teachers from the initial cadre of ten, six teachers taught tenth grade biology and two teachers taught ninth grade integrated science.

Purposive sampling was then employed to reduce confounding variables by limiting the study to tenth grade students. This study focused its attention at primarily the tenth grade level based on Simpson, Koballa, Oliver, and Crawley's (1994) argument that high school tracking choices offer the first opportunity for the pipeline to leak. This study shows that interventions are needed prior to when course-taking decisions to take higher level science in the latter two years of high school are made.

The sample size was increased by studying all possible tenth grade biology classes for each of the remaining participating science teachers. Of the six remaining teachers, two teachers were given different teaching assignments by their school administration for the new academic school year and no longer taught tenth grade science classes. This eliminated them from the study. Of the four teachers remaining, one teacher elected to drop out of the study. Three more tenth grade teachers were acquired through snowball convenience sampling as one teacher participant solicited another teacher at one high school on behalf of the study and an administrator at the school where the teacher dropped out managed to recruit two other tenth grade teachers to participate in the study. A total of seven tenth grade science teachers participated in the study with twenty-five classes being administered the survey instrument over the course of a four- month period within two high schools.

The approximate number of Hispanic females that were projected to be included in the study was calculated by taking the total *N* to be studied and multiplying this figure by the school district Hispanic representation of 29.30%. This figure represented the total estimated number of Hispanics, both male and female, that might be included in the study. This figure was therefore multiplied by 50% which represented the probability that half of the Hispanic population was female.

Based on an approximate sample *N* of 563, it was estimated that approximately 147 Hispanic students would be represented in the sample group, 74 of which would be estimated to be female. These figures were based on administering the student questionnaire to all twenty-five classes represented by the seven participating teachers. It was thought that if the percentage of Hispanics studied was higher that the district average of 29.30%, then the actual number of Hispanic female tenth grade students included in the study would also be increased.

In the actual comprehensive study, 272 students brought back the signed parent consent letter allowing them to be included in the study. Of this sample, 152 were designated Hispanic. Of this number, 80 were designated Hispanic females. This figure represents 29.4% of the total sample population studied and is higher than the OCPS district Hispanic representation of 29.30%. It also was higher than the state average of 21.7% and the national southern region average of 19% as cited. Since results meet or exceed these percentages, the results can therefore be generalized to district, state and regional samples of Hispanic female tenth grade students in urban settings.

Development of Instrumentation

Students were administered a 90-item questionnaire (Appendix L) which included 27 items taken in whole, directly from the Science Self-efficacy Questionnaire (SSEQ) developed by Smist (1993). Author's permission to use the SSEQ instrument can be seen in Appendix S. The SSEQ was developed to assess students' self-efficacy in science by measuring students' own beliefs about their competence to perform or complete science-related tasks. The original instrument was field-tested on 826 New England high school students. Mean age of the students was sixteen and the sample was predominantly (86%) White. More than half the sample (57.7%) had taken both biology and chemistry. Only 6% had taken physics (Smist, 1997, p. 69).

Smist analyzed her original SSEQ data using factor analysis. Four factors were extracted, explaining 89% of the covariance (Smist, 1993). Cronbach's alpha estimates for the four scales which emerged were satisfactory: Biology Self-efficacy (8 items), 0.87; Physics Self-efficacy (5 items), 0.93; Chemistry Self-efficacy (7 items), 0.85; and Laboratory Self-efficacy (6 items), 0.90 (Smist, 1993, p. 6, Smist, 1997, p. 68).

The additional 63 items included beyond the 27 SSEQ items in the student questionnaire were items that measured other variables not part of the current study (i.e. demographic information, mobility, attitudes, classroom environment, etc.). However, these variables could become part of future studies and analyses, and were included for this purpose. Appendix K shows the blueprint used for construction of the instrument.

Data Analysis

The study utilized a sequential, two-phase, mixed methods approach, employing both quantitative and qualitative research methods. The computer statistical program, SPSS, was used for all quantitative analyses. To prohibit reading and mathematics achievement levels from acting as extraneous confounding variables that potentially can impact science performance, a measure of reading and mathematics achievement was added with a measure of science achievement (prior year science grade) in a matrix developed to determine an overall science achievement score. The science achievement score was used to (a) determine high and low performing Hispanic female groups and (b) in a multiple regression analysis to determine if a correlation existed between science self-efficacy and science achievement.

Quantitative Analyses.

In response to the first quantitative research question, “What is the difference in science self-efficacy perceptions between tenth grade Hispanic females and other tenth grade female subgroups, based on race/ethnicity, as measured by the Smist (1993) Science Self-Efficacy Questionnaire (SSEQ)?”, an ANOVA was used to test differences between the female student subgroups in the study broken down by race/ethnicity on SSEQ items.

In response to the second quantitative research question, “Is there a significant correlation of science achievement as measured by (a) prior year reading achievement as measured by the SAT 9 standardized test; (b) prior year mathematics achievement as measured by the SAT 9 standardized test, and (c) prior year final science grades on the science self-efficacy in Hispanic females as measured by the Smist (1993) SSEQ?", students completed a questionnaire which included the 27 items relating to students' science self –efficacy perception score gleaned from the SSEQ (Smist, 1993). The science achievement matrix score accounted for reading and mathematics as indirect, influencing, and potentially confounding variables. The national percentile scores for prior year reading and mathematics achievement was entered into SPSS for each student participant. A multiple regression statistical analysis was then performed to determine if a significant relationship specifically existed between science self-efficacy and science achievement in Hispanic females.

Lastly, SSEQ test reliability, used specifically with the student population in this study, utilized a principal factor analysis using oblique (Promax) rotation as one of the statistical measures, as was performed in Smist's original study. Cronbach's alpha was also calculated for all the extracted to measure the internal consistency of each of four factors that were extracted.

Qualitative Analysis

The third research question was , "What factors may influence science self-efficacy in tenth grade Hispanic female science student as measured through phenomenological study?" Betz (2004) stated that factors in a student's background such as country of origin, family culture and values, gender, ethnicity, and socioeconomic status (SES) are thought to inform students' self-efficacy beliefs. Therefore, responses from the qualitative phenomenological study of four Hispanic female science students were gathered through a brief structured interview to find underlying beliefs and values which may have influence science self-efficacy perceptions. The Hispanic females were randomly selected from a cross reference of performance data on the ninth grade SAT 9 reading and mathematics national percentile rank scores and ninth grade final science grades. Next, the Hispanic female participants were divided into high and low scoring achievement groups using the calculated matrix score (Appendix P). Two students were then randomly selected from each performance group for the brief structured interview. A total of four Hispanic females participated in the interview process. Audio tapes were transcribed (Appendix V)and a coding procedure (Appendix W) using the constant comparative process described in the grounded theory approach, identified common themes to add to the depth of understanding of the quantitative statistical analyses.

Significance of the Study

A study of the affective domain in science education needed more attention as a research priority. Science self-efficacy, as a belief in the affective domain, was important to study for several reasons. First, understanding the impact of science self-efficacy on science achievement could help teachers evaluate learning environments and current instructional practices. Secondly, the findings could have general import for educating traditionally underrepresented populations of ethnic and minority students. Findings will be disseminated to gender education, science education, and ethnic minority education research communities. Hopefully, science teachers, school administrators, collaborative school districts and other policy makers will avail themselves of this information through peer reviewed publications.

The study specifically contributes to the understanding of self-efficacy as a means to increase science achievement and motivation in minority Hispanic females. Lending new knowledge to the field of Hispanic education enhances the long term goals for this information to: (a) assist in education policy decisions at all levels (federal, state, local) of decision-making, (b) to help institutions, schools, and classrooms better understand how gender differences, if present in science instruction, are likely to influence performance and participation of Hispanic females in STEM learning environments, and (c) inform development of teacher guidelines on how to maximize learning for Hispanic females within science classrooms. Changes implemented serves to ameliorate the underrepresentation of Hispanics and other racial/ethnic minorities in high school STEM preparation.

Identification of beliefs which influence science self-efficacy leads to the elimination or reduction of opportunity barriers and ultimately serves to elevate the numbers of women, and chiefly Hispanic women, entering professional preparation for science-related fields beyond high school. Increasing the representation of historically under-represented groups is a straightforward way to tap previously underutilized potential and increase the available amount of human capital in the science workforce. Resultant participation by Hispanic females in science fields would integrate socio-cultural perspectives that foster more gender, ethnic, and racial equity in science participation. Increasing Hispanic female presence in science-related fields also creates new paradigms for science learning environments. This change has the potential to propagate larger numbers of Hispanic women within STEM professions in the future.

Summary

Data on the relationship of science self-efficacy in the high school science classroom to science achievement among Hispanic females serves to inform science educators on best practices regarding necessary prerequisites for career preparation in STEM fields by future Hispanic female and other minority high school students. Correlations between science self-efficacy to measures of reading, mathematics, and science achievement, assists educators in proactively planning to increase science self-efficacy for minority females within the classroom, and reduces the leak in the science pipeline. As a result, previously overlooked potential in the talent pool can be harnessed and guided.

CHAPTER TWO: LITERATURE REVIEW

Review of Related Research and Literature

Three variables of primary interest in this study are science self-efficacy, science education, and Hispanic females. The relationship of students' self-efficacy to student achievement in the science classroom impacts how educators redesign the learning environment to increase science achievement. Increasing achievement with the domain of science education maximizes human potential by reducing the "leaky pipeline" and increasing the numbers of traditionally underrepresented groups in STEM professions. Since Hispanic females are least represented in STEM fields, they were therefore the focus of the study. Research studies that address gender or racial/ethnic differences are additionally discussed within these general frameworks.

Self-Efficacy Construct as a Theoretical Framework

How can teachers structure the learning environment to provide an educational experience that significantly changes students' perception of their ability to engage in scientific enterprise? How can this be done specifically for one minority group, Hispanic females, who wander outside the science mainstream?

The field of study in science education began in the late 1950's, though affective research in science education is relatively new (Simpson, et al., 1994), emerging within the past decade. The concept of an affective domain includes a host of constructs, such as attitudes, values, beliefs, opinions, interests, and motivation. The study of attitudes toward science is most predominant in affective research literature with very little attention paid to the affective study of beliefs. Beliefs can influence success in science education (Simpson, et al, 1994). They defined beliefs as a general cognitive acceptance or rejection of basic ideas that are intricately tied to the desire to act or not act as a major component to motivation.

One such self belief is self-efficacy. Bandura (1977) describes self-efficacy as a belief in one's own capability to organize and execute the courses of action needed to manage prospective situations. It is supposed that self-efficacy beliefs contribute to (a) the types of goals a person sets for themselves, (b) how much effort a person will expend in performing a task, (c) how long a person will persevere in the face of difficulties, and (d) how resilient the individual will be to failures (Bandura, 1993, 1997, Eccles & Wigfield, 2002).

Bloom (1974) postulated that the beliefs students have regarding themselves and their abilities may be the most important variable in the educational process of learning. Bandura (1977, 1986, 1994) and Betz (2004) define self-efficacy as judgments one makes about their own capabilities on specific tasks, behaviors, levels, or domains. Pajares (2003) believes self-efficacy to be a students' confidence in their academic abilities. Betz (2004) argues that higher levels of self-efficacy lead to behaviors that guide a person into interest areas and a subsequent career path.

Pajares (1996, 2002, 2003) states self-efficacy beliefs provide the foundation for human motivation and are strongly related to critical classroom variables such as persistence. The more tasks or goals accomplished, the greater an individual's self-efficacy and the more they can learn. Bong and Clark (1999) argue that of all the factors that influence goal commitment, only self-efficacy influences the effort needed to have persistence to tasks needed to arrive at goals. Self-efficacy holds tremendous potential for understanding and explaining academic performance in various domains (Lent, Brown, & Larkin, 1986; Zimmerman, Bandura, & Martinez-Pons, 1992; Betz, 2004). Overall, past studies has shown that students with high self-efficacy perceptions have persevered and persisted in their educational pursuits compared to those students with low self-efficacy (Betz & Hackett, 1983; Taylor & Betz, 1983; Lent, Brown, & Larkin, 1986; Betz, 2004).

The study of self-efficacy in the science domain has been recommended as one research priority in a spectrum of multiple approaches to attack the attrition of women and minorities from STEM fields. Dietz, Anderson, & Katzenmeyer (2002), all NSF program officers, list different strategies which can uncover important patterns in STEM field attrition by women and minorities. One such strategy is to focus research efforts in four distinct areas, of which a self-efficacy approach is one. The authors believe that research should include a study of the influence of belief systems on the representation and culture of science. Kahle (2005) believes that among many factors which affect women, and especially Hispanic women, self-efficacy and motivation are critical factors to study. Lewis (2003) argues the need for research aimed at gaining a greater depth of understanding of the intricacies of underrepresentation and highlights students' lower levels of confidence in their abilities to do science as one of six factors contributing to underrepresentation, specifically within in African American populations.

Behavioral Consequences and Causes

Bandura (1977, 1997) describes desired outcome behaviors in successful students. Self-efficacy consequences are listed as (a) approach or avoidance behavior, (b) quality of performance behaviors in the target domain, and (c) persistence in the face of obstacles or conflicts that fail to confirm capabilities. As seen in the Figure 3 schematic to represent Bandura's premise, positive behavioral consequences show that approach behaviors can serve to increase performance and persistence in the target domain. Also shown is Bandura's idea that negative behavioral consequences can also result in low self-efficacy and can be evident in the avoidance behaviors that lead to poor task persistence and reduced performance.

Important to this proposed study, however, are the causes of perceived self-efficacy stemming from a variety of sources: (a) accomplishments, (b) modeling, (c) low anxiety, and (d) encouragement and support (Betz, 2004). The causes can be interpreted narrowly through focus on the classroom learning environment. Classroom variables that can be manipulated by the classroom teacher and take place in the general school environment. Teachers can exercise a large measure of control over how concepts are presented. Teachers can make decisions regarding what cognitive level they will present information to students. They can further adjust the pacing or speed of delivery of instruction, and decide how often a concept should bear repetition. Teachers can control classroom teacher and peer interactions that either support or fail to encourage students. Ultimately, classroom science teachers can unknowingly or purposefully manipulate these spectrum variables in the learning environment to create optimal learning environments that offer the least amount of anxiety with the highest achievement yield. Therefore if science self-efficacy is found to be significantly related to science achievement, the causal factors could become the foundation for establishing teacher instructional decision-making guidelines that would increase the science self-efficacy perception within Hispanic females.

Other sources of self-efficacy beliefs fall outside the domain and control of the educational environment. Factors in a student's background such as country of origin, family culture and values, gender, ethnicity, and socioeconomic status (SES) are thought to inform students' self-efficacy beliefs (Betz, 2004). The primary focus of this study was the self-efficacy of Hispanic female students within the behavioral domain of science classroom learning environments. Secondary qualitative analyses were performed utilizing other factors in the Hispanic female students' background outside the control of the educational environment.

Self-efficacy and the Science Domain

New research on self-efficacy in science could indicate that science self-efficacy is a factor which influences persistence in continued science study and increases educational opportunity among Hispanic female high school students. Measurements of science self-efficacy have only been studied in predominantly male-dominated science occupations in the past (Betz & Hackett, 1997). It is hoped that this research focus on the science self-efficacy of Hispanic females adds to the body of knowledge in science education literature, affective domain research, and gender-related research. It also attempts to influence and advance more research in the area of Hispanic education. While the literature provides evidence for behavioral differences on the basis of gender in science performance, there is less information on what contributes to the differences within learning environments that may play a role in forming student science self-efficacy beliefs. This study takes a close look at mediating variables that help inform such beliefs and consequently influences student achievement and persistence in high school science. Guidelines for designing learning environments which inform instructional practices and support positive science belief adoption in high school females in grades nine through twelve is a topic for further study beyond this dissertation. The guidelines, once developed, can be applied across multiple science content domains and to all students in all racial and ethnic populations. Science education settings that are tailored to positively impact girls' engagement in their high school science classes better support efforts at retention in STEM field preparation at the high school level.

Science Education in the United States

The National Science Education Standards (National Research Council, 1996), and Inquiry and the National Science Education Standards (National Research Council, 2000) advance the science education goal that all children be scientifically literate. The National Science Education Standards (NSES) applies to all students, regardless of age, gender, cultural or ethnic background, disabilities, aspirations, or interest and motivation in science (NRC, 1996). The NSES focus on equity in science highlights the need to provide the opportunity for all students to learn science and become scientifically literate.

Interestingly, Kahle and Meece (1994) stated that research shows that when boys and girls take the same kind of science coursework, girls tend to outperform boys. Overall trends in education equity data generally demonstrates an equal ability to succeed. However, despite these trends, males scored higher than females on the NAEP 2000 science assessment, demonstrating a gender gap increase from the 1996 science assessment (Freeman, 2004, NCES, 2003c). Unfortunately, not all children are scientifically literate. Variations in performance levels across racial/ethnic groups are more apparent than variations between males and females (NCES, 2003c). This may be a contributing factor to the low percentages of women and racial/ethnic minorities in STEM fields.

Collectively, as individuals and as a society, all have a stake in scientific literacy (NRC, 1996). We share an interest in comprehending and making sense of the physical world. Additionally, scientific literacy can help us with creative problem-solving of issues that face our society. Building and maintaining a diverse and talented science pool helps our nation to keep pace with our global neighbors and provides opportunity and access to professions traditionally reserved for White males (NRC, 1996).

Enrollment and Participation Patterns in STEM Fields

A dwindling talent pool can have ramifications for national growth in discovery and innovation, health, and national security. Hence, *No Child Left Behind* legislation (NCLB, 2001) has included provisions for science assessment at grades five, eight, and ten to track science achievement to serve the national interest. Since this inclusion, attention and priority is beginning to focus at both state and local levels through the design and implementation of school, district, and state accountability assessments for science achievement. In addition, more school districts have taken the initiative to assume the financial commitment to test in the area of science education prior to the fall 2007 timeline established in NCLB legislation. States such as Florida, where the study took place, piloted a criterion-referenced science assessment known as FCAT Science. Initial school-level results began to be reported in 2004. Individual student reports will ensue with the spring 2007 test administration. In time, FCAT Science results are being considered for inclusion in the tabulation of an individual school's overall progress at both the state and national level to meet Adequate Yearly Progress (AYP).

Nationally, NAEP state science assessments began in 1990 with voluntary state involvement, testing only eighth grade students. By 1996, 44 states took part in the NAEP state science assessment, while nationally grades four, eight and twelve were tested. (O'Sullivan, Jerry, Ballator, & Herr, 1997). Figure 4 shows the average science scale scores by gender in public and private schools, comparing results for both 1996 and 2000 state science assessments (NCES, 1996, 2000).

Gender Equity

The topic of gender equity in science education regained national attention when Lawrence H. Summers, President of Harvard University, made speculative, disparaging remarks at a conference regarding female intellectual deficiency as explanation for the discrepancy in STEM numbers (Summers, 2005a). Summer's comments sparked a firestorm which has reignited attention to the problem of female underrepresentation in science. Summers asserted that his controversial comments regarding females lacking the physiologic biology to succeed in science were unintended (Summers, 2005b). His claim was contradictory to findings by Maccoby and Jacklin (1971) and Kahle and Meece (1994), both of whom had already found strong evidence that there are few differences between men and women in intellectual functioning. Equivalence in mental ability between males and females was assumed and was not studied. Instead, differences in knowledge skills and beliefs were examined in the research.

Gender equity studies have been implemented for the past fifteen years in an effort to build the talent pool through education reform. The results are unfortunately dismal. Data shows that the numbers of women entering STEM fields has not grown significantly (Baker, 2002). Figure 1 depicts the underrepresentation of women and minorities in science and engineering. Apparently the information disseminated in the initial studies during the 1980's has not been significant enough to filter down to teacher preparation programs at the university level, district teacher professional development programs, or individual science classrooms where female and ethnic minority science students reside. Other researchers believe the dismal numbers are due to ineffective recruitment and retention programs (Kahle & Meece, 1994). They believe recruitment efforts should incorporate the study of factors which influence persistence in science study by females. This study followed their recommendation.

The fact that the culture of science remains a predominantly male one is one reason given for why girls avoid science (Kelly, 1985). Learning environments along the leaky pipeline may unintentionally serve to promote females and minorities to leave science pursuits. Females were less likely to report liking science in the NAEP results (Freeman, 2004). Interestingly, many students in developed nations feel that school science is a foreign culture (Aikenhead & Jegede, 1999). Aikenhead and Jegede conceptualized the transition from a student's real life world and the science classroom as a "cultural border crossing" (p. 269). Culture mediates all learning through prior indigenous knowledge and takes place in social contexts (Jegede & Aikenhead, 1999). Therefore, if the science learning environments are the result of a long history of science instruction and organization that has been informed by males who predominate in STEM occupations, science alienation would be accentuated in women, and most especially in women who do not share the predominant White culture. Kahle (2004) supports this thinking and believes that stereotypical science follows the socio-cultural White masculine model as its own science culture and language. This White masculine model challenges typical female identification, and especially identification in female minorities, of which Hispanic females are members. The absence of diversity in both participants and perspectives, most especially minority Hispanic females, fails to inform the field and misses the opportunity to change the cultural face of science education. Status quo science education, sans cultural (gender and ethnic) sensitivity, work against understanding and developing the "science for all" programs that the National Science Education Standards (National Research Council, 2000) promotes and supports.

The Hispanic Female Student

Many girls, especially minority Hispanic girls, may have negative and non-constructive beliefs regarding science which can ultimately serves to self-select them out of upper level science coursework in high school. Muller, Stage, and Kinzie (2001) state that these misperceptions are prompted and reinforced by societal beliefs about female ability and the inappropriateness of girls in science. Consequently, girls, specifically Hispanic girls, need social experiences that run counter to the predominant beliefs that science is not for girls. Bandura's (1986) social model helps to bridge the divide. According to the model, one restructuring opportunity would be to construct learning environments within the classroom for positive social interactions. The teacher's chosen methods and strategies for delivery of instruction is influenced by decisions as to activities, desk arrangements, groupings, resources used, texts chosen, level of peer interaction, etc. All of these factors influence the nature and depth of communication within coordinated learning contexts while influencing the experience for all students.

Interpretive Summary

Albert Bandura's (1977, 1986, 1993, 1994, 1997) construct of self-efficacy is a vehicle for promoting positive change for individual learners. The construct of self-efficacy is recognized by both researchers and educators as an essential element to overcome obstacles in the learning environment. This perception of one's own capabilities influences choice in career preparation, especially in the area of science education. Smist (1993, 1994), extended the construct of self-efficacy to include science self-efficacy in the exploration of career development. This study generalized this information to specifically Hispanic female high school students. Students who fail to take upper-level science course work have served to deselect themselves out of opportunities to participate in higher-paying science, technology, and engineering careers.

CHAPTER THREE: RESEARCH METHODOLOGY

Introduction

The purpose of this study was to discover what role, if any, science self-efficacy beliefs played in the science achievement of Hispanic female high school students. Information derived from the research will inform science educators at all levels, curriculum developers, and science teacher preparation personnel in higher education about interventions that positively impact the preparation of Hispanic females for STEM professions.

Cross-sectional survey research was chosen for this study in an effort to generalize results to the wider population. By studying a sample, inferences regarding science self-efficacy and science achievement in the general population could be made (Creswell, 2003). Survey research was economical to design, easily disseminated, had rapid turnaround in data collection, and most importantly, was least obtrusive to the classroom teacher and the learning environment. Students' class time spent on the research was valuable because the research was focused and effective in getting the information needed and caused minimal disruption to the classroom learning environment.

This study provides a review of the research questions particular to this study. Additionally, the nature of the setting and sample participants are discussed as well as the design rationale that was used to research the questions. The development of the assessment instruments, data collection procedures and analysis, and the accompanying inferential statistical methods used to evaluate the data are included. Finally, ethical considerations regarding reliability and validity conclude the discussion.

Research Paradigm

Using Creswell's (2003) mixed methods design, this study utilized a sequential, two-phase, mixed methods approach to generate the data necessary to identify science self-efficacy trends in tenth grade Hispanic female high school students. A quantitative study using factor analysis was conducted on science self-efficacy questionnaire results. Further quantitative analyses were conducted using multiple regression to test the relationship of science self-efficacy on reading and mathematics data (prior year SAT 9 Reading and Mathematics standardized national percentile score) and science achievement data (prior year final science grade).

Additionally, this study attempted to provide deeper understandings that may possibly underlie student questionnaire responses to science self-efficacy items by Hispanic female high school students. The matrix of science achievement scores combining reading achievement, mathematics achievement, and science grades was used to determine high and low performing achievement groups in Hispanic females for random selection of interview participants.

Research Questions in Review

Are there differences in science self-efficacy between tenth grade Hispanic females and other female subgroups, defined by race/ethnicity? Can science self-efficacy be used to identify a significant correlation between science self-efficacy and science achievement? The research questions that arose from these specific issues were: (1) What is the difference in science self-efficacy perceptions between tenth grade Hispanic females and other tenth grade female subgroups as measured by the Smist (1993) SSEQ?; (2) Is there a significant correlation of science achievement as measured by (a) prior year reading achievement as measured by the SAT 9 standardized test; (b) prior year mathematics achievement as measured by the SAT 9 standardized test, and (c) prior year final science grades on the science self-efficacy in Hispanic females as measured by the Smist (1993) SSEQ?; and (3) What other factors may influence science self-efficacy in tenth grade Hispanic female science student as measured through a phenomenological study?

Research Design

Past research on self-efficacy in general predicts that higher science self-efficacy beliefs would result in greater academic achievement trends (Pajares, 1996, 2002). Significant correlations between science self-efficacy and science achievement could indicate a propensity by students with high science self-efficacy scores to select higher level science coursework needed for college entrance into STEM field preparation programs as per Bandura's construct of self-efficacy (1977, 1997). Given this research, the presence of a significant correlation between science self-efficacy and three measures of academic achievement, i.e. prior year standardized reading score, prior year standardized mathematics score, and prior year final science grade, was therefore analyzed. The purpose and the approach in this study reached a step beyond by building on gender research in the sciences by specifically studying Hispanic females. It further isolated science self-efficacy as a variable in the affective domain which could influence science achievement. Results provide insights for influencing Hispanic females' science self-efficacy beliefs as well as science achievement and persistence. The study hoped to build a strong empirical research base in this area.

Setting

Discussion of populations and samples will always refer specifically to student populations. This study was conducted in two public high schools within a central Florida school district. The Orange County Public School system (OCPS) is the twelfth largest school district out of 16,000 school districts in the nation, and is the fifth largest school district in the State of Florida. Considered urban, OCPS serves over 177,771 students, with 51, 039 students being served in seventeen high schools. Demographic breakdown of the school district is shown in Table 2 (OCPS, 2005). As compared to other school districts in the state of Florida, Orange County has one of the higher percentages of Hispanic populations under the age of eighteen, exceeding 15.38%, and totaling greater than 49, 296 students. (NCES, 2004), hence the reason OCPS was selected for the study.

Population, Sample, and Participants

The population represented in this study was tenth grade Hispanic females taking a science course in two high schools within the Orange County Public School district. A convenience sampling of teachers subsequently determined the student participants for the study by utilizing all the tenth grade science classes from the cadre of teachers who volunteered to participate. All student ability levels were represented. Since Hispanic population statistics within OCPS demonstrates higher averages than either state or national averages, it was hoped that the number of Hispanic females in the study would minimally be mirrored in this study. If the percentage of Hispanic females that were participants in the study met or exceeded the school district percentage of Hispanic representation of 29.30%, then results could be generalized to both state and national Hispanic females in similar urban fringe settings.

Teacher Selection

Convenience sampling was employed since the study relied upon teachers to volunteer to become participants. Science department chairs at each high school were identified with the assistance of OCPS district personnel. Following an email contact to every science department chair at each of the high schools in the district, pre-notice letters were sent out in March of 2005 to science teachers working in schools whose department chairs had responded to the initial contact (Appendix C). A teacher survey instrument was developed and administered to ninety-one high school science teachers. The science teachers were sent and asked to complete the survey instrument, including one question indicating a willingness to become a research participant (Appendix D). The question fulfilled the requirement for the informed consent process for minimal risk participation and was used to form a cadre of ten teacher participants.

The teacher survey instrument was comprised of thirty-three items from Rentoul & Fraser's, (1979) Individualized Classroom Environment Questionnaire (ICEQ) (See Appendix D). The initial study had proposed to examine differences between classroom environments and teaching methodologies as a factor which may influence participation in higher level coursework and future STEM related preparation. However, a disproportionate number of teachers reported using direct instruction as a science teaching method as compared to those using inquiry-based science instruction, as seen in Table 3. As a result, no clear cadre of teachers from each teaching method could be identified. The initially proposed study was then modified to research science self-efficacy rather than science teaching methodology as the factor which may influence gender/ethnic disparity in science education. Using Dillman's (2000) five-contact method for survey research, the questionnaire return rate was 45%.

Phase one. The first ten teachers who responded affirmatively to participate in the fall comprehensive study became the cadre of teacher participants. From this cadre of ten teachers, two teachers were randomly selected from the ten volunteer teacher respondents to participate in a pilot study conducted on May 23, 2005.

Phase two. Of the remaining eight teachers remaining in the cadre, six teachers taught tenth grade and two taught ninth grade. Purposive sampling was employed to eliminate confounding variables due to grade effect. The two teachers who did not teach tenth grade were eliminated from participation.

Phase three. Of the six tenth grade science teachers who remained, two were found to have had their course schedules changed since initial contact was made with them in the Spring of 2005. Their school administration had assigned them courses that did not include tenth grade students. As a result, these two teachers also had to be eliminated from participation.

Phase four. The four remaining teachers were contacted several weeks into the 2005-2006 academic school year. All four teachers were scheduled for the study to be administered in their classrooms during the months of September and October. Parent Consent Letters were sent to each teacher for dissemination to all of their students in tenth grade science classes. Two of the teachers had 2 classes each, one teacher had four classes, and one teacher had five classes of students who were eligible for study.

Phase five. After one teacher elected to not participate in the study after the Parent Consent Form materials were sent, five classes of students were subsequently eliminated. On behalf of the researcher, the school administration at that teacher's high school recruited two other science teachers to participate whose students qualified as tenth grade students to be eligible for study. This snowball convenience sampling yielded eleven classes of students to replace the five that were lost.

Another snowball convenience sample was drawn from one of the participating teachers in the study. Recruitment of a fellow colleague yielded another four classes to be studied. Even though one teacher with five classes was lost, three teachers with a total of fifteen classes were gained. The entire process yielded a total of six teachers and twenty-three classrooms of tenth grade students as participants in the study.

Student Selection

The investigator used naturally formed groups (i.e. classrooms) as part of the overall convenience sampling process. To reduce confounding variables, a purposive sampling method was employed to limit the comprehensive study to tenth grade students. Why did the study focus on tenth grade students? Simpson, et al. (1994) believed that high school tracking choices were the first stage of the leaky pipeline to emerge. Interest in science and science-related professions among students translate into greater interest in the study of subsequent high school science coursework. Affective factors such as science self-efficacy beliefs could influence course selections into academic science preparation. Simpson (1990) states a positive science self-concept as influential to selection and achievement in high school science courses. Further, Simpson and Oliver's (1990) ten-year study found a close relationship between science self-concept at the end of tenth grade and the election of additional non-required science courses in the eleventh and twelfth grades. Course selections of non-required higher level coursework, as associated with academic tracking in high school, show these students to complete more science and mathematics courses that are more challenging, and are more prepared to enter college STEM programs (Simpson, et al., 1994, p.219).

Therefore, using this rationale, all of the tenth grade classes from each of the remaining six teachers were given an opportunity to participate in the study. Students were assigned by school administration to each of the six participating teachers at the beginning of the school year via normal placement decision processes. Since this study did not use an experimental design, no manipulation of student assignment was. All that was required was a signed Parental Consent form (Appendix H and I) and subsequent child assent (Appendix J).

Based on the convenience sampling methods previously described, 503 students were given a Parent Consent Letter, 144 of which were Hispanic females. It was estimated that approximately 80% of the students would return the signed Parent Consent letters, yielding 402 students as the population *N*. Given that the average district Hispanic representation of the school district is 29.30% (OCPS, 2005), it was further estimated that approximately 115 Hispanic females would become part of the survey sample population. Instead, final results indicate that the Parent Consent letters had a return rate of 67.5% rather than the estimated 80% yielding 272 participants in the study, 80 of which were classified as Hispanic females (29.40%) by OCPS performance data.

Using district-level data (prior year SAT 9 Reading national percentile rank, prior year SAT 9 Mathematics national percentile rank, and prior year final science grade measured in percentage points), Hispanic female participants were divided into high and low scoring science achievement groups. Two students from each group were then randomly chosen to become the participants for the brief, structured interview (See Appendix M).

Human Subjects Clearance

The University of Central Florida granted clearance for the proposed study on March 17, 2005 with requested modifications, due to a change in research design, approved and granted on May 10, 2005. Orange County Public Schools granted permission for the study in March of 2005. Supporting documents are found in Appendix A, G, and B respectively.

Instrumentation

Student Survey Instrument

The SSEQ was developed by Smist (1993) to assess students' self-efficacy in science by measuring beliefs about competence in school science tasks. The 90 item student questionnaire administered in this study (Appendix K) embedded the 27-item SSEQ in its entirety. All other items included in the instrument, except the 27 SSEQ items, were informational and for possible use in secondary and subsequent analyses as part of the results discussion.

SSEQ construct validity. The original SSEQ was field-tested on 826 New England high school students. The mean age of the students was sixteen and the sample was predominantly (86%) White. More than half the sample (57.7%) had taken both biology and chemistry. Only 6% had taken Physics (Smist, 1997, p. 69).

The field test data collected by Smist was subjected to exploratory principal factor analysis using oblique rotation, with four factors extracted, explaining 89% of the covariance (Smist, 1993). Cronbach's alpha was used and estimates for the four scales which emerged were considered satisfactory: Biology Self-efficacy (8 items), 0.87; Physics Self-efficacy (5 items), 0.93; Chemistry Self-efficacy (7 items), 0.85; and Laboratory Self-efficacy (6 items), 0.90 (Smist, 1993, p. 6, Smist, 1997, p. 68). Even though the sample population used in the study was different from the original field test, conducting the same factor analysis as done by Smist verified the reliability of the SSEQ instrument for use with more diverse populations, "especially when used with a sample *N* of one hundred students or more " (Smist, 2005).

Structured Interview Questions

The interview protocol was developed by the researcher to introduce underlying themes which may be influencing the science self-efficacy of participants. A brief structured, one-on-one, face-to-face, personal interview was conducted with a random selection of Hispanic females from the sample student population. All Hispanic female students that possessed all three components of the Science Achievement Matrix (Reading Score, Mathematics Score, and Science Grade) had their scores added and then prioritized on a list from highest to lowest performance. Reading and Mathematics scores used national percentile ranks on a one-hundred point scale. Science grades were assigned a point value equal to the highest point value of each grade scale window as determined by the state of Florida. Using these point values, an "A" grade earned 100 percentage points, a "B"earned 89 percentage points, a "C" earned 79 percentage points, and a "D" earned 69 percentage points. Honor and International Baccalaureate (IB) classes received an additional five percentage points for the added degree of difficulty inherent in Honors or IB classes. Using this paradigm, scores greater than 198 percentage points (which represents 66% of the total possible 300 percentage points) were included in the high performing group. Scores that equaled less than 197 percentage points were assigned to the low performing group. The researcher then randomly selected two Hispanic female students from each of the performance groups. The researcher made use of the high and low performing random interview selection list to determine which girls had returned parental consent letters and who could be chosen for interview. Since the parental consent letters were not collected until the day the research was conducted, the random interview selection list depicting the random selection order assisted in a quick determination of which four girls were chosen for inclusion in the phenomenological study.

The structured interview questions were developed by the researcher for the pilot study and were also employed for use in the fall comprehensive study. Questions on background demographic information and past science experience were low-anxiety questions that built rapport with the participants. Many of the initial questions were additionally used to check on validity and honesty of student responses as compared to district database information.

As the interviewer progressed into the open-ended phase of questioning, the intent was to find underlying themes that are influencing student participation and perception of self-efficacy in science both in and outside the science classroom. This phase of questioning intended to elicit views and opinions of the participant. Through triangulation (Brannen, 2004), the information gleaned complemented the quantitative data on self-efficacy derived from the student questionnaire.

Preliminary and Pilot Studies

Student Questionnaire

The student questionnaire was initially administered to a focus group of three high school science students on May 10, 2005. Weaknesses in form and wording, and timing of administration were identified and revised for increased clarity, comprehension, and ease of matriculation through the instrument when answering questions. Students were given as much time as they needed to complete the questionnaire. The questionnaire and its administration took approximately forty minutes to complete. Since administration fell within the boundaries of a traditional high school instructional period, no time constraint was placed on the administration during the pilot or subsequent comprehensive study.

The revised student questionnaire was then administered to a pilot sample of two high school science classes encompassing forty-two students on May 23, 2005. The two classes were randomly chosen from the original cadre of ten volunteer teacher participants. The students were given as much time as they needed to complete the questionnaire. An Event Log was completed and is included in Appendix O.

Student Structured Interviews

Structured interviews with two randomly selected Hispanic female science students were conducted in the pilot study. The interviews were audio-taped and transcribed (Appendix N). Questions were analyzed on the basis of how well the question is understood by the respondent. Some additional wording revisions were added for use in the comprehensive study to aid in clarity of understanding. It was determined that structured interviews will take approximately fifteen minutes to complete per subject.

Pilot Study Data Collection and Analysis

In the pilot, the student questionnaire was administered to 40 science students from two high schools in central Florida. The mean age of the pilot student sample was 14.35 years. The demographic breakdown of the sample was 40% males, 60% females, 47.5% White, 47.5 % Black Not Hispanic, and 5% Hispanic. Only 12.5% of the population received special services for Exceptional Student Education (ESE), and 2.5% participated in the Limited English Proficient (LEP) program. Twenty-two percent were on an Academic Improvement Plan (AIP), 2.5% of the students had special learning accommodations (a 504 Plan) such as seating or extended time on assignments due to some temporary disability or condition not covered under an Individualized Educational Plan (IEP) delivered through ESE services. Forty percent of the pilot sample participated in the federal Free/Reduced school lunch program, a measure of poverty within school populations. Of the entire population in the pilot sample, only 5% (two students) were Hispanic and both were females. These two Hispanic females were interviewed separately following completion of the questionnaire. All of the students were taking ninth grade integrated science; subsequently, none of the students had taken a full year of biology, chemistry, or physics. As a result students were instructed to predict how well they could perform in these areas when answering items which addressed the content areas on the questionnaire.

SSEQ Pilot Reliability

Science self-efficacy was measured via the questionnaire wherein 27 questions came directly from the Smist (1993) SSEQ. The student questionnaire (Appendix L) for the comprehensive research study was identical to the instrument that was used for the preliminary and pilot studies with minor modifications to wording and format to increase clarity. The instrument blueprint (Appendix K) for the student questionnaire was compiled of from the ICEQ (33 items), the NELS: 88 survey (NCES, 1989) (3 items), science attribution (Weiner, 1985) (16 items), influence (2 items), mathematics enrollment (1 item), general information (8 items), and the 27 items derived directly from Smist (1993) SSEQ. The construct validity of the SSEQ was determined by Smist (1993) to be 89%. All other items included in the student instrument that were not the 27 SSEQ items were for informational purposes and were not a direct component of this study. They composed part of the secondary analyses, however, and future studies could be indicated.

Using SPSS subprogram ‘scale’, in Table 4, shows the reliability coefficient for the entire set of 27 questions in the pilot study was 0.9477. However, due to the small sample size (Smist, 2005), seven factors were extracted rather than the four extracted by Smist (1993) in the original study. A similar extraction of four factors would become evident in samples with a population *N* exceeding 100 (Smist, 2005).

The data was subsequently subjected to exploratory principal factor analysis using SPSS subprogram 'data reduction' and oblique rotation (Promax) as was done in Smist's (1993) original validity testing of the SSEQ instrument to purposefully extract four factors. Tables 5 and Table 6 show the four factors extracted, explaining 82.2% of the covariance, slightly lower than the 89% explained in Smist's field study.

Internal consistency using Cronbach's alpha estimates for four scales emerged when SPSS was asked to extract four factors. In doing so, all four were considered satisfactory since all were ≥ .40: Biology Self-efficacy (6 items), 0.862; Chemistry Self-efficacy (6 items), 0.837; Physics Self-efficacy (5 items), 0.850; and Laboratory Self-efficacy (10 items), 0.764. From the results of the pilot test, the Science Self-efficacy Questionnaire need not be modified, despite the small sample size. In addition, Smist (2005) stated that with an *N* of 100 or more, four factors would naturally be extracted.

Comprehensive Study Data Collection

In September, October, and November of 2005, following parental consent and child assent, administration of the questionnaire was conducted by the researcher. A visit to each of the participating teacher's tenth grade classrooms was scheduled and the Student Questionnaire containing the 27 embedded SSEQ items was administered. Students responded to questionnaire items without time constraint and submitted questionnaires directly to the researcher upon completion. The researcher interviewed any of the Hispanic females that were randomly selected from the high and low performing science achievement groups after completion of the questionnaire phase.

Comprehensive Study Data Analysis

Quantitative Analyses

Science self-efficacy. Construct reliability was calculated and compared against Smist's (1993) validity data using SPSS statistical programming. Using oblique (Promax) rotation, a factor analysis was utilized to naturally extract factors and Cronbach's Alpha was used to measure internal consistency within the factors, as was done by Smist (1993) in the original statistical analysis of field test data. The study further tested for significant differences in gender and ethnicity on extracted factors using one-way ANOVA.

Academic achievement. A multiple regression statistical analysis was performed to determine if a correlation existed between science self-efficacy extracted factors and various indicators of student science achievement. Student performance data was collected from district records on prior year SAT 9 reading and mathematics standardized achievement scores and prior year final science grades to comprise a matrix score representing science achievement. Science grade scores were input as follows: A=100 points, B= 89 points, C=79 points, D=69 points, F= no points. Higher level college track science classes (i.e. Honors, International Baccalaureate) earned an additional five points. Grades input represented in most cases the highest science coursework attempted the prior year. Courses that were scheduled by semester to equal one year earned the higher of the two semester grades, thereby demonstrating maximum student potential for that course. Likewise, wherein a student took two science courses in the ninth grade year, the higher of the two course grades was entered.

Qualitative Analyses

Phenomenological study. To add depth of understanding to statistical analyses, qualitative data was derived from four Hispanic female science students, The data were collected through four face-to-face, semi-structured, interviews. Analysis of the content employed the grounded theory process (Glaser & Strauss, 1967: 5-6; Creswell,1998: 56; Strauss & Corbin, 1998): of data analysis which follows a systematic and standard format. Results were then triangulated with quantitative survey data.

School Communication

Initial communication with the school system began with the research approval process with school district personnel. Once approval for the research was granted from OCPS (Appendix B), subsequent contacts were made through a variety of media. Initial email contacts were followed by written communication to enlist participation from teacher participants. Each teacher volunteer was contacted personally with a thank you letter also reminding them that the researcher would be contacting them in the fall for the comprehensive study. For the two teachers who were randomly selected for the pilot, both email and telephone communications were used to assist in scheduling the visits to conduct the pilot research study. Prior to entry into each school, an email or personal contact was made to each principal, requesting their support to conduct the study in their building. Before proceeding to the classroom, personal contact was additionally made by the researcher upon arrival at the school site. Following the research, the researcher contacted each of the participating pilot teachers and thanked them for their participation. These same communication structures were implemented in both the pilot and comprehensive studies.

Conducting the Comprehensive Study

The researcher arrived at each classroom early to prepare the instruments for dissemination, and greeted students at the door to increase familiarity and comfort. The researcher introduced herself personally to the Hispanic female in the class who had been chosen by the prioritized interview selection list and who had also returned a signed parental consent letter. The researcher sought child assent to participate in the structured interview. All four of the Hispanic females that were randomly chosen to be interviewed had returned a signed parental consent letter and all four girls elected to participate in the interview phase of the study.

The researcher allowed the teacher to gather and organize the class in preparation for the study. Those students not participating were seated in an alternate portion of the classroom and given a quiet alternate assignment. The researcher checked the Parent Consent letters and ensured that non-participants were separated from the group.

Once the class was ready for questionnaire administration, the researcher introduced herself and read the formal child assent script prior to starting. The script explained the purpose for the visit and the focus of the research. All students in the participating group elected to stay and take part in the study. The questionnaire was disseminated and the researcher waited until students had completed their questionnaire prior to its collection. No time constraints were imposed.

After the questionnaire phase was complete, a brief structured interview was conducted with the Hispanic females that had been randomly chosen and had attained both parental consent and gave child assent. The interviews were conducted in a science store room located adjacent to the student's classroom. The interviews were audio-taped and the tape recorder was held by the interviewee and in full view at all times. Each Hispanic female student was asked to pick an alias name of their choosing that would be used as reference in the study. Doing so ensured their confidentiality and enabled the researcher to establish immediate rapport with the student prior to starting the interview. By doing so, it was hoped the student felt more comfortable and would answer questions more truthfully. The questions were designed to build from closed-ended responses to more revealing, thought-provoking, open-ended questions. The researcher went through each question and expanded on responses where and when necessary to gain clarity and build rapport. The interview sessions lasted about fifteen minutes each.

Scoring Students' Responses

Science Self-efficacy Questionnaire Items

Questionnaire responses and school district student achievement data were entered into the SPSS Statistical program to check reliability and internal consistency against Smist's (1993) original SSEQ instrument through factor analysis. A one-way ANOVA was also run to compare all female responses to the 27 SSEQ items against Hispanic female responses. Finally, a multiple regression analysis was conducted to determine if a significant correlation existed between all SSEQ items and the three measures which comprised science achievement.

Structured Interviews

Audio tapes from the structured interviews were transcribed and hand coded using a constant comparative analysis from the grounded theory approach to identify common themes for interpretation and discussion. Recurring ideas were identified and grouped according to overriding general topics. Emergent themes were formed and subthemes were categorized under one of the themes by causes, interactions, or contextual similarity to the theme. Once the outline of themes was complete, underlying propositions created a narrative story, specific to the four Hispanic females interviewed.

Ethical Considerations

The original SSEQ instrument designed by Smist (1993) was conducted on predominantly White students. Hispanics were minimally represented in the population. Additionally, the demographic location in the original field test was New England. It is not stated whether the New England students were from urban, urban-fringe, or suburban New England areas. The original test was also administered to students, some of whom had already taken biology and physics. The students who participated in this study were from a large urban school district and were in the middle of their first semester of their tenth grade science course. Most had not taken physics or chemistry and therefore had to predict their confidence levels in these science content areas. Results from the study were framed in this context.

Chapter Summary

Through convenience sampling, a cadre of ten teacher volunteers consented to participate in the research study. From the cadre of ten teachers, two teachers were randomly selected for the pilot study on May 23, 2005 to test reliability of the questionnaire against the original instrument designed by Smist (1993). The pilot instrument earned a reliability coefficient of 0.9477 and was administered to the larger student sample, with minor revisions, in September, October, and November of 2005.

The study was conducted in two high schools located in an urban central Florida school district which served over 51,039 high school students. Over 29.3% of OCPS students are Hispanic (OCPS, 2005). The methodology employed in the convenience sample aimed at capturing this same percentage or greater.

The two-phase, sequential, mixed methods research design used multiple regression analyses to test the correlation of science self-efficacy on a measure of science achievement (prior year achievement data in standardized reading and mathematics scores, in combination with prior year science grade). The quantitative data was then entered into the SPSS statistical program and analyzed.

Lastly, a brief structured interview with a random selection of four Hispanic female science students, two each from the high and low achievement groups, allowed for more rich, thought provoking qualitative analyses and subsequent interpretation of possible influencing factors on students' science self-efficacy perceptions.

CHAPTER FOUR: RESEARCH FINDINGS

Overview

This chapter presents an analysis of the findings of this study. The study was designed to extend prior gender research in science education to Hispanic females and investigate if science self-efficacy has any significant influence in this population of students. General self-efficacy data support the idea that higher self-efficacy leads to greater motivation and engagement in the learning process. The inquiry was therefore aimed at determining if there were differences among females, on the basis of their ethnicity, in their level of science self-efficacy. The research design was established to address the three research questions:

1. What is the difference in science self-efficacy perceptions between tenth grade Hispanic females and other tenth grade female subgroups, based on race/ethnicity, as measured by the Smist (1993) Science Self-Efficacy Questionnaire (SSEQ)?
2. Is there a significant correlation of science achievement as measured by (a) prior year reading achievement as measured by the SAT 9 standardized test; (b) prior year mathematics achievement as measured by the SAT 9 standardized test, and (c) prior year final science grades on the science self-efficacy in Hispanic females as measured by the Smist (1993) SSEQ?

3. What factors may influence science self-efficacy in tenth grade Hispanic female science student as measured through phenomenological study?

The data collected from this study were based on the information gathered from a survey instrument, the Science Self-Efficacy Survey (SSEQ) developed by Smist (1993), with 272 tenth grade students participating in the study. Performance data were collected on all participants from the school district. The results were calculated from the SSEQ survey instrument.

Characteristics of the Overall Sample

The population sample for this study was significantly different from the original field test on the SSEQ. The original SSEQ questionnaire was field-tested on 826 New England high school students. The mean age of the students was higher in the field tested group (age 16) and the sample was predominantly 86% White. In this field test sample, more than half the sample (57.7%) had taken both biology and chemistry and only 6% had taken Physics (Smist, 1997, p. 69).

By comparison, this study was conducted on a more diverse population of students. The questionnaire was administered to 272 tenth grade science students from two high schools in central Florida. The predominant age of the overall student sample was 15 years old (66.7%), followed by students who were 16 (23.0%). There were 128 males (47.06%) and 144 females numbered (52.94%). However, as seen in Table 7, the Hispanic representation was the largest (56.3%) followed by Whites (21.9%), Asian/Pacific Islander (10.4%), Blacks (9.3%), Native American (1.5%) and Other (.7%).

Since all the students in the study were in tenth grade, most were currently enrolled in biology. Only one of the 11 classes studied was a chemistry class. No students had yet completed a course in Physics.

Characteristics of the Racial/Ethnic Female Sample

The Hispanic portion of the overall sample (56.3%) was almost twice that of the district representation of 29.30%. Hispanic females alone comprised 29.41% of the overall sample, an amount greater than the entire Hispanic student population in the school district. The specific demographic profile of the 144 female participants in the study can be seen in Table 8. The racial/ethnic female sample was comprised of 80 Hispanic (55.6%), followed by 32 Whites (22.2%), 14 Asian/Pacific Islander (9.7%), 14 Blacks (9.7%), 3 Native Americans (2.1%) and 1 Other (.7%).

Other characteristics of the racial/ethnic female population were included. Surprisingly, Table 9 demonstrates that only 19.5% of the racial/ethnic female students were actively enrolled in a Limited English Proficient (LEP) program in light of the fact that 55.6% of the females were Hispanic. Of the entire racial/ethnic female population, 15.3% received Exceptional Student Education (ESE) services, 9% of which were identified as having a specific learning disability (SLD) and 6.3% identified as Gifted. Table 10 shows the complete breakdown of all ESE services provided to the racial/ethnic female sample population as well as the overall population that was studied. Table 10 also shows the percentage of participation by the racial/ethnic females in other academic programs. Approximately 27.1% of the racial/ethnic female students who participated in the study were on an Academic Improvement Plan (AIP). Seven percent of the racial/ethnic female students had a federal 504 Plan for other special learning accommodations to address temporary needs such as Attention Deficit Disorder (ADD), Attention Deficit Hyperactivity Disorder (ADHD), or even the need to be provided a computer for standardized testing due to a hand fracture. The federal Free/Reduced school lunch program, a measure of poverty within school populations demonstrated that 30.6% of the racial/ethnic female sample received such assistance. Worth noting is that over half (60.4%) of the population read below grade level as measured by the Florida Comprehensive Assessment Test (FCAT), the state assessment instrument.

Statistical Procedures

To compare science self-efficacy trends in tenth grade Hispanic female high school students and other female subgroups, the differences between the variables of gender (females) and ethnicity (racial/ethnic subgroups), and science self-efficacy were simultaneously studied through survey research methods to generate data. The predictive relationship of past student performance and science self-efficacy in racial/ethnic female subgroups was also analyzed.

Using SPSS statistical programming, subtest 'data reduction', a factor analysis was conducted on the 27-item science self-efficacy questionnaire data using the overall sample. The data were subjected to exploratory principal factor analysis using oblique rotation as was performed in the original Smist (1993) study to verify construct reliability of the SSEQ for use with more diverse populations of students. Extracted factors were subjected to an analysis for reliability and internal consistency using Cronbach's alpha. Once construct reliability and internal consistency were established, then further quantitative analyses were performed to find differences and relationships among the racial/ethnic females on the extracted science self-efficacy factors.

Research Question #1: What is the difference in science self-efficacy perceptions between tenth grade Hispanic females and other tenth grade female subgroups, based on race/ethnicity, as measured by the Smist (1993) Science Self-Efficacy Questionnaire (SSEQ)? A one-way ANOVA was computed on all racial/ethnic females to determine significant differences between racial/ethnic subgroups on the extracted factors of science self-efficacy.

Research Question #2: Is there a significant correlation of science achievement as measured by (a) prior year reading achievement as measured by the SAT 9 standardized test; (b) prior year mathematics achievement as measured by the SAT 9 standardized test, and (c) prior year final science grades on the science self-efficacy in Hispanic females as measured by the Smist (1993) SSEQ? A linear multiple regression analysis was used to test the relationship of past achievement, specifically prior year SAT 9 Reading and Mathematics standardized national percentile score and prior year final science grade on the extracted science self-efficacy factors to assess their predictive value.

Description of Quantitative Results

The data were initially subjected to a factor reduction and analysis. Once the factors were extracted, the construct reliability was calculated. Following this statistical procedure, the extracted factors were measured against all racial/ethnic female groups through using ANOVA procedures to determine differences between groups. Lastly, past achievement in mathematics, reading, and science were regressed on each of the extracted factors to determine if past achievement could predict the science self-efficacy factors.

Factor Analysis

Science self-efficacy was measured via the questionnaire wherein 27 questions came directly from Smist's (1993) SSEQ. The data were subjected to exploratory principal factor analysis using SPSS subprogram 'data reduction' and oblique rotation (Promax) as was done in Smist's (1993) original validity testing of the SSEQ instrument . Factor analysis was used to reduce the set of variables for the questionnaire, to a set of factors able to account for a large portion of the variability.

The descriptive statistics of the item responses are presented in Table 11. Upon examination, no variables deviated from the mean more than the other variables. It was further observed that the standard deviations are smaller than the respective means and that no one standard deviation stands out upon gross observation as remarkably larger than the other variables.

The maximum likelihood estimation procedure was used to extract the factors from the variable data. Kaiser's rule was used to determine which factors were most eligible for interpretation by using Eigenvalues greater than 1.0. A review of the initial factor loadings suggests that a proper solution was attainable through maximum likelihood, as it was capable of converging three factors (see Table 12) in seven iterations (Table 13). Initially five factors had Eigenvalues greater than 1.0, however, the percent of communality to total variance for factors four and five was only 8% and therefore omitted. Three factors were successfully extracted, explaining a total of 52.9% of the covariance. Even though the covariance was less than the 89% covariance explained in Smist's (1993) original field study, there is internal structure evidence supporting the conclusion that the scores from the Science Self-efficacy instrument in this study were a valid measurement of the tenth grade science students' self-efficacy preferences. None of the results were nonpositive definite.

Communalities showed both initial and extracted sets, none of which exceeded 1.0 demonstrating further that the results were appropriate for interpretation to continue (see Table 14). Linear transformation and interpretation of the data was later accomplished.

The Promax procedure tells us how much one variable is correlated to each of the other variables. A Promax rotation of the data was chosen because it was assumed that correlations were possible (see Table 15) as was the case in the original study. The correlations in this study were large enough to be further interpreted. Results ranged from 0.587 to 0.626. Varimax rotation did not need to be utilized because correlations were indeed possible and results approximate zero .

Reviewing the structure Coefficient matrix suggested that the three factors group the items in theoretically understandable ways (i.e. themes). The coefficients suggest consistency in the way the tenth grade students in the overall sample responded to the science self-efficacy items. For at least 23 of the 27 science self-efficacy variables, student responses tended to be very similar.

Extracted Factors

Factor 1, Academic Engagement, indicated understanding concepts and suggests that self-efficacy regarding academic engagement was correlated 0.790 with Factor 1and accounts for 37.26% of the variance of that factor. Factor 2, Laboratory, indicates the theme was consistent with performing laboratory experiment activities and suggests that self-efficacy in using laboratory apparatus was correlated 0.773 with factor 2 and accounts for 5.97% of the variance for that factor. Biology content was correlated 0.852 with Factor 3, Biology, and accounts for 4.34% of the variance for Factor 3.

Means Comparison

The descriptive statistics of the three extracted factors are presented in Table 16. The mean was greatest for Factor 1, Academic Engagement (M=42.57, sd =12.30). The second greatest mean was Factor 2, Laboratory (M=19.35, sd =5.84). The smallest mean was Factor 3, Biology (M=19.35, sd =5.38). A correlation among the three extracted factors was calculated to determine the relationship of each of the three factors to each other and is shown in Table 17. All three factors showed significant correlation to each other ($p < .01$).

Between-group correlations

A strong positive correlation was found (r (256) = 0.720, $p < .01$), indicating a significant linear relationship between Academic Engagement and Biology. Those students who perceived a high degree of science self-efficacy through academic engagement also responded with high science self-efficacy perceptions in biology.

A second strong positive correlation was found (r (252) = 0.685, $p < .01$), indicating a significant linear relationship between Academic Engagement self-efficacy and Laboratory self-efficacy. Those tenth grade science students who had high perceptions of science self-efficacy in academic engagement also tended to respond as having high perceptions of science self-efficacy in using laboratory apparatus.

Lastly, a strong positive correlation was found (r (263) = 0.557, $p < .01$), indicating a significant linear relationship between Laboratory and Biology as well. Those tenth grade science students who had high science self-efficacy perceptions using laboratory apparatus also had high science self-efficacy perceptions in biology. In summary, the relationship of all three factors to each other was strong.

Reliability

Another measure of construct validity is reliability. Reliability measures the internal consistency within extracted factors. Reliability coefficients used Cronbach's

Alpha estimates for the three scales which emerged when SPSS was asked to extract three factors as seen in Table 18. All three extracted factors were considered satisfactory as all were ≥ .40: Academic Engagement Science Self-efficacy (14 items), 0.924; Laboratory Science Self-efficacy (7 items), 0.834; and Biology Science Self-efficacy (6 items), 0.782. Respondents perceptions of different types of science activities obtained from the SSEQ questionnaire were judged to be fairly reliable for the tenth grade high school science students to whom the SSEQ was administered.

Comparison to the Original Study

Reliability for the three extracted factors in this study showed similarity to Smist's (1993) original study in which four factors were extracted (See Table 19). For example, in comparing the two studies, Biology Science Self-efficacy in this study had a higher reliability coefficient (+0.088). Laboratory Science Self-efficacy was slightly lower than the original study (-.066). The number of items differed slightly, as some of the extracted factors from the original study, Factor Chemistry and Factor Physics, were reduced into this study's extracted Factor Academic Engagement, demonstrating a higher internal consistency of 0.924, when combining these items during this study's reduction process.

Covariance in the original study was 89%. The covariance of the SSEQ when used with the more diverse population studied was 52.9%. The SSEQ instrument demonstrates more variability within its construct variables and is less reliable when used with a more diverse population of tenth grade science students.

One-way ANOVA

A one-way ANOVA was calculated on female racial/ethnic subgroups to determine the differences between each of these variables on the three extracted factors of science self-efficacy. One-way ANOVA was chosen over multiple *t*-tests to reduce or avoid Type I errors. These comparisons yielded single answers that informed if any of the groups were different from any of the other groups. All groups were independent of each other and none belonged to more than one group. Refer to Table 20 for a summary of the results.

Factor One: Academic Engagement

The test found significant differences (F=4, 130) = 5.055, p <.05=.001) between all female race/ethnic groups on the science self-efficacy factor Academic Engagement. Native American students scored higher on Academic Engagement (m = .766, sd =1.199) than Asian/Pacific Islander students (m = .729, sd =.798), Black students (m = .158, sd =.941), Hispanic students (m = -.253, sd =.873), and White students (m = -.330, sd =.847). It is important to note that the sample size for the Native American females was small (3 students).

Tukey's Honestly Significant Difference (HSD) post hoc test was then used to determine the nature of the differences between female racial/ethnic subgroups on the extracted science self-efficacy factor Academic Engagement. The analysis revealed a statistically significant difference in means between both Hispanic females (p<.002) and White females (p<.003) compared to Asian/Pacific Islander females, a subgroup which had higher science self-efficacy perceptions. These between group comparisons were accounting for the majority of the overall significant differences in the factor Academic Engagement. No other statistically significant differences were found between any other subgroups

Factor Two: Laboratory

Second, the test found significant differences (F=4, 130) = 3428, p <.05=.011) between all female race/ethnic groups on the science self-efficacy factor Laboratory. This analysis revealed again, that Native American students scored higher on Laboratory (m = .663, sd =.723) than Asian/Pacific Islander students (m = .629, sd =.598), Black students (m = .071, sd =.918), Hispanic students (m = -.154, sd =.822), and White students (m = -.258, sd =.968). Again, it is important to note that the small sample size (3) for the Native American females.

Tukey's HSD was used to determine the nature of the differences between female racial/ethnic subgroups in the extracted science self-efficacy factor Laboratory. Again, the post hoc analysis revealed a statistically significant difference in means between both Hispanic females (p<.021) and White females (p<.016) compared to Asian/Pacific Islander females, one of the subgroups with higher science self-efficacy perceptions. These between group comparisons were accounting for the majority of the overall significant differences in the factor Laboratory. No other statistically significant differences were found between any other subgroups.

Factor Three: Biology

Lastly, the test also found significant differences (*F*=4, 130) = 2.582, *p* <.05=.040) between all female race/ethnic groups on the science self-efficacy factor of Biology. This analysis revealed that Asian/Pacific Islander students (*m* = .590, *sd* =.770) exceeded the second place position attained in the other two factors by scoring higher on Biology than Native American students (*m* = .532, *sd* =.899). These means were followed by Black students (*m* = .176, *sd* =1.091), White students (*m* = -.112, *sd* =.958), and Hispanic students (*m* = -.216, *sd* =.934). Also noteworthy is that unlike the first two factors in which White females had the lowest mean, the mean of the Hispanic females ranked the lowest on factor Biology. The sample *N* for the Native American females remained small (3).

Tukey's HSD was used to determine the nature of the differences between the female racial/ethnic groups for the extracted science self-efficacy factor Biology. The post hoc analysis revealed a statistically significant difference in means between Hispanic females (*p*<.040) and White females (*p*<.016) as compared to Asian/Pacific Islander females, a higher perceiving subgroups with regard to science self-efficacy. These between group comparisons were accounting for the majority of the overall significant differences in the factor Laboratory. No other statistically significant differences were found between any other subgroups.

ANOVA Summary

The one-way ANOVA compared the science self-efficacy scores of female students who were from different racial and ethnic backgrounds. Table 20 and Figures 5, 6, and 7 show Hispanics females scoring lower means than all other female race/ethnic groups, except for White females, on two of three science self-efficacy factors (Academic Engagement and Laboratory). On Biology Hispanic females had the lowest mean for science self-efficacy perceptions. This trend was not replicated when an additional ANOVA, comprised of males and females together, was calculated for comparison purposes. When racial/ethnic subgroups are computed with females only, White females are showing lower science self-efficacy than all other female racial/ethnic subgroups on two of three factors. This may represent an example of data that can be missed when data fails to be disaggregated beyond general analysis.

Using the Tukey HSD post hoc test, the most statistically significant difference in means was demonstrated between Asian/Pacific Islander females and Hispanic females on all three factors, demonstrating a significant gap in science self-efficacy perceptions between these two female subgroups. Another statistically significant difference in means was found between the Asian/Pacific Islander females and White females on two of the three factors. White females are not as low on science self-efficacy perceptions on the factor Biology as in the other two factors of Academic Engagement and Laboratory. When comparing the statistically significant difference in means, Hispanic females demonstrate the lowest science self-efficacy due to significance in all three extracted factors. The greatest significant differences between subgroups were found in the factor

Academic Engagement between the low White and Hispanic females and the high Asian/Pacific Islanders in science self-efficacy perceptions.

Multiple Regression

Using data from tenth grade Hispanic female science students, a multiple linear regression analysis was conducted to determine if a statistically significant correlation existed between a measure of science achievement used in this study, specifically prior year Norm-referenced Test (NRT) Reading score, prior year NRT Mathematics score, and prior year science grade and the three extracted science self-efficacy factors. All of the performance data were not statistically significant predictors of any of the science self-efficacy factors.

Factor One: Academic Engagement

The multiple linear regression calculated to predict Academic Engagement in tenth grade Hispanic female science students based on the measure of science achievement used in this study (past standardized test scores in reading and mathematics and performance in past science coursework) did not yield significant results. The regression equation was not significant ($F (3, 51) = .197, p > .05 = .898$) with an R^2 of .011 as seen in Table 21. In tenth grade Hispanic female science students, only 1.1% of the variation in factor Academic Engagement can be predicted by standardized reading score, standardized mathematics score, and prior year science grade. Neither science grade, standardized reading score, or standardized mathematics score can be used to predict Academic Engagement.

Factor Two: Laboratory

The multiple linear regression calculated to predict Laboratory self-efficacy in tenth grade Hispanic female science students based on the measure of science achievement used in this study (past standardized test scores in reading and mathematics and performance in past science coursework) also did not yield significant results. The regression equation was not significant (F (3, 51) = 1.707, p >.05 =.177) with an R^2 of .091 as seen in Table 21. Thus, 9% of the variation in factor Laboratory can be predicted by standardized reading score, standardized mathematics score, and prior year science grade in tenth grade Hispanic female science students. Neither science grade, standardized reading score, or standardized mathematics score can be used to predict Laboratory self-efficacy in the science classroom in this female subgroup.

Factor Three: Biology

Lastly, the multiple linear regression calculated to predict Biology self-efficacy in tenth grade Hispanic female science students based on the measure of science achievement used in this study (past standardized test scores in reading and mathematics and performance in past science coursework) did not yield significant results. The regression equation was not significant (F (3, 51) = .462, p >.05 =.710) with an R^2 of .026 as seen in Table 21. Standardized Reading, Mathematics, and prior year science performance were not significant predictors of science self-efficacy in Biology, accounting for only slightly over 2% of the variation in this factor. The science grade, standardized reading score, or standardized mathematics score cannot be used to predict Biology self-efficacy in the science classroom in this female subgroup.

Description of Qualitative Results

Research Question #3: What factors may influence science self-efficacy in tenth grade Hispanic female science students as measured through phenomenological study? The second phase of this mixed methods study attempted to provide deeper understandings that may support student questionnaire responses to science self-efficacy items by tenth grade Hispanic female high school students. Semi-structured interviews were conducted with two high-ability and two low-ability Hispanic females chosen randomly from each performance group.

The Participants

Two of the four participants were born in this country (New York). The remaining two were foreign born (Cuba, Colombia). All four girls had parents born outside the United States (Cuba, Colombia, and the Dominican Republic). Three of the four girls were second generation Americans, while one girl was first generation. The native language was Spanish for all girls and was the primary language spoken in their homes even though English was also spoken there. All four girls report that they read and write primarily in English.

Grounded Theory Process of Coding

The data were collected through four face-to-face, semi-structured interviews. Analysis of the content employed the grounded theory process (Glaser & Strauss, 1967; Creswell, 1998; Strauss & Corbin, 1998) of data analysis which is systematic and follows a standard format. Two high performing and two low performing Hispanic females were randomly selected as interview participants. Audio tapes from the structured interviews were transcribed and hand coded using a constant comparative analysis from the grounded theory approach to identify common themes for interpretation and discussion. Recurring ideas were identified and grouped according to overriding general topics. Emergent themes were formed and subthemes were categorized under one of the themes by causes, interactions, or contextual similarity to the theme. Once the outline of themes was complete, underlying propositions created a narrative story, specific to the four Hispanic females interviewed.

Emergent Themes

Three general themes emerged from the open coding in the grounded theory approach. See Appendix W for a complete description of the grounded theory coding process used in this study. The general themes were Classroom Variables, Outside School Variables, and Personal Variables. The next step in the grounded theory process was axial coding to identify conditions or interactions that influence the general themes. Appendix X shows each Hispanic female's comments in a running account relative to each of seven sub themes that were identified and outlined in Table 22. The identified sub themes were Perception that content is difficult, Mathematics ability perception, Presence of hands-on activities, Perception of facilitation of learning strategies, Perception of teacher, Family and peer influences, and Career and motivation to persist. A matrix showing the incidence of each of the subthemes can be found in Table 23.

CHAPTER FIVE: DISCUSSION

Interpretation of Results

Chapter 5 presents a discussion on the analysis of the findings for each of three research questions. The study was designed to extend prior knowledge in gender research in science education through a comparative study of science self-efficacy among Hispanic females and other subgroups of females. A review of the Literature in Chapter Two indicated Albert Bandura's (1977, 1986, 1993, 1994, 1997) construct of self-efficacy as a vehicle for promoting positive change for individual learners and an essential element to overcoming obstacles in the learning environment. He maintained that ability and self-efficacy perceptions are important in complex task performance, with self-efficacy helping to determine how well people use their skill. Bandura (1986) argued that some overestimation of capability increases effort and persistence to task performance. Little attention has been paid to the study of affective variables, such as self-efficacy in the science learning environment. Studying subpopulations of females within science education classrooms also needed attention in the research literature. Specifically, this study addressed science self-efficacy in tenth grade Hispanic female science students.

Clewell and Ginorio (1996) found that race and ethnicity explain more variance in science achievement scores than gender alone. In both 1996 and 2000 science assessments, the National Center for Education Statistics (NCES, 2003c) indicated that Hispanic students scored consistently behind their White, Asian, and American Indian counterparts. In addition, only 22% of scientists and engineers are women (NSF, 1996), and only 10% of that population are Hispanic as noted in the 1996 National Science Foundation (NSF) report. It can therefore be estimated that only 2% of those who enter Science, Technology, Engineering, and Mathematics (STEM) related careers in the United States are Hispanic women. In studying science self-efficacy as a possible affective factor in these statistics, the study hoped to find a different trend. Results could inform the field regarding the particular changes necessary to be implemented within the secondary science classroom environment. Changes perceived as desirable could encourage more Hispanic females to persist in their science study during their precollege years.

The domains of biology, chemistry, physics, and laboratory skills were explored through a 27-item questionnaire administered to 272 tenth grade high school science students, 80 of whom were Hispanic females. Three factors converged to explain 52.9% of the covariance among the variables. Internal structure evidence supported the conclusion that the scores from the SSEQ instrument in this study were a valid measurement of the participants' science self-efficacy preferences.

Student responses were consistent among 23 of the 27 items as evidenced by the coefficient results produced in the factor analysis. Those who responded in a particular direction on an item tended to respond in the same direction with a majority of the other items included in the SSEQ. Strong positive correlations among the three variables indicated that Academic Engagement, Laboratory, and Biology had significant linear relationships to each other which accounts for the internal consistency.

Research Question #1

What is the difference in science self-efficacy perceptions between tenth grade Hispanic females and other tenth grade female subgroups, based on race/ethnicity, as measured by the Smist (1993) Science Self-Efficacy Questionnaire (SSEQ)?

Comparing Hispanic Females and Other Racial/Ethnic Subgroups

Racial/ethnic differences in science achievement are generally larger than gender differences at all grade levels, yet remain largely unexamined (Hanson, 1996). In addition, gender and ethnicity have rarely been studied simultaneously (Drew, 1996) as was done in this study.

A one-way ANOVA using SPSS programming, subprogram "Regression", was computed on all tenth grade female racial/ethnic subgroups to determine significant differences between Hispanic females and other racial/ethnic females who responded to science self-efficacy items using the Science Self-Efficacy Questionnaire (SSEQ) developed and validated by Smist (1993).

Significant differences were demonstrated in all three factors between all female racial/ethnic groups. Native Americans scored highest on two of the three factors (Academic Engagement and Laboratory), however, their population was small (3) and comprised only 2.1% of the female population. Asian/Pacific Islanders scored the highest on the factor Biology. Black females placed third on all three factors. Hispanics students demonstrated the lowest science self-efficacy perceptions on Biology while White females scored the lowest self-efficacy on the factors Academic Engagement and

Laboratory. This finding does not mirror national research (NCES, 2003c) which showed Hispanic students scoring consistently behind their White, Asian, and American Indian counterparts. It was expected that Hispanics would perceive that they are less academically engaged in their science studies on all three factors as demonstrated by the research literature. However, when gender and racial/ethnicity were simultaneously taken into account when calculating ANOVA, the White females in this study performed more poorly than expected on two of the three factors extracted. Caution should be noted in interpreting these results. The results could be due to a nonrepresentative sample size of only 22.2 percent White female population in this study. The school district represents Whites as 36.43% of the student population, while the state of Florida has a White representation of 49.80% (Tables 1 and 2 respectively). Future research should minimally approximate representative samples found in the district demographic profile.

The unexpected poor performance of the White female subgroup could also be the result of focused and effective science education with Hispanic students since they comprised the majority racial/ethnic population at both the high schools where the research was conducted. Being a member of the minority population in this setting might have deleterious effects on communication and learning. The White females could be experiencing an array of influencing variables within the learning environment that negatively affect their beliefs and performance, just as other minorities experience in predominantly White majority learning environments. A cross-section of school district, state, and national student demographic data show overall White student percentage representation at 36.43% (OCPS, 2005), 49.80% (Florida DOE, 2003), and 58% (U.S. Census Bureau, 2004) respectively. It is not known if this finding is unique to this study or perhaps a reflection of the lack of sensitivity when data fails to be disaggregated as in the comparative studies, resulting in missing information. Should the study be replicated in a similar setting, the White female sample size should be increased to determine if findings could resolve this question.

Research Question #2

Is there a significant correlation of science achievement as measured by (a) prior year reading achievement as measured by the SAT 9 standardized test; (b) prior year mathematics achievement as measured by the SAT 9 standardized test, and (c) prior year final science grades on the science self-efficacy in Hispanic females as measured by the Smist (1993) SSEQ?

Predicting Science Self-efficacy from Past Achievement

A multiple linear regression analysis using SPSS programming, subprogram "regression" was utilized to test the relationship of past student achievement on three extracted factors of science self-efficacy, specifically reading and mathematics data (prior year SAT 9 Reading and Mathematics standardized national percentile score) and science achievement data (prior year final science grade).

Achievement data used in the multiple linear regression belonged to actual participants and not generalized national research data. The achievement information of all participants was regressed on all three extracted science self-efficacy factors, and no significant predictive value was found on any of the science self-efficacy factors. The results did not match the same predictive pattern evident in the research literature utilizing national generalized assessment data. This lack of support could be due to the smaller sample sizes in this study. Other causation might include the inclusion of reading and mathematics performance data as part of the science achievement measure, and not a measure of standardized science achievement data used alone as found in the literature.

Research Question #3

What factors may influence science self-efficacy in tenth grade Hispanic female science students as measured through phenomenological study?

Semi-structured Interviews

The second phase of this mixed methods study attempted to provide deeper understandings that may support student questionnaire responses to science self-efficacy items by tenth grade Hispanic female high school students. Two high performing and two low performing Hispanic females were randomly selected as interview participants. Four brief semi-structured interviews were conducted, transcribed (Appendix V), and coded for predominant themes (Appendix W) using grounded theory processes. Data were then available for interpretation. Please refer to Table 23 that shows three general themes having emerged from the results throughout the following discussions.

Emergent Themes

The first theme was Classroom Variables comprised of curricular (2 tertiary themes) and instructional (3 tertiary themes) components. The second theme was Outside School Variables comprised of one sub theme: Family and Peer Influence. The last general theme was named Personal Variables, comprised of the sub theme Career and Motivation to persist. There were a total of seven sub themes available for interpretation. (See Table 23).

Structural Descriptions

Classroom Variables

The operational definition of Classroom variables are those variables that fall within the domain of the science classroom learning environment. Classroom variables are comprised of both curricular and instructional components.

Science content is difficult. One curricular component that was reflected in the student responses included the perception that science content is difficult. One quote by Stephanie, a low performing female, puts it succinctly:

> "So few women pursue science careers because it's hard. As we go on each day it gets harder and harder, like, really there has been like one thing that I've found easy in this class."

All four Hispanic females perceived that science content is difficult to comprehend. Since both high and low ability females had similar perceptions, the perception is likely due to factors other than reading or mathematics ability, and prior year science achievement, since these variables were calculated into what defined high and low ability females for inclusion to be interviewed.

Mathematics ability perception. The second curricular component, the perception of the students' own math ability as "good" or "bad", served to help or hinder their understanding of science. Two high-ability Hispanic females and one low-ability Hispanic female perceived that they were good at mathematics, yet expressed a continued struggle with mathematics, subsequently making the science content more difficult to learn. One low-ability female said:

> "I'm not really good in math. It [math] is making it [science] difficult."

Even a high-ability student remarked:

> "[I] didn't like the [chemistry] formulas because of the math. "

When mathematics is the language of science, reinforcing mathematics concepts which support science comprehension might help students feel more confident in science calculations and data analysis. Despite the lack of statistical significance demonstrated in the multiple linear regression using standardized mathematics score as a component of science achievement with the population of students in this study, research shows that enrollment patterns in mathematics courses contribute to gender stratification in the science pipeline. Hanson, et al. (1996) found a remarkable consistency in the pattern of twelfth grade mathematics classes to twelfth grade physics classes. While girls take the same number of mathematics classes in high school, they tend to take lower level mathematics classes rather than advanced mathematics courses that would better prepare them for the needed science calculations required in upper level science classes. This may account for why even the high-ability Hispanic females perceived that they continued to struggle with the formulas and calculations in their science classes.

Hands-on activities. The first instructional subtheme included within the general theme of Classroom Variables was the perception of engaging hands on activities as being present or absent in the classroom. All four girls responded that the classroom was not much fun, since the instructional activities chosen were lacking in challenging laboratory experiences, and engaging group-work activities that would help them understand the content more easily. This perception was not dependent on ability, since all females, regardless of ability level, made negative comments regarding the lack of hands-on instruction and experiential learning. One respondent remarked:

> "[I] like the experiments. I would probably like to do experiments because I know everybody loves that type of stuff, but not boring experiments. You know because experiments like they would be like, "Oh yeah, that's cool, let's do this", you know."

Another respondent said:

> "When we did [do experiments] they were really fun. Like we would have to like construct roller coasters when we were doing like friction and stuff, in groups."

When respondents were asked to recall a memory of a science experience that motivated them to like science, all four had an episodic memory account developed around the idea of a project that they had worked on in the past (i.e. volcano, roller coaster, etc). According to the respondents, project-based learning experiences seemed to facilitate mastery learning and nurture interest in previous science classes, yet were less evident in their more immediate science experiences, preparation, and training. Working with others in peer collaborating experiences helped to make the content more comprehensible for them. This instructional feature is a central component of the National Science Education Standards (NRC, 1995). "Teaching should enable scientific concepts to be mastered through investigations so that students can learn science, learn to do science, and learn about science (p. xv)." The social interaction model of instruction (Joyce, Weils, & Calhoun, 2003) also supports and encourages group interaction as a basis for teaching and learning new concepts and skills. Teachers who allow students to collaborate with flexible ability partners or in small groups help to create non-threatening learning environments in which students feel safer asking questions and gaining information (Gage & Berliner, 1991). When students cooperate on a learning task, they become more engaged intrinsically. Sharan and Shaulov (1990) believe this increased internal motivation develops positive classroom cultures that can support vigorous learning activities. Lev Vygotsky (1986) firmly believed that social interaction is the primary source of cognition and behavior and developed a learning theory abound this model.

A more humanistic approach focuses on the affective/emotional filter to connect the environment to internal thoughts or feelings and connecting knowledge and feelings to action. A student's science self-efficacy perception could therefore have an effect on their ability to persist in science preparation and training. Unfortunately, according to the perception of the four Hispanic females interviewed, instruction was not student-centered. Having activities that Hispanic females consider engaging might influence this underrepresented group to want to persist in their science study.

Facilitation of learning strategies. The second instructional component was the perception of a need for learning strategies to be facilitated in the classroom to help students learn. The National Science Education Standards (NRC, 1995) states that learning strategies be taught to help students master science skills and content. The perception that teachers do not take the time to teach students how to employ strategies to help make the content easier to understand was a perception of one low achieving Hispanic female named Stephanie who said:

> "Learn better study strategies, and like stuff like that because honestly, like the teachers, they've never really taught me how to study and if they do then it's never a way that I understand"

Stephanie knew what she needed to help her learn. At one point in all of the interviews each of the girls also spoke of the need to receive help because science content is difficult. Many students can come to class everyday and participate in the activities yet not fully engage in the learning process to help them learn the content. The student who stated a need for direct instruction of learning strategies supports the belief that students lack knowledge of the learning process but do not necessarily lack the motivation to learn. Teachers who engage in direct instruction of strategies and skills for reading science content tend facilitate independent learning. These strategies might include outlining major ideas, note-taking during class discussions, and how to study for both informal (i.e. teacher or text-made criterion referenced) and formal (i.e. standardized state and national) assessments. Another finding from science for learning research states that students be able to organize knowledge in ways that facilitate retrieval and application (Elmore & Tennyson, 1996). This finding also supports the use of the Information-Processing model of instruction (Joyce, Weils, & Calhoun, 2003) which teaches students how to organize sets of disconnected facts in order to have opportunities to make learning comprehensible. Use of inquiry training and advanced organizers can assist students in the process. By developing a framework or schema in which to remember, retrieve, and transfer learning to new situations, students can develop competence in the science classroom. Lenz and Deshler (2004) also validate Stephanie's beliefs. The use of metacognitive strategies and skills can assist students in their ability to develop higher order thinking. Skills such as predicting outcomes, explaining to understand, noting failures to comprehend, planning ahead, using time and memory to learn, and activating prior knowledge through interactive questioning and classroom discussion can help make content more comprehensible.

Classroom discussions. One high-ability and two low-ability female stated that more classroom discussions that bring in personal experiences helps to get them interested and thinking on the topic being discussed. Paola, a low-ability student, put it like this:

> "If you're like talking to your students, making them participate, you're like, "Oh what do you think of this?" They will get even more into the class."

"E", another low-ability student also commented:

> "I would talk to them about it; ask them their experience. Like what they think about it."

Elmore &Tennyson (1996) reinforced these students' perceptions. If students' initial understanding is not engaged or activated, they may fail to grasp the new concepts and information that are taught. Listening to peers talk about their ideas might stimulate Hispanic females to engage and come up with their own ideas and increase the likelihood they will learn the material and perform more successfully.

Perception of the teacher. A third instructional component which emerged from the interviews was the perception that teachers possessed particular characteristics that helped or hindered interest, motivation, and understanding of science content.

Teacher delivery. Two high-ability and one low-ability Hispanic female had negative perceptions of former science teachers. After studying the comments from all four girls, the word "boring" was mentioned repeatedly:

> "Some teachers, they are not good at it. I'm sorry, but they are not good at it, some teachers, and that is why you know people are going to go like "Oh my God." Like my 6^{th}, 7^{th} and 8^{th} teacher, he was good. Like he was funny, he was always telling stories about science and stuff like that. Like in 8^{th} grade he turned boring. I didn't like him anymore."

However, "E", a low-ability participant, specifically made comments regarding the delivery by the teacher and how the teacher spoke with the students:

> "If the teacher is exciting, then the kids will get excited."

The perception was that science was boring tone implied a lack of passion for the content. If the teacher wasn't excited and having fun with the content, the students felt it was more difficult to be engaged or motivated to learn the content.

Fewer topics. Another comment regarding teachers was made by one low-ability Hispanic female. Stephanie, a low-ability student, noted that science teachers should spend more time on fewer topics to allow time for the learner to engage:

> If the teacher spends more time on one thing instead of, like, Ms. "S", she is great. Like, she has helped me a lot, and like in understanding things and just making me feel better, I guess, about science. [We] spent more time on one topic rather then less time on a lot of topics.

Her comments are supported by Lenz and Deshler (2004) who maintain that teaching should involve less content in more depth, to enhance student learning and mastery. There is much more important information to teach than can feasibly be taught in a meaningful way. When more detail about each topic is provided, the content is rendered more comprehensible to students. This is a difficult task in the age of curriculum standards and state assessments that require specific learning outcomes be taught because students will be assessed on them. However, not all outcomes are assessed, and some are included less often. Professional development in the area of instructional planning that includes methods for determining which outcomes are most often evaluated at the state level could assist science teachers at the school level in determining the length of time to be spent in specific content areas. If an outcome is not assessed, a teacher could use discretion and eliminate that particular content, allowing time for the remaining topics to be covered in more depth. Training is the practical application of inquiry-based learning might prove beneficial to more enriched learning experiences. Teachers must also exercise caution to not over-dwell on topics they enjoy teaching, even if assessed. Allotment of the appropriate amount of time is crucial in allowing the kinds of enriched and engaging activities that students enjoy most to retain their interest and increase motivation.

Academic engagement time. Decrease time spent on nonacademic discussion and activity during the class period was another comment made by Catherine, a high-ability Hispanic female. Catherine perceived that teachers should focus more on teaching content and focus less on behaviors (i.e. tardies, getting ready to go home, etc.) Decreasing wasted time increases academic time engaging with the science content. Catherine said:

> “Don’t focus on, like… she is always talking to us like if you are late, if you do something wrong, like, focus on the study part and you know like make sure we do the homework, make sure we understand things. Don’t focus on like if we’re late or we are going home”

Catherine’s perception is reinforced by the research literature. Greenwood, Horton, & Utley (2002) found that academic engagement positively mediated the relationship between instruction and achievement. A teacher’s lack of attention on the importance of “time on task”, can eat away at the available time to engage in meaningful activities and opportunities that facilitate learning.

Further, increased student engagement time shows the strongest relationship to student achievement (Caldwell, Huitt, & Graeber, 1982; Gest & Gest, 2005). Increased academic engagement time can also effect self-efficacy in the classroom. Of particular interest to this study are the research findings of Meece, Herman, and McCombs (2003). Meece et al. found that when learner-centered teaching practices were utilized, academic engagement was improved and revealed a significant correlation to self-efficacy. Both the comments by the interview participants and the highest mean perceptions of self-efficacy were related to activities which demonstrated academic engagement.

Cultural sensitivity. Catherine’s comments are also validated by Tucker, Porter, Reinke, Herman, Mack, and Jackson (2005). Tucker et al. confirmed that teachers who work with low-income, culturally diverse students tend to have lower expectations and fewer interactions with these students, resulting in less academic engagement. The relationship between teacher efficacy and student achievement is likely due to differences in teacher behavior. Teachers’ racial attitudes and perceived ability to work with diverse students can influence their teacher efficacy to teach students from culturally diverse backgrounds. Therefore teacher beliefs and ensuing behaviors may help explain the large and persistent gap between white students and culturally diverse students, especially Black and Hispanic students (NCES, 2001). Teachers should be trained to identify and understand the multiple external factors that impact the academic performance of their students. Knowledge of their students can increase learner-centered instruction and increase academic engagement and ultimately student achievement.

Outside School Influences

The operational definition of outside school influences are those activities which are not directly controllable because they fall within the scope of not being a part of the direct learning environment and classroom setting.

The cultural theme evident in the interview dialogues encompasses family and peer influences. Both low-ability participants had cultural perceptions that were antagonistic toward science careers for Hispanic women. Specifically mentioned by two of the females was the perception that Hispanic males have of Hispanic women staying at home to cook, clean, and raise the children.

Family influence. Family influence appears to be able to have more influence on student perceptions than general cultural perceptions. All four participants perceive that Hispanic women don't study science because Hispanic men think Hispanic women should stay at home to cook, clean, and raise the children and should not follow a career. Clearly stated by one high-ability female name Paola:

> "The truth is I've always believed that people always look down on women when they want that [science] because men are sexist. I don't

> know; they think they can do anything. Well, the Hispanic men they really think that the woman should be at the house just cooking and cleaning, and I don't think it should be like that. It doesn't fit with you having a career in science."

Catherine, another high-ability Hispanic female, said it this way:

> "In my personal opinion it's like the Latin woman is more of a house women, like she is always in the house, like, with the kids, cooking, school and, you know, they will work for some [inaudible], to work if she needs the money and because [inaudible]. Like I say she rather prefer to stay in the house, cleaning the house, making food for us, and stuff like that; not really liking studying for 8 years to be a scientist. I don't think like that. I don't want to. I don't want to stay in the house, see my kids and stuff like that. Like I want to be married like 20 years, something like that. I want to party first, and have a degree, and all that stuff."

Two of the girls have a family member who has a science career in some capacity and have been encouraged by them, despite difficulties in science. One Hispanic female noted that her father encourages her in her science study since he himself is an engineer, conjecturing that perhaps her father does not see potential that goes beyond being a wife. Whatever the reason, supportive parents were found to be positively related to women's interest level and ultimate participation in the sciences (Maple, 1994; Stage & Maple, 1996). Gonzalez-DeHass, Willems, and Doan Holbein (2005) showed a beneficial relationship between parental involvement and various motivational constructs, including perceived competence (i.e. self-efficacy).

Schools can influence the way parents value education. Providing opportunities for parent education in the area of career exploration and discussions of stereotypes can dispel some of the current beliefs regarding appropriate careers for Hispanic girls. Parent collaboration and education should occur early in the student's secondary career. One effort at making science more culturally available to Hispanic girls would involve working specifically with targeted Hispanic females who possess the academic ability to study science. Focus group discussions of students' cultural influence on their academic decision-making would broaden paradigms for career exploration and planning. In addition, providing science experiences that are engaging to Hispanic girls would assist the girls in making science content more comprehensible and subsequently increase their confidence. Inviting role models as guest speakers, creating externships, or coordinating field experiences in the community would demonstrate direct application of science content knowledge and illuminate possible career choices. Science mentorships, and other relationships with caring adults in the scientific community, could be arranged to increase students' potential as viable minority candidates for future STEM careers.

Peer Influence. Peers, as a whole, were generally non-supportive. Only one of the four girls states that friends encourage her to go into the science albeit for the money it might yield as a Hispanic female funding her education. The other three girls state that their friend either don't care and don't say anything, or further states that science "sucks" because it is boring and difficult. A support group of Hispanic girls who possess both the academic ability and the interest to possible pursue science as a career could serve to facilitate new perceptions from peers. If there are enough in the group at each level, they could possibly form study groups as well. The groups could meet during an assigned time and could be facilitated by a willing science teacher or counselor.

Personal Variables

The operational definition of a personal variable is an affective personality trait or characteristic which might influence perceptions of science self-efficacy.

Career and motivation to persist. Only one of the four girls plans to continue taking science classes. All four girls admit to not liking science because they do not enjoy science. However both of the high-ability girls had career aspirations (i.e. physician, forensic scientist) that require they continue to take sciences in high school. For example, Catherine, a high-ability student said:

> "I am not a big fan of science. I have to like science because I want to become a doctor, so I have to like it."

There appears to be a conflict in the girls' idea of what it takes to prepare for the science career they are wishing to enter. This may be due to a lack of accurate career information and college entrance requirements for various STEM field preparation programs.

"E", a low-ability student felt that studying science involves an element of risk. She commented:

> "Maybe they [girls] don't have an open mind, like the guys. They don't like to experience stuff. [I] think that's true of [me]. [I] play it safe."

Creating experiential learning environments which explore a variety of science careers through group projects, guest speakers, mentorships, and field trips would bring the possibility of have a science profession alive for students, and expand perceived career opportunities for especially Hispanic girls.

Summary of Findings

Students come to the classroom with preconceptions about how the world works. Past and present experiences define what perceptions students will formulate regarding their capability to do difficult science work successfully. Classroom environments are especially important in mediating the formation of a student's science self-efficacy.

Research Question #1

What is the difference in science self-efficacy perceptions between tenth grade Hispanic females and other tenth grade female subgroups, based on by race/ethnicity, as measured by the Smist (1993) Science Self-Efficacy Questionnaire (SSEQ)?

The results of the factor analysis performed by the SSPS program showed that the extracted factors of Academic Engagement, Laboratory, and Biology appeared to be good indicators of the science self-efficacy constructs. Of the three factors, Academic Engagement had the highest mean and greatest number of interacting items from the SSEQ questionnaire. Academic Engagement also had the highest reliability.

An ANOVA simultaneously computed significant differences between all female racial/ethnic subgroups. An unexpected pattern of science self-efficacy perception was observed which did not follow past research literature describing trends in achievement data. In this study, White females scored lower than Hispanic females in two of the three extracted factors (Academic Engagement and Laboratory). This trend was not evident when either gender or race/ethnicity was computed alone. The study would have to be replicated to determine if this outcome was unique to this study. However, the finding that White females had the lowest science self-efficacy perceptions in two of the three extracted factors could be an example of data that may have been overlooked when the data failed to be disaggregated beyond general analysis as is predominantly done in the research literature.

Hispanic females consistently scored among the lowest of all racial/ethnic subgroups on all three science self-efficacy extracted factors. The trend mirrors past data in the research literature on science achievement.

Research Question #2

Is there a significant correlation of science achievement as measured by (a) prior year reading achievement as measured by the SAT 9 standardized test; (b) prior year mathematics achievement as measured by the SAT 9 standardized test, and (c) prior year final science grades on the science self-efficacy in Hispanic females as measured by the Smist (1993) SSEQ?

Results demonstrated that no statistically significant correlation existed between past achievement in reading, mathematics, or science as defined in this study and measured against science self-efficacy using the (SSEQ) with this diverse population of students. It is unclear whether this finding is a result of the diverse population studied or due to using subjective science grades as a component of the science achievement measure. The student’s ninth grade science grade was incorporated into the calculation rather than purely standardized measures of science achievement, as in the research literature, because no standardized science achievement measure was available for correlation. Either of these causations may have affected this outcome.

Research Question #3

What factors may influence science self-efficacy in tenth grade Hispanic female science student as measured through phenomenological study?

Two general themes were found in the interview discussions with two high-ability and two low-ability Hispanic females. The first theme, Classroom Variables, are those variables which educators can manipulate directly to influence the learning environment and the students therein. The subthemes in this category revolve around a number of variables in the learning environment that influence decision-making. Curriculum that is challenging to comprehend is mitigated by perceptions of mathematics ability that are very often present in the science curriculum. Comments regarding the presence or absence of academically engaging activities appeared to dominate the interview discussions. Instructional planning and delivery is under the discretion of the science classroom teacher. The presence of hands-on activities and project-based learning experiences which utilize the social interaction model is more student-centered and humanistic, taking into consideration the ability, past experiences, student interests, and skill set of the students. Making content comprehensible through direct instruction of learning strategies, mathematics skills, and study skills fall within the domain and discretion of the teacher as well. Table 24 illustrates a matrix demonstrating a synthesis of suggestions made by the four interview participants. Responses confirm the idea that the most important single variable in positive student learning and achievement is the classroom teacher. All four girls wanted their science teachers to be less boring and serious, plan more challenging activities, and allow students to collaborate more often through experimentation, group investigations, and project-based experiences. Students need their teachers to teach them how to learn with specific strategies to help increase their understanding. They want their teachers to engage in more interactive questioning and classroom discussions to elicit their prior knowledge and past experiences and to have opportunities to listen and learn from their peers. Teachers who are more student-centered and humanistic will help students build confidence in their science knowledge, skills, and abilities.

Outside School Influences are those factors which can inform Hispanic females but are not under the direct control of educators. Family members have the most direct influence on student perception of self-efficacy in a variety of areas. In Hispanic families, culture and values play a big role. Women are seen as the nurturers and are expected to stay within the home to raise their families. They are not readily seen in contexts outside the home or especially in professional contexts, such as in the STEM professions of chemistry, physics, or engineering. However, if family members are involved in the sciences, the daughters appear to be more encouraged to explore such areas. If influences outside the family could change the thinking paradigm of the parents or family, it is possible to influence the Hispanic females into nontraditional careers. It appears that structured peer support for Hispanic females to study science is negligible or ambivalent. Peer groups that might influence a positive paradigm shift might come from a cohort of students who share like interests in science. Schools could facilitate such a support groups and learning communities.

Lastly, the two girls who decided to their science study despite its difficulty only said they would do so because of their interest in a science related career. Their developed vision of those particular careers helped these girls keep their focus. For more Hispanic females to develop such a vision for the wide array of professions in the sciences, these students must have experiential learning experiences in the scientific community and other career exploration activities that enable Hispanic female science students to see themselves as capable of doing these jobs. Science careers, if they prove interesting, can act as their own motivators.

Limitations of the Study

Findings from this research must be considered in light of the limitations of the study. The research was limited to the simultaneous study race/ethnicity female tenth grade science students at a significant juncture in the science pipeline. Other grade levels, males, and other content domains were not studied. Perceptions of tenth grade students regarding their science capabilities were derived from perceptions of factors within and outside the learning environment. Other structural and cultural factors (i.e. attendance rate, mobility rate, poverty level, parent level of education, etc.) that could affect this relationship were not controlled.

In addition, sample sizes for some of the different racial/ethnic subgroups are small and may have affected analysis. Replication of this study should employ larger numbers of students within individual racial/ethnic subgroups.

Thirdly, use of the prior year science grade as a measure of science achievement should be substituted with a more standardized form of achievement measurement if available. The state science assessment scores were not available at the time the research was implemented. However, if in the future this study were to be replicated, a standardized science achievement measure would be preferable. The lack of a statistically significant correlation of science achievement to science self-efficacy could have been influenced by the use of the subjective measure of science grades.

The information gathered in the interview component presents a fourth limitation of the study. The information provided by the Hispanic female interviewees was filtered through their views and perceptions and potentially subjected to bias as a result of the researcher's presence. Comprehension of the interview questions and articulation ability of the interviewees may have affected constructed meaning as individuals are not equally adept at understanding ideas and communicating thoughts to others. The researcher had to implement more probing discussion to innervate the dialogue, most especially with the lower-ability participants. If the study were to be replicated, it is suggested that anticipated probing questions be scripted in an effort to further limit researcher bias during the dialogue.

Lastly, a final limitation of the study was that researcher bias may have entered into the phenomenological interpretation and construction of meaning within the qualitative interview component. Even though two additional coders were employed to establish inter-coder reliability, the information yielded from the emergent themes could potentially be subjected to a wide variety of interpretations by both raters and readers.

Implications for Future Research

Future research is required in documenting the effect of science self-efficacy on science achievement. The research has implications for educators and researchers interested in achieving gender and racial/ethnic equity in science. Science self-efficacy could be measured using an experimental design comparing varying instructional variables. Science self-efficacy could also be measured against student's attitudes and motivation, economic status, urbanicity, or comparing academic programming. The relationship between science self-efficacy and reading or mathematics achievement could be studied in separate analyses, isolated from the science achievement matrix scores used. When Hispanic females relate a lack of talent or interest in the sciences, research should continue to find out what influences these beliefs. Since lack of interactive learning environments and dynamic instruction and hands-on experiences incorporating project-based learning activities were repeatedly mentioned during the four interviews, continued research which investigates how to improve science teaching might prove insightful.

The science teacher may be the most important variable in the learning environment. More research on optimal and effective teacher dispositions particular to science learning environments would inform teacher preparation programs at the college or university level. Future research could incorporate years of science teaching experience as a variable influencing teacher effectiveness in promoting positive science self-efficacy beliefs.

Hispanic females generally lack support systems in promoting high science self-efficacy and motivation to persist in science study. Research which measures the effectiveness of an intervening support program could provide models for other educators to replicate and emulate. Other racial/ethnic minority subgroups could be studied in the same manner.

Even though the pattern of Hispanic female achievement mirrors that of national research data in holding last place in the racial/ethnic and gender rankings, these findings indicate that not much has changed since the study of gender and racial/ethnic equity research began in earnest over twenty years ago. Gender and racial/ethnic differences should continue to be simultaneously studied to avoid oversimplification of conclusions and misinterpretation of findings due to the potential loss of valuable information. Research could perhaps include longitudinal examinations which could detect and explain changes in studying gender and racial/ethnic sub groupings. Such research is rare (Hanson, 1996). Further studies would also provide insights and evidence for the impact of science self-efficacy on science achievement and the ability of traditionally underrepresented racial/ethnic females to persist in their science preparation and training to prevent leaving the pipeline at this crucial juncture.

Conclusions

Hispanic females continue to perform far below their racial/ethnic counterparts. The low perception of their science self-efficacy mirrors trends in their historically poor science achievement. These findings indicate that substantial racial/ethnic and gender differences remain in science education during the high school years. Not much has changed despite research calling attention to this concern over twenty years ago. It could be possible that the structure of the highly inclusive American educational system serves to promote gender and racial/ethnic differentiation by allowing more people to participate. In countries that are more elite and exclusive in delivering educational training, males and females have more equitable participation in STEM preparation and career opportunities (Hanson, et al, 1996). The same finding could be applied to minority participation. Since this falls outside the realm of this study, the question shall be left to educational policymakers. Therefore, the focus will remain on researchers' and educators' need to concentrate on agendas which converge on factors in the learning environment that serve to eliminate the racial/ethnic and gender gaps in the science pipeline.

Upon examination of both the quantitative and qualitative components of this study, one general finding appears to bind this study together. The Hispanic females interviewed placed an extraordinary amount of emphasis on the need for the classroom learning environments to present a variety of interactive activities that engage student interest, increase comprehension, and aid student learning of difficult content. Concurrently, the quantitative analysis yielded similar results. The extracted science self-efficacy factor Academic Engagement had the highest mean for all genders and racial/ethnic subgroups.

Perhaps the dissonance caused by differences between student perception and reality may cause frustration and act as a demotivator in students' determination to continue their science study. If students feel they are capable of engaging in rigorous and interactive science activities to enable their own learning and are not provided the opportunity to do so, may have decided that science is either too boring to interest them or too hard to continue their academic engagement and elect to get out when given the opportunity in their junior year of high school. For Hispanic females and other minorities who might experience this dissonance, they exhibit the beginning of the "leak" when deselecting themselves out of the science pipeline at this important juncture. Continued underrepresentation in STEM field professions will remain as long as negative pedagogical agents in the science learning environment go unaddressed.

Educators at all levels must engage in serious self-reflection over current science teaching practices under their domain and control. What is found in the research literature regarding effective science teaching practices and what is happening in secondary science classrooms are not asynchronous. Focus should center on varying instruction to include dynamic and interactive project-based and inquiry-based learning experiences that address the standards rather than direct instruction of textbook resource materials. Until theory and practice are in close alignment, underrepresentation of Hispanic females and other minority subgroups will continue to bleed themselves away from science preparation and practice.

APPENDIX A: UCF IRB APPROVAL LETTER

University of Central Florida

Office of Research & Commercialization

March 17, 2005

Maria Miller
2812 Trenton Lane
Oviedo, Fl 32765

Dear Ms. Miller

With reference to your protocol #05-2474 entitled, "So what are you going to do with Science? A comparative Study of Two Science Teaching Methodologies on the Self-efficacy of Females to Pursue Careers in the Sciences" I am enclosing for your records the approved, expedited document of the UCFIRB Form you had submitted to our office. **The expiration date for this study will be 3/9/06.** Should there be a need to extend this study, a Continuing Review form must be submitted to the IRB Office for review by the Chairman or full IRB at least one month prior to the expiration date. This is the responsibility of the investigator.

Please be advised that this approval is given for one year. Should there be any addendums or administrative changes to the already approved protocol, they must also be submitted to the Board through use of the Addendum/Modification Request form. Changes should not be initiated until written IRB approval is received. Adverse events should be reported to the IRB as they occur.

Should you have any questions, please do not hesitate to call me at 407-823-2901.

Please accept our best wishes for the success of your endeavors.

Cordially,

Barbara Ward

Barbara Ward, CIM
IRB Coordinator

Copy: IRB file

12443 Research Parkway • Suite 302 • Orlando, FL 32826-3252 • 407-823-3778 • Fax 407-823-3299
An Equal Opportunity and Affirmative Action Institution

APPENDIX B: OCPS APPROVAL LETTER

Submit this form and a copy of your proposal to:
Accountability, Research, and Assessment
P.O. Box 271
Orlando, FL 32802-0271

Orange County Public Schools

RESEARCH REQUEST FORM

Your research proposal should include: Project Title; Purpose and Research Problem; Instruments; Procedures and Proposed Data Analysis

Requester's Name Maria D. Miller, M. Ed. Date 03/04/05

Address: Home 2812 Trenton Lane, Oviedo, FL 32765 Phone 407-971-1233

Business Ventura Elementary 440 Woodgate Blvd. Phone 407-249-6400x2235

Project Director or Advisor Dr. Karen Biraimah, Department Chair, Ed. Studies Phone

Address University of Central Florida, Orlando, FL 407-823-2428

Degree Sought: (check one) ☐ Associate ☒ Doctorate ☐ Bachelor's ☐ None ☐ Master's ☐ Specialist

Project Title "So what are you goingto do with science? A comparative study ofdirect instruction and inquiry-based instruction in science onp the perception of females to do well in science."

ESTIMATED INVOLVEMENT

PERSONNEL/CENTERS	NUMBER	AMOUNT OF TIME (DAYS, HOURS, ETC.)	SPECIFY/DESCRIBE GRADES, SCHOOLS, SPECIAL NEEDS, ETC.
Students	250	15 hrs of classtime each	High school science.
Teachers	250	Initial:3hrs ea.; Subsequent:15 hrs ea.(8 teachers ANY	
Administrators	2-3	1 hr. purely to enlist support.	
Schools/Centers	High schools not yet identified. Initial study will identify		
Others (specify)			

Specify possible benefits to students/school system: To investigate and see data on the effect of different science teaching methods of high school females to enter upper level course in science to prepare for careers in science, engineering and technology, to reduce exclusion in these classes. The knowledge may help create science environements more adaptive to female participation.

ASSURANCE

Using the proposed procedures and instrument, I hereby agree to conduct research in accordance with the policies of the Orange County Public Schools. Deviations from the approved procedures shall be cleared through the Senior Director of Accountability, Research, and Assessment. Reports and materials shall be supplied as specified.

Requester's Signature *Maria D. Miller*

Approval Granted: ☒ Yes ☐ No Date: 3-17-05

Signature of the Senior Director for Accountability, Research, and Assessment *Lee Bolden*

NOTE TO REQUESTER: When seeking approval at the school level, a copy of this form, signed by the Senior Director, Accountability, Research, and Assessment, should be shown to the school principal.

Reference School Board Policy GCS, p. 249

FORM ID #GB0103/23-1/1FY REV 1/04

APPENDIX C: TEACHER INFORMED CONSENT LETTER

University of Central Florida

2812 Trenton Lane
Oviedo, FL 32765
(407) 971-1233- Home
(407) 687-5062- Mobile

Introduction and Informed Consent Letter

Date

Dear ______________________:
Teacher's Name

You have been identified through the OCPS personnel department as having a high school science teaching assignment this year. I am conducting preliminary research on high school science teachers for the purpose of identifying a cadre of teachers for a larger research study scheduled to begin in the Fall of 2005 in conjunction with the University of Central Florida as part of a dissertation by Maria D. Miller from the College of Education, and the Department of Educational Studies.

The purpose of the study will be to compare the two widely studied science instructional methods (direct instruction and inquiry-based instruction) and determine which method, if any, is more effective in assisting female high school students in increasing their self-efficacy toward taking upper level science course work (e.g. chemistry, physics) that could lead to careers in science, engineering and technology which are historically underrepresented by women. Your participation will help science educators more fully understand the variables in classroom environments that influence high school girls to continue to study the sciences.

A cadre of 10 teachers representing each teaching methodology (20 total) is the purpose of my contact with you today. Your participation will help science educators, both locally and nationally, more fully understand the variables in your classroom environment that influence high school girls to continue to study the sciences. Teacher participants, as well as their associated schools, will not be identified by name in any written report, analysis, or publication.

By completing the following survey, providing your name, phone number, work location, and email, you are consenting to become part of this study and may be contacted for follow-up. You may cease to participate in this study at any time by simply contacting me at the above address or phone numbers.

I appreciate the time and effort that you put forward as you complete the enclosed survey.

Sincerely,

Maria D. Miller

Maria D. Miller
University of Central Florida
College of Education

APPROVED BY
University of Central Florida
Institutional Review Board
SFD 10 MARCH 2005
CHAIRMAN

Please return your survey in the enclosed postage-paid envelope within 1 week of receiving it. Thank you very much.

APPENDIX D: TEACHER QUESTIONNAIRE

Thank You!

Thank you for taking the time to complete the questionnaire. Your help in providing this information will assist in the future development of high school science courses that help to prepare young people, for upper level coursework that can lead to careers in science, technology, and engineering.

If there is anything else you would like to say about your experiences in teaching your high school science classes, please feel free to do so in the space below:

To request this questionnaire in an alternate format for the hearing or visually impaired, or in another language, please call 407-687-5062.

Please return your questionnaire to the designated person.

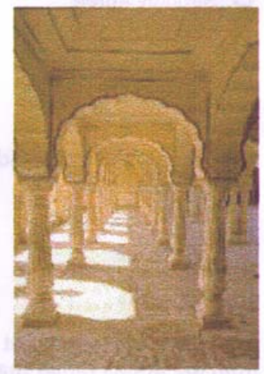
Maria D. Miller
Department of Educational Studies
University of Central Florida
2812 Trenton Lane
Oviedo, FL 32765

092

What will you do with Science beyond High School?

Survey for Teachers of High School Science Students

University of Central Florida
Department of Educational Studies



Teacher Name:

Please fill in the following information:

High School Name: ______________

Gender: ☐ Female ☐ Male

Grade(s) currently teaching:
Grade 9 ☐ Grade 11 ☐
Grade 10 ☐ Grade 12 ☐

Please read each statement and indicate the extent to which you agree or disagree, from "Strongly Agree" to "Strongly Disagree".

PLEASE ANSWER BY MARKING THE CORRECT BOX WITH AN X.

↓ **START HERE**

1. **The teacher should talk with each student.**
   - ☐ Strongly Agree
   - ☐ Agree
   - ☐ Disagree
   - ☐ Strongly Disagree
   - ☐ N/A

2. **Students should give their opinion during discussion.**
   - ☐ Strongly Agree
   - ☐ Agree
   - ☐ Disagree
   - ☐ Strongly Disagree
   - ☐ N/A

3. **The teacher should decide where students sit.**
   - ☐ Strongly Agree
   - ☐ Agree
   - ☐ Disagree
   - ☐ Strongly Disagree
   - ☐ N/A

4. **Students should find out answers to questions from from the books rather than from investigation.**
   - ☐ Strongly Agree
   - ☐ Agree
   - ☐ Disagree
   - ☐ Strongly Disagree
   - ☐ N/A

Please go to next page----->

Please answer by marking the correct box with an **X.**

↓ *CONTINUE HERE*

5. **Different students should do different work.**
   - ☐ Strongly Agree
   - ☐ Agree
   - ☐ Disagree
   - ☐ Strongly Disagree
   - ☐ N/A

6. **The teacher should take a personal interest in each student.**
   - ☐ Strongly Agree
   - ☐ Agree
   - ☐ Disagree
   - ☐ Strongly Disagree
   - ☐ N/A

7. **The teacher should lecture without answering or asking questions.**
   - ☐ Strongly Agree
   - ☐ Agree
   - ☐ Disagree
   - ☐ Strongly Disagree
   - ☐ N/A

8. **Students should choose their partners for group work.**
   - ☐ Strongly Agree
   - ☐ Agree
   - ☐ Disagree
   - ☐ Strongly Disagree
   - ☐ N/A

Please go to next page----->

*Please answer by marking the correct box with an **X**.*

➔ *CONTINUE HERE*

9. Students should carry out investigations to test ideas.
- ❑ Strongly Agree
- ❑ Agree
- ❑ Disagree
- ❑ Strongly Disagree
- ❑ N/A

10. All students in the class should do the same work at the same time.
- ❑ Strongly Agree
- ❑ Agree
- ❑ Disagree
- ❑ Strongly Disagree
- ❑ N/A

11. The teacher should be unfriendly to students.
- ❑ Strongly Agree
- ❑ Agree
- ❑ Disagree
- ❑ Strongly Disagree
- ❑ N/A

12. Students' ideas and suggestions should be used during classroom discussion.
- ❑ Strongly Agree
- ❑ Agree
- ❑ Disagree
- ❑ Strongly Disagree
- ❑ N/A

Please go to next page----->

*Please answer by marking the correct box with an **X**.*

➔ *CONTINUE HERE*

13. Students should be told how to behave in the classroom.
- ❑ Strongly Agree
- ❑ Agree
- ❑ Disagree
- ❑ Strongly Disagree
- ❑ N/A

14. Students should carry out investigations to answer questions coming from class discussion.
- ❑ Strongly Agree
- ❑ Agree
- ❑ Disagree
- ❑ Strongly Disagree
- ❑ N/A

15. Different students should use different books, equipment, and materials.
- ❑ Strongly Agree
- ❑ Agree
- ❑ Disagree
- ❑ Strongly Disagree
- ❑ N/A

16. The teacher should help each student who is having trouble with the work.
- ❑ Strongly Agree
- ❑ Agree
- ❑ Disagree
- ❑ Strongly Disagree
- ❑ N/A

Please go to next page----->

5

Please answer by marking the correct box with an **X**.

➔ CONTINUE HERE

17. Students should ask the teacher questions.
- ☐ Strongly Agree
- ☐ Agree
- ☐ Disagree
- ☐ Strongly Disagree
- ☐ N/A

18. The teacher should which students should work together.
- ☐ Strongly Agree
- ☐ Agree
- ☐ Disagree
- ☐ Strongly Disagree
- ☐ N/A

19. Students should explain the meanings of statements, diagrams, and graphs.
- ☐ Strongly Agree
- ☐ Agree
- ☐ Disagree
- ☐ Strongly Disagree
- ☐ N/A

20. Students who work faster than others should move to the next topic.
- ☐ Strongly Agree
- ☐ Agree
- ☐ Disagree
- ☐ Strongly Disagree
- ☐ N/A

Please go to next page----->

6

Please answer by marking the correct box with an **X**.

➔ CONTINUE HERE

21. The teacher should consider students' feelings.
- ☐ Strongly Agree
- ☐ Agree
- ☐ Disagree
- ☐ Strongly Disagree
- ☐ N/A

22. There should be classroom discussion.
- ☐ Strongly Agree
- ☐ Agree
- ☐ Disagree
- ☐ Strongly Disagree
- ☐ N/A

23. The teacher should decide how much movement and talk there should be in the classroom.
- ☐ Strongly Agree
- ☐ Agree
- ☐ Disagree
- ☐ Strongly Disagree
- ☐ N/A

24. Students should carry out investigations to Answer questions which puzzle them.
- ☐ Strongly Agree
- ☐ Agree
- ☐ Disagree
- ☐ Strongly Disagree
- ☐ N/A

Please go to next page----->

➜ *CONTINUE HERE*

25. The same teaching aid (e.g. white board, overhead) should be used for all the students in the classroom.
- ❑ Strongly Agree
- ❑ Agree
- ❑ Disagree
- ❑ Strongly Disagree
- ❑ N/A

25. I prefer to teach by mostly lecture and notes.
- ❑ Strongly Agree
- ❑ Agree
- ❑ Disagree
- ❑ Strongly Disagree
- ❑ N/A

26. I prefer to teach by mostly learning group activities.
- ❑ Strongly Agree
- ❑ Agree
- ❑ Disagree
- ❑ Strongly Disagree
- ❑ N/A

27. I utilize technology to help teach in the classroom.
- ❑ Strongly Agree
- ❑ Agree
- ❑ Disagree
- ❑ Strongly Disagree
- ❑ N/A

28. The number of times I have participated in science fair projects in my classroom in the last five years are:
- ❑ Less than 2
- ❑ 3
- ❑ 4 or more

Please go to next page----->

Please answer by marking the correct box with an **X**.

➜ *CONTINUE HERE*

29. How many science-related field trips did you participate in with your class during the last five years?
- ❑ Less than 2
- ❑ 3
- ❑ 4 or more

30. How often do you have labs in your class?
- ❑ Once per quarter
- ❑ Once a month
- ❑ Once every two weeks
- ❑ Once a week
- ❑ Daily
- ❑ Rarely, if ever, had labs

31. Describe your favorite science activity that you have taught and how you implemented it.

____

____

32. Name one science activity you would like or Have tried with your students.

____

Why?__________________________

Barrier?________________________

Please go to next page----->

Please answer by marking the correct box with an **X**.

↓ *CONTINUE HERE*

33. How long have you been teaching science?
- ❑ 3 or less years
- ❑ 4-5 years
- ❑ 6-10 years
- ❑ 11-15 years
- ❑ 16-20 years
- ❑ 21-25 years
- ❑ 25+ years

34. What is your racial/ ethnic background?
- ❑ Asian/Pacific Islander
- ❑ Hispanic
- ❑ Black Not Hispanic
- ❑ White Not Hispanic
- ❑ Native American
- ❑ Other________________

35. What is the highest level of schooling you have attained? *(Name of degree and area)*
- ❑ Bachelors:________________
- ❑ Masters:________________
- ❑ Doctorate:________________

36. Courses I am presently teaching are:
- ❑ Earth and/or Space Science
- ❑ Biology
- ❑ AP Biology
- ❑ Anatomy & Physiology
- ❑ Chemistry
- ❑ AP Chemistry
- ❑ Physics
- ❑ AP Physics
- ❑ Not listed:________________
- ❑ Not listed:________________

Please go to next page----->

Please answer by marking the correct box with an **X**.

↓ *CONTINUE HERE*

37. In general do you feel you are encouraging to females in the classroom:
- ❑ Yes
- ❑ No

Why?________________

38. In your most upper level science class that you teach, the gender makeup of the class is:

________% Male ________%Female

40. I prefer to teach using the following method:
- ❑ Direct instruction
- ❑ Inquiry
- ❑ Other:________________

43. As far as I know, I will be at the same high school next year:
- ❑ Yes
- ❑ No
- ❑ Not sure
- ❑ Transferring to:________________

44. Are you interested in becoming a participant in the research study? *(All names are kept anonymous, a general summary of the report can be provided to you upon request).*
- ❑ Yes
- ❑ No

If yes, how can I contact you?

Email:________________

Prefer Home phone:________________

Prefer Business phone:____________Ext.____

Please go to next page----->

APPENDIX E: TEACHER FOLLOW UP CONTACT LETTER

April 21, 2005

Last week a questionnaire seeking your opinions about your high school science classes was mailed to you. Your name was obtained from a list of all Orange County high school science teachers. All information obtained on from the questionnaire is held in strict confidentiality.

For the many of you who have already completed and returned the questionnaire, please accept a sincere thank you. If you have not returned the questionnaire, please do so today. We are especially grateful for your help because it is only by asking teachers like you to share your experiences that we can begin to understand why students decide to take upper level science classes and pursue a possible career in the sciences, the topic for the larger study in the fall of 2005. I further thank those of you who have already consented to be in the larger study. You will be contacted personally in the near future.

If you did not receive a questionnaire, or if it was misplaced, please call 407-249-6400 Ext. 2235 (feel free to leave a message) and another questionnaire will be sent to you today.

Sincerely,

Maria D. Miller
Department of Educational Studies
University of Central Florida

APPENDIX F: TEACHER FOLLOW UP REMINDER LETTER

University of Central Florida

May 6, 2005

Dear ,

During the last month I have sent you two mailings about an important research study I am conducting as my dissertation at the University of Central Florida.

The purpose of the study is to help education agencies and schools understand the reasons high school students take upper level science classes. Their experiences might help encourage students to pursue careers in science, engineering, and technology. I first need to hear from teachers, such as yourself, and your input on what and how you teach and whether you would be interested in becoming part of the fall study.

I am sending this letter because of my concern that teachers who have not yet responded may have had different experiences than those who have already responded. Hearing from everyone in the small district-wide high school sample helps assure that the survey results are as accurate as possible.

I also want to assure you that your response to this study is voluntary. You can still fill out the survey and indicate on the last question you are not interested in participating. If you are not a high school science teacher who has taught or is not currently teaching a science class, and you feel that I have made a mistake including you in this study, please let me know by returning the blank questionnaire with a note indicating so. This would be very helpful to my research.

Finally, I appreciate your willingness to consider my request. Thank you very much.

Sincerely,

Maria Miller

Maria D. Miller
Department of Educational Studies
University of Central Florida

APPENDIX G: UCF IRB ADDENDUM CONSENT LETTER

Revised 02/05

THE UNIVERSITY OF CENTRAL FLORIDA   05-2618

INSTITUTIONAL REVIEW BOARD (IRB)

IRB Addendum/Modification Request

INSTRUCTIONS: Please complete the upper portion of this form and attach all revised/new consent forms, altered data collection instruments, and/or any other documents that have been updated. The proposed changes on the revised documents must be clearly indicated by using bold print, highlighting, or any other method of visible indication. The Addendum/Modification must be sent the IRB Office: ATTN: IRB Coordinator, 12443 Research Parkway, Suite 301, Orlando, FL 32826, Email: IRB@mail.ucf.edu, Phone: 407-823-2901, Fax: 407-823-3299.

- **DATE OF ADDENDUM:** May 5, 2005 to IRB# 05-2474
- **PROJECT TITLE:**

The title must be changed to reflect an inability in the initial survey to identify two distinct teaching methodologies. New title would be: "So what are you going to do with science? The science self-efficacy of Hispanic female high school students."

- **PRINCIPAL INVESTIGATOR:** Maria D. Miller
- **MAILING ADDRESS:** 2812 Trenton Lane, Oviedo, FL 32765
- **PHONE NUMBER & EMAIL ADDRESS:** (407) 971-1233 Email: mariadmiller@yahoo.com
- **REASON FOR ADDENDUM/MODIFICATION:**
- **DESCRIPTION OF WHAT YOU WANT TO ADD OR MODIFY:**

1) On item #6 New wording would read: Hispanic females are the least represented group in Science, computer technology, and engineering fields. The purpose of the investigation is to determine how Hispanic females view their science abilities. Science self-efficacy is determined to be a key factor in academic persistence, science achievement, and career determination. *(See page 2)*

SECTION BELOW - FOR UCF OOR/IRB USE ONLY

X Approved ___ Disapproved [signature] IRB Chair Signature 10 May 2005 Date

___ Full Board X Chair Expedited

1

2) I would like to add that two of the classrooms identified from the first ten teacher respondents willing to become a participant in this study be specifically used to conduct a pilot study of the student survey and science benchmark test administration. From the two pilot classrooms, one Hispanic female will be randomly chosen with whom to conduct a brief pilot structured interview.

3) Modification to incorporate in the IRB the high school science student phase of the dissertation study. This would include administration of the student survey and administration of the Orange County Science benchmark test. This group of 9th and 10th grade students would be members of 8 classrooms chosen from the cadre of the first ten teacher volunteer participants. Total *N* would be 200 students. It is estimated that approximately 40 Hispanic female science students will participate in the study. Everything remains minimal risk and confidentiality maintained.

(See separately attached Parent Informed Consent Letter, Child Assent Script, and Student Survey).

**Note: Research approval for the entire study has been attained from the Orange County Public Schools, where the research will be conducted.

This addendum form does NOT extend the IRB approval period or replace the Continuing Review form for renewal of the study.

SECTION BELOW - FOR UCF OOR/IRB USE ONLY

X Approved ___ Disapproved [signature] IRB Chair Signature 10 May 2005 Date

___ Full Board _X_ Chair Expedited

2

APPENDIX H: PARENT INFORMED CONSENT LETTER

University of Central Florida

Parent Informed Consent Letter

May, 2005

Dear Parent/Guardian of ________________________________:
Student's Name

I am a doctoral student at the University of Central Florida under the supervision of faculty member, Dr. Karen Biraimah, conducting research on students' perception of their science abilities. The purpose of this study is to see if student science self-efficacy can be correlated to their science achievement. Research indicates that students who persist in their academic study will increase their self-efficacy, set more goals, and ultimately learn more from their science classes. Students who learn and do well on science achievement tests tend to enroll in more higher level science coursework to prepare themselves for careers in the sciences, technology, and engineering. Results from this study may help science educators better understand how to influence science self-efficacy and allow them to design instructional practices accordingly in an effort to draw more students to science fields. These results may not directly help your child today, but may benefit future science students.

All of the students in your child's science class will be administered a classroom environment and science self-efficacy questionnaire as well as an Orange County Public Schools (OCPS) science benchmark test. Students may volunteer to participate in a short structured interview. I will administer the questionnaire which will take an estimated 35-40 minutes to complete. The classroom teacher will administer the OCPS science test.

The study will take place in two phases: The pilot study will be conducted during the month of May and the comprehensive study will take place during September and October. Although the students will be asked to write their names on the questionnaires for matching purposes, teacher and student participants, as well as their associated schools, will not be identified by name in any written report, analysis, or publication and kept confidential to the extent provided by law. Names are replaced with code numbers for questionnaire and science test data. Fictitious names will be assigned to student volunteers who participate in the short structured interviews. Participation or nonparticipation in this study will not affect your child's grades or placement in any programs.

You and your child have the right to withdraw consent for your child's participation at any time without consequence. There are no known risks or immediate benefits to the participants. No compensation is offered for participation. Group results of this study will be available in the Spring of 2006 upon request. If you have any questions abut this research project, please contact me at (407) 687-5062. Questions or concerns about research participant's rights may be directed to the UCFIRB office, University of Central Florida Office of Research, Orlando Tech Center, 12443 Research Parkway, Suite 207, Orlando, FL 32826. The hours of operation are 8:00 am until 5:00 pm, Monday through Friday except on University of Central Florida official holidays. The phone number is (407) 823-2901.

Sincerely,

Maria D. Miller

_____________I have read the procedure described above.

_____________I voluntarily give my consent for my child, _________________________, to participate in Maria Miller's study of students' perception of their science abilities.

________________________________ ________________________
Parent/Guardian Signature Date

________________________________ ________________________
Parent/Guardian Signature Date

APPROVED BY
University of Central Florida
Institutional Review Board
SFD 10 May 2005
CHAIRMAN

APPENDIX I: PARENT INFORMED CONSENT LETTER (SPANISH)

May, 2005 Carta de Informe de Consentimiento de Padres

Estimados padres/Guardianes de___________________________________
Nombre del estudiante

Soy una estudiante de doctorado de la Universidad Central de Florida bajo la supervisión del Dr. Karen Biraimah, miembro de facultad, llevando a cabo una investigación sobre percepción de los estudiantes en sus habilidades en ciencia. El propósito de este estudio es considerar si la efectividad científica en el estudiante está correlacionada a su logro académico en ciencia. Estudios indican que los estudiantes que persisten en sus estudios académicos aumentarán su efectividad, fijan mayores metas y aprenden, en última instancia, más en sus clases de ciencia. Los estudiantes que aprenden y hacen buen trabajo en sus pruebas de ciencia, tienen la tendencia a matricularse en niveles avanzados de ciencia para auto prepararse para las profesiones de ciencias, tecnología, y la ingeniería. Los resultados de este estudio pueden ayudar a educadores de la ciencia a entender mejor cómo influir en la efectividad científica y permitirles que diseñen prácticas educacionales en un esfuerzo de atraer a más estudiantes al campo de la ciencia. Estos resultados pueden no ayudar directamente a su niño hoy, pero pueden beneficiar a futuros estudiantes de ciencia.

A todos los estudiantes en la clase de ciencia de su niño, se les administrará un cuestionario de ambiente del salón de clases y efectividad, al igual que una prueba de aprovechamiento en ciencia de las Escuelas Públicas del Condado de Orange. Los estudiantes pueden ofrecerse, voluntariamente, a participar en una entrevista corta estructurada. Yo administraré el cuestionario, el mismo durará aproximadamente 35-40 minutos para ser completado. El maestro(a) del salón administrará la prueba de ciencia de OCPS.

El estudio estará dividido en dos fases. El estudio piloto será conducido durante el mes de mayo y el estudio comprensivo se llevará a cabo durante septiembre y octubre. Aun cuando se le pedirá a los estudiante que escriban su nombre para efectos de identificación, maestros y estudiantes participantes, al igual que la escuela asociada, no identificaran por nombre ningún informe escrito, análisis, o publicación y mantendrán confidencialidad según determina la ley. Los nombres en los cuestionarios y pruebas de ciencia serán reemplazados por códigos numéricos. Se le asignarán nombres ficticios para aquellos voluntarios a participar en la entrevista corta estructurada. La participación o no participación en este estudio, en nada afectará a su hijo en sus notas o la ubicación a algún programa.

Usted y su hijo tienen el derecho a retirar el consentimiento de participación a su hijo en cualquier momento sin ninguna consecuencia. No existe ningún conocimiento de riesgo o gratificación inmediata por participar. Ninguna compensación es ofrecida por participar. Los datos de grupo sobre el estudio estarán disponibles en la primavera del 2006, a petición. Si tiene alguna pregunta con relación a este proyecto de estudio, favor de comunicarse conmigo al (407) 687-5062. Preguntas o preocupaciones sobre los derechos del participante deberán ser dirigidas a la oficina de UCFIRB, University of Central Florida Office of Research , Orlando Tech Center, 12443 Research Parkway, Suite 207, Orlando, FL 32826. Las horas de servicio son de 8:00 AM hasta las 5:00 PM, lunes a viernes, con excepción de los días feriados de la Universidad Central de la Florida. El número de teléfono es (407) 823-2901.

Sinceramente,

Maria D. Miller

__________Yo he leído los procedimientos antes descritos.

__________Yo voluntariamente doy mi consentimiento a mi hijo____________________, para participar en el estudio sobre la percepción de los estudiantes sobre sus habilidades en ciencia.

________________________________ ________________
Firma de padres/guardianes Fecha

________________________________ ________________
Firma de padres/guardianes Fecha

APPENDIX J: CHILD ASSENT SCRIPT (ENGLISH AND SPANISH)

University of Central Florida

Child Assent Script for Student Survey

For High School Students:

My name is Mrs. Miller and I am a doctoral student at the University of Central Florida. I would like to ask you to complete a questionnaire for me on science classroom learning environments and your perceptions about your science abilities. The questionnaire will take about 35 minutes to complete. Only my faculty advisor and I will see the results of any particular responses you might give. Even though you will be asked to write your name on the questionnaire, your actual name will never be used. In fact, questionnaires are given a code number so that student, teacher and school names remain confidential. If you choose to participate, you may withdraw from participation at any time, and you will not have to answer any questions you do not want to answer. Only group data will be shared with your teacher or your parents if they request it. There are no risks and no compensation for participation. Although there is no direct benefit to you as a participant, I hope this research will help future high school science students just like you. Are you interested in participating?

(You will note at the end of the student questionnaire there is a question asking if you are interested in participating in a short 15-20 minute interview. If you are willing, be sure to indicate this on the questionnaire and fill out the requested information so I can arrange the interview).

APPROVED BY
University of Central Florida
Institutional Review Board
SFD 10 May 2005
CHAIRMAN

University of Central Florida

Consentimiento escrito para encuesta de estudiante

Para estudiantes de Escuela Superior:

Mi nombre es la Sra. Miller y soy estudiante a nivel doctoral de la Universidad Central de la Florida. Quisiera pedirle que completen un cuestionario sobre ambiente de aprendizaje en el salón de clases de ciencia y su percepción sobre la habilidad en ciencia. El cuestionario le tomará aproximadamente 35 minutos para ser completado. Sólo mi consejero y yo veremos los resultados de cualquier respuesta en particular que usted pueda ofrecer. Aun cuando se le pide que escriba su nombre en el cuestionario, su nombre actual nunca será usado. En efecto, los cuestionarios tendrán un código para proteger la confidencialidad de los nombres de estudiantes, maestros y escuelas. Si usted decide participar, usted puede retirarse de la participación en cualquier momento y usted no tendrá que contestar ninguna pregunta que usted no desee. Solamente los datos del grupo serán compartidos con su maestro(a) o sus padres si los solicitan. No existe ningún riesgo o compensación por participar. Incluso no existe ningún beneficio directo para usted por participar. Espero que esta investigación ayude a futuros estudiantes de ciencia de escuela superior como ustedes. ¿Está usted interesado en participar?

(Usted notará al final del cuestionario de estudiante una pregunta pidiéndole si esta interesado en participar en una entrevista corta de 15-20 minutos. Si usted lo desea, indícamelo en el cuestionario y complete la información requerida para poder hacer los arreglos para la entrevista).

APPENDIX K: STUDENT QUESTIONNAIRE BLUEPRINT

STUDENT QUESTIONNAIRE BLUEPRINT

Study of Self-efficacy of Hispanic female high school science students

Content Category	Number of Items	Item #
Classroom Environment (ICEQ) (Rentoul & Fraser, 1979)	33	1-31, 37, 38
NELS:88 (NCES, 1989)	3	35, 36, 88
Science Self-efficacy Questionnaire (SSEQ) (Smist, 1993)	27	39-65
Science Attributions	16	66-81
Influence	2	82,83
Mathematics Enrollment	1	34
General	8	32-33, 84-87,89-90
Rationale	*Total items*	*90*

For the dissertation study:

1) The most important area is in the area of **Science Self-efficacy** (27 items). Self-efficacy is a determinant in the rigor of goal setting and attainment (Bandura, 1977, 1986, 1993, 1994, 1997; Bandura, Barbaranelli, Caprara, & Pastorelli, 1996). Science self-efficacy may be a major predictor of science achievement as well as enrollment in higher level science coursework in preparation for career majors in the sciences.

<u>Not part of the dissertation study but may be used for future discussion and/or research:</u>

2) **Science Attributions** (Weiner, 1985) (16 items) measures the attributions students give to their abilities and accomplishments. Science attributions may have a relationship to science self-efficacy as well as also being a predictor of science achievement.
3) **Influence** (2 items) as an influencing factor outside the classroom. Relationship of culture to self-efficacy and indirectly a predictor to student achievement.
4) **Learning Environment** (ICEQ) (33 items). The purpose of the learning environment items is to determine variables which may affect a particular response to

determine gender and ethnic differences for possible secondary analysis. The questions match those included in the teacher questionnaire to determine volunteers for the study.

5) **NELS: 88** data (3 items) to yield secondary analysis and attempt to make correlations on the study group to past student data for possible discussion.
6) **General Attitude** questions (8 items) seek to find a relationship from the data given in the other item categories, including a self-score on science learning interest, values, mobility, ethnicity, country of origin, and home language.
7) The **Mathematics Enrollment** item (1 item) seeks a relationship between level of coursework achieved in mathematics and science self-efficacy and achievement.

Data collected directly from the school district:

- Age
- Socioeconomic status (free or reduced lunch)
- LEP status
- Reading (FCAT-NRT) prior year national percentile score
- Mathematics (FCAT-NRT) prior year national percentile score
- Prior year final Science grade

APPENDIX L: STUDENT QUESTIONNAIRE

Thank You!

Thank you for taking the time to complete the questionnaire. Your help in providing this information will assist in the future development of high school science courses that help to prepare young people, such as yourself, for upper level coursework that can lead to careers in science, technology, and engineering.

If there is anything else you would like to say about your experiences in your high school science classes, please feel free to do so in the space below:

To request this questionnaire in an alternate format for the hearing or visually impaired, or in another language, please call 407-687-5062.

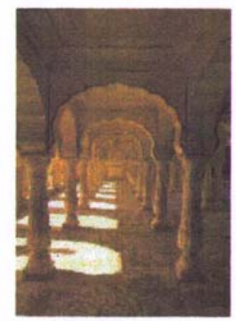
Please return your questionnaire to the designated person.

Maria D. Miller
Department of Educational Studies
University of Central Florida
2812 Trenton Lane
Oviedo, FL 32765

What will you do with Science beyond High School?

Survey for High School Science Students

University of Central Florida
Department of Educational Studies



Student : ____________________

Teacher: ____________________

Please fill in the following information:

High School Name: ____________________

Gender: ❑ Female ❑Male

Grade your are in:
Grade 9 ❑ Grade 11 ❑
Grade 10 ❑ Grade 12 ❑

Please read each statement and indicate the extent to which you agree or disagree, from "Strongly Agree" to "Strongly Disagree".

PLEASE ANSWER BY MARKING THE CORRECT BOX WITH AN X.

↓ START HERE

Please answer by marking the correct box with an **X**.

1. **The teacher should talk with each student.**
   - ☐ Strongly Agree
   - ☐ Agree
   - ☐ Disagree
   - ☐ Strongly Disagree
   - ☐ N/A

2. **Students should give their opinion during discussion.**
   - ☐ Strongly Agree
   - ☐ Agree
   - ☐ Disagree
   - ☐ Strongly Disagree
   - ☐ N/A

3. **The teacher should decide where students sit.**
   - ☐ Strongly Agree
   - ☐ Agree
   - ☐ Disagree
   - ☐ Strongly Disagree
   - ☐ N/A

4. **Students should find out answers to questions from from the books rather than from investigation.**
   - ☐ Strongly Agree
   - ☐ Agree
   - ☐ Disagree
   - ☐ Strongly Disagree
   - ☐ N/A

Please go to next page----->

Please answer by marking the correct box with an **X**.

↓ CONTINUE HERE

5. **Different students should do different work.**
   - ☐ Strongly Agree
   - ☐ Agree
   - ☐ Disagree
   - ☐ Strongly Disagree
   - ☐ N/A

6. **The teacher should take a personal interest in each student.**
   - ☐ Strongly Agree
   - ☐ Agree
   - ☐ Disagree
   - ☐ Strongly Disagree
   - ☐ N/A

7. **The teacher should lecture without answering or asking questions.**
   - ☐ Strongly Agree
   - ☐ Agree
   - ☐ Disagree
   - ☐ Strongly Disagree
   - ☐ N/A

8. **Students should choose their partners for group work.**
   - ☐ Strongly Agree
   - ☐ Agree
   - ☐ Disagree
   - ☐ Strongly Disagree
   - ☐ N/A

Please go to next page----->

3

Please answer by marking the correct box with an **X**.

➜ ***CONTINUE HERE***

9. Students should carry out investigations to test ideas.

- ❑ Strongly Agree
- ❑ Agree
- ❑ Disagree
- ❑ Strongly Disagree
- ❑ N/A

10. All students in the class should do the same work at the same time.

- ❑ Strongly Agree
- ❑ Agree
- ❑ Disagree
- ❑ Strongly Disagree
- ❑ N/A

11. The teacher should be unfriendly to students.

- ❑ Strongly Agree
- ❑ Agree
- ❑ Disagree
- ❑ Strongly Disagree
- ❑ N/A

12. Students' ideas and suggestions should be used during classroom discussion.

- ❑ Strongly Agree
- ❑ Agree
- ❑ Disagree
- ❑ Strongly Disagree
- ❑ N/A

Please go to next page----->

4

Please answer by marking the correct box with an **X**.

➜ ***CONTINUE HERE***

13. Students should be told how to behave in the classroom.

- ❑ Strongly Agree
- ❑ Agree
- ❑ Disagree
- ❑ Strongly Disagree
- ❑ N/A

14. Students should carry out investigations to answer questions coming from class discussion.

- ❑ Strongly Agree
- ❑ Agree
- ❑ Disagree
- ❑ Strongly Disagree
- ❑ N/A

15. Different students should use different books, equipment, and materials.

- ❑ Strongly Agree
- ❑ Agree
- ❑ Disagree
- ❑ Strongly Disagree
- ❑ N/A

16. The teacher should help each student who is having trouble with the work.

- ❑ Strongly Agree
- ❑ Agree
- ❑ Disagree
- ❑ Strongly Disagree
- ❑ N/A

Please go to next page----->

Please answer by marking the correct box with an **X**.

➜ *CONTINUE HERE*

17. Students should ask the teacher questions.

- ❑ Strongly Agree
- ❑ Agree
- ❑ Disagree
- ❑ Strongly Disagree
- ❑ N/A

18. The teacher should decide which students should work together.

- ❑ Strongly Agree
- ❑ Agree
- ❑ Disagree
- ❑ Strongly Disagree
- ❑ N/A

19. Students should explain the meanings of statements, diagrams, and graphs.

- ❑ Strongly Agree
- ❑ Agree
- ❑ Disagree
- ❑ Strongly Disagree
- ❑ N/A

20. Students who work faster than others should move to the next topic.

- ❑ Strongly Agree
- ❑ Agree
- ❑ Disagree
- ❑ Strongly Disagree
- ❑ N/A

Please go to next page----->

Please answer by marking the correct box with an **X**.

➜ *CONTINUE HERE*

21. The teacher should consider students' feelings.

- ❑ Strongly Agree
- ❑ Agree
- ❑ Disagree
- ❑ Strongly Disagree
- ❑ N/A

22. There should be classroom discussion.

- ❑ Strongly Agree
- ❑ Agree
- ❑ Disagree
- ❑ Strongly Disagree
- ❑ N/A

23. The teacher should decide how much movement and talk there should be in the classroom.

- ❑ Strongly Agree
- ❑ Agree
- ❑ Disagree
- ❑ Strongly Disagree
- ❑ N/A

24. Students should carry out investigations to answer questions which puzzle them.

- ❑ Strongly Agree
- ❑ Agree
- ❑ Disagree
- ❑ Strongly Disagree
- ❑ N/A

Please go to next page----->

↓ ***CONTINUE HERE***

25. The same teaching aid (e.g. white board, overhead) should be used for all the students in the classroom.
- ❑ Strongly Agree
- ❑ Agree
- ❑ Disagree
- ❑ Strongly Disagree
- ❑ N/A

26. I prefer to learn by mostly lecture and notes.
- ❑ Strongly Agree
- ❑ Agree
- ❑ Disagree
- ❑ Strongly Disagree
- ❑ N/A

27. I prefer to learn by mostly through group activities.
- ❑ Strongly Agree
- ❑ Agree
- ❑ Disagree
- ❑ Strongly Disagree
- ❑ N/A

28. I utilize technology to help learn in class.
- ❑ Strongly Agree
- ❑ Agree
- ❑ Disagree
- ❑ Strongly Disagree
- ❑ N/A

29. The number of times I have participated in science fair projects in my classroom in the last five years are:
- ❑ 2 or less
- ❑ 3
- ❑ 4 or more

Please go to next page----->

Please answer by marking the correct box with an **X**.

↓ ***CONTINUE HERE***

30. How many science-related field trips did you participate in with your class during the last five years?
- ❑ 2 or less
- ❑ 3
- ❑ 4 or more

31. How often do you have labs in your class?
- ❑ Once per quarter
- ❑ Once a month
- ❑ Once every two weeks
- ❑ Once a week
- ❑ Daily
- ❑ Rarely, if ever, had labs

32. Describe your favorite science activity.

____

____

33. Name one science activity you wish you had.

____

____

34. What is the highest level of Mathematics class you have taken so far in high school?

____

Please go to next page----->

9

Please answer by marking the correct box with an **X**.

↓ *CONTINUE HERE*

35. Science teachers have encouraged me to continue to study in the sciences.
- ❑ Strongly Agree
- ❑ Agree
- ❑ Disagree
- ❑ Strongly Disagree
- ❑ N/A

36. Science teachers are interested in their students.
- ❑ Strongly Agree
- ❑ Agree
- ❑ Disagree
- ❑ Strongly Disagree
- ❑ N/A

37. My favorite science teacher taught mostly by lecture and having us take notes.
- ❑ Strongly Agree
- ❑ Agree
- ❑ Disagree
- ❑ Strongly Disagree
- ❑ N/A

38. My favorite science teacher taught mostly by using labs and experimentation.
- ❑ Strongly Agree
- ❑ Agree
- ❑ Disagree
- ❑ Strongly Disagree
- ❑ N/A

Please go to next page----->

10

How much confidence do you have about doing each of the behaviors listed below? If you have not had physics or chemistry, ***predict*** *your confidence level. Circle the number that best represents your beliefs for each item.*

1 2 3 4 5

Very Little ←-----------------------------------→ Quite a lot

CONFIDENCE

↓ *CONTINUE HERE*

39. Using a computer in science class.	1 2 3 4 5
40. Understanding concepts in a biology textbook.	1 2 3 4 5
41. Using chemical formulas and equations.	1 2 3 4 5
42. Doing well on a biology exam.	1 2 3 4 5
43. Doing chemistry homework problems well.	1 2 3 4 5
44. Doing physics lab experiments well.	1 2 3 4 5
45. Using a microscope.	1 2 3 4 5
46. Lighting a lab Bunsen burner.	1 2 3 4 5
47. Winning a science fair award for a biology project.	1 2 3 4 5
48. Handling laboratory chemicals.	1 2 3 4 5
49. Doing physics homework problems well.	1 2 3 4 5
50. Taking essay tests in biology.	1 2 3 4 5

Please go to next page----->

1	2	3	4	5

Very little ←---------------------------------→ Quite a lot

CONFIDENCE

➔ *Circle the number that best represent your beliefs for each item.*

51. Performing lab experiments using electricity.	1	2	3	4	5
52. Getting good grades in biology.	1	2	3	4	5
53. Answering questions in biology class .	1	2	3	4	5
54. Asking questions in chemistry class.	1	2	3	4	5
55. Memorizing factual information.	1	2	3	4	5
56. Understanding concepts in a chemistry textbook.	1	2	3	4	5
57. Asking questions in biology class.	1	2	3	4	5
58. Learning about famous scientists.	1	2	3	4	5
59. Understanding concepts in a physics textbook.	1	2	3	4	5
60. Getting good grades in chemistry.	1	2	3	4	5
61. Understanding abstract chemical concepts.	1	2	3	4	5
62. Asking questions in physics class.	1	2	3	4	5
63. Getting good grades in physics.	1	2	3	4	5
64. Experiments with simple machines .	1	2	3	4	5
65. Doing science activities for fun.	1	2	3	4	5

Please go to next page----->

For each statement below, draw a circle around

SA if you **STRONGLY AGREE** with the statement;
A if you **AGREE** with the statement;
N if you are **NOT SURE**;
D if you **DISAGREE** with the statement;
SD if you **STRONGLY DISAGREE** with the statement.

➔ *CONTINUE HERE Answer all questions.*

When I do well on a biology assignment, it is because

66. it was easy.	SA	A	N	D	SD
67. I was lucky.	SA	A	N	D	SD
68. I worked very hard.	SA	A	N	D	SD
69. I have high ability in this area.	SA	A	N	D	SD

When I do well on a chemistry assignment, it is because

70. it was easy.	SA	A	N	D	SD
71. I was lucky.	SA	A	N	D	SD
72. I worked very hard.	SA	A	N	D	SD
73. I have high ability in this area.	SA	A	N	D	SD

When I do badly on a biology assignment, it is because

74. it was hard.	SA	A	N	D	SD
75. I was unlucky.	SA	A	N	D	SD
76. I didn't work very hard.	SA	A	N	D	SD
77. My ability in biology is not high.	SA	A	N	D	SD

When I do badly on a chemistry assignment, its because

78. it was hard.	SA	A	N	D	SD
79. I was unlucky.	SA	A	N	D	SD
80. I didn't work very hard.	SA	A	N	D	SD
81. My ability in chemistry isn't high.	SA	A	N	D	SD

Please go to next page----->

Please answer by marking the correct box with an **X**.

➔ CONTINUE HERE

82. My friends encourage me to study science.
- ❑ Strongly Agree
- ❑ Agree
- ❑ Disagree
- ❑ Strongly Disagree
- ❑ N/A

83. My parent(s) encourage me to study science.
- ❑ Strongly Agree
- ❑ Agree
- ❑ Disagree
- ❑ Strongly Disagree
- ❑ N/A

84. What is your racial/ ethnic background?
- ❑ Asian/Pacific Islander
- ❑ Black Not Hispanic
- ❑ Hispanic
- ❑ Native American
- ❑ White Not Hispanic
- ❑ Other____________________

85. If answered "Hispanic" in #84 above, what is your country of origin?
- ❑ I am not Hispanic
- ❑ Mexico
- ❑ Puerto Rico
- ❑ Cuba
- ❑ Central and South America
- ❑ Other Hispanic origin

86. What is the predominant language spoken in your home?
- ❑ Spanish
- ❑ English
- ❑ Other ____________________

Please go to next page----->

➔ CONTINUE HERE

87. How many times since starting first grade have you changed schools due to changes in where you lived? *Write the number below:*

____

Please answer by marking the correct box with an **X**.

88. What is the highest level of schooling your MOTHER attained?
- ❑ Did not finish high school
- ❑ Finished high school
- ❑ Some college
- ❑ Finished college
- ❑ Some graduate work
- ❑ Master's Degree
- ❑ Doctoral Degree

89. What is the highest level of schooling your FATHER attained?
- ❑ Did not finish high school
- ❑ Finished high school
- ❑ Some college
- ❑ Finished college
- ❑ Some graduate work
- ❑ Master's Degree
- ❑ Doctoral Degree

90. I am interested in entering a career in the sciences, engineering, or technology.
- ❑ Strongly Agree
- ❑ Agree
- ❑ Disagree
- ❑ Strongly Disagree
- ❑ N/A

Please go to next page----->

APPENDIX M: STUDENT STRUCTURED INTERVIEW PROTOCOL

INTERVIEW PROTOCOL

Background Information:
- Name?
- Grade?

Family/Cultural Influence:
- Where were you born?
- Where were your parents born? Mother? Father?
- How long have you been in this country?
- What generation in this country? Who in your family is the first to come to this country?
- What language did you first learn to speak (Native language)?
- What language is spoken in the home (Home Language)?
- Which language is most frequently spoken in the home?
- Any other languages spoken in the home
- First language you tend to use to speak/listen?
- First language you tend to use to read/write in?

Schooling Attended:

- How many elementary schools attended in US? Where?
- How many middle schools attended in US? Where?
- How many high schools attended in US? Where?
- How long have you been at this high school?

1. Please describe your past and present science experiences?

2. What experiences contributed to taking science classes in high school?

3. How were/are you influenced by others? *(Family, teachers, peers culture?)*

4. What did people say to you about studying science?

   What messages did you receive about girls/females in science-related careers?

5. How would you describe your feelings and beliefs about science as you were studying it?

   How does studying science make you feel?

6. Tell me one memorable story that would really help me to understand how you arrived at your feelings/beliefs about science?

7. Why do you think so few women (and Hispanic women) pursue science-related careers? What could be done to change that?

8. Considering your academic history, if you could do anything different, what would that be?

9. Pretend you were the teacher. If you had taught the class, what would you have done differently to improve interaction and the students' experiences?

10. How will your science experiences influence your decision about taking future science classes?

APPENDIX N: INTERVIEW TRANSCRIPTS FROM PILOT STUDY

Pilot Study Transcription #1

"Anna" HS #1
May 23, 2005

R=Researcher
A=Anna, the Hispanic female student

R: What' your name?
S: Anna
R: What grade are you in?
A: ninth
R: ninth Grade. What country are you from, your origin, like your parents?
A: My mother is from Costa Rica, and my father is from Puerto Rico.
R: And how long have you been in this country?
A: Since I was born.
R: When I ask you what generation are you in this country, were your parents born here?
A: My father was born here.
R: So you are actually second generation because your father was born here. Now what about his parents?
A: They were born in Puerto Rico.
R: What is the language spoken in the home?
A: English.
R: Any other languages spoken in the home?
A: Spanish, but not so much.
R: When you speak and listen, what language do you use, English or Spanish?
A: English.
R: When you read and write, what language do you tend to use?
A: English.
R: How many elementary schools have you attended in the United States?
A: Umm, three.
R: Where were they?
A: Two were in New Jersey, and one was here in Florida.
R: And how many middle schools?
A: One.
R: And where was that?
A: Here in Florida.
R: Was that in Orlando?
A: Uh-huh.
R: Okay. And high schools?
A: One.
R: And that would be this one?
A: Yes.
R: And you have been here one year since you are in ninth grade.
A: Yes.

R: The next questions are going to be open-ended so whatever comes to your mind is perfectly fine. The first question is please describe your past and present science experience.
A: I never really liked science, but my teachers were all nice so, I liked it.
R: Because of the teachers?
A: But I don't like the [can't understand].
R: When did you realize that you didn't like it?
A: It was when I first started.
R: Which was when?
A: Um, probably 5th grade.
R: 5th grade?
A: Uh-hum.
R: Was there any particular experience where you said "Ugh, I don't like this!"?
A: No, the whole animals and the way of life was not very interesting.
R: Not interesting to you. What experiences have contributed to you taking science classes in high school besides the fact that they are required?
A: Well, high school is when you're supposed to be doing the labs and stuff. I always want to do the labs. That is part that I DO like about science.
R: Did you get many labs in fourth, 5th, 6th, 7th, eighth grade?
A: No, I never did labs.
R: This is the first time you have done labs?
A: Uh-huh.
R: Well maybe we need to change that!
A: Yeh
R: Hopefully I'll get that out of some of your responses in your survey.
R: How are you influenced by others, like family, teachers, peers, your culture, anybody telling you that science is something you should do, or not do?
A: Yeh, like my aunt, she's a teacher.
R: Good for her!
A: So, she is always saying how we need science. Mainly her.
R: What does she teach?
A: She teaches elementary.
R: Elementary. Does she say we need females?
A: Yeh.
R: Does she say we need Hispanic females?
A: Yes. My mom's friend always is saying that, that since I am a female and Hispanic that I need to you know, do science.
R: So have you given any thought to that?
A: I do, but I know I want to go to college and everything to do that.
R: Well, than I would stick with it because your aunt is absolutely correct—it's why I am doing this study.
R: So when people talk to you about studying sciences, what messages did you receive about girls or females in science-related careers besides your aunt?
A: [Hesitate]
R: Like did anyone say like "Aww, don't study cuz you're a girl, or girls can't do it." Anybody tell you anything like that?

A: No.
R: So the only messages you have really gotten have been from your aunt? What about your teachers?
A: My teachers tell me just like my family members. Everything is to the positive, positive about it.
R: So everybody urges you to do it, but your biggest influence is your aunt.
A: Yes.
R: How would you describe your feelings and beliefs about science as you were studying it? How does it make you feel? No you have said already that you didn't like it because it wasn't fun. Were there any other reasons that you didn't like it earlier that you might like it now?
A: Well, I like it now because we practice and we do like open conversations and then the labs we do every week. So now I am starting to like science.
R: When you have the open conversations, does your teacher take something that you have talked about and make it part of the class?
A: Yes.
R: How does she do that, what does she do with your questions?
A: She like uses examples.
R: I hope this is picking up on you. Boy, they are awful loud [next door]. Here, put this on your lap! [laugh]. I know the questions, but I got to hear the answers.
A: She uses examples like everyday life-how science is part of everyday life.
R: Well, that's excellent. So you have all your prior experiences to tie into that.
A: Yes.
R: Tell me one memorable story that would really help me to understand how you arrived at your feelings about science?
A: [Hesitate]
R: One thing in particular you could tell me a story about?
A: Like why I like science?
R: When you say you like it…
A: Okay, like two weeks ago, we do labs every Wednesday. And um, in movies you always see them doing labs high school so I always wanted to do labs, like when the chemical blows up on you and whatever. [Laugh] So, like two weeks ago we did a lab. And everything was changing colors like when we put the chemicals in.
R: It was a chemistry lab.
A: Yes! So like the lab. Everything started changing different colors when you put one chemical in it. Then I thought that was so cool [excited], I was even recording it, it was so cool!
R: Years ago, the precursors of scientists were all the magicians way back in the old ages, Renaissance, and they would do stuff like that and people would think it was magic, but it really isn't magic-WE know why that stuff happens now!
R: So you like watching changes happen in your lab?
A: Yes.
R: That is cool.
R: Why do you think so few women or even Hispanic women don't enter the sciences? Do you have any thoughts on that?

A: I feel that girls or Hispanics, maybe since they see that there are not a lot, they get discouraged too. And with the class, I think that once you start excelling in it, that males kind of try to bring you down.
R: Have you felt that in class?
A: Well sometimes, like if you make really good grades, the boys they'll be like "Oh, you're a girl; I should be getting better grades than you." Like once in a while that would happen, but not too often.
R: What does that make you want to do? Show them up?
A: Yes! Like keep on doing better!
R: But for some girls it doesn't it makes them drop out. It's not female-friendly is what I am hearing you say.
A: Some girls just try to be "cute" so they just let the boys do everything.
R: So they let them actually do the lab stuff. So what do they do just write stuff down?
A: Yeh, they'll just be talking and I think that's why girls, they are not very focused. But that's just, they're friends and stuff.
R: They are not focused in class. The boys are pretty much keeping them down with some comments like you said. For you it makes you want to show them up, but for most it doesn't. They want to be just be the pretty little face.
A: Yeh.
R: That's too bad. You need to get in there and [whisper] tell them "Don't let him talk to you that way! Show him up!"
R: What could WE do as educators or teachers to help change that do you think?
A: I think a lot of the educators try to change it now. It's just they say it's like reality. That girls shouldn't let boys, or anything, try to bring them down, and they need to stay focused.
R: Do you find that most of your science teachers that you've had are like that, whether they are male or female?
A: Uh-huh.
R: Do find more females saying that to you than males?
A: Well I have always had female science teachers.
R: Well. That's odd don't you think?
A: Yes!
R: We don't have any science females.
A: A lot of my teachers, I only had a couple of male teachers.
R: Uh-hum. Did you find them to be any different?
A: Yeh! And like they're always saying like females don't excel in everything.
R: So they are trying to get you girls to focus on that.
R: Considering your academic history (and you know what your academic history is), if you could do anything different, what would that be?
A: Probably just study more.
R: Are you finding you have to study a lot in science?
A: No, I don't know why but like, a lot of my classes I really don't study a lot and I still do good. And I think I take that as an advantage.
R: As long as you are still developing your study skills cause one day you may hit a wall.
A: I know![laugh]

R: What that is saying is that you have got a lot of talent. If you can do well without studying, just imagine what you could do with studying. The sky's the limit.
R: Pretend you were the teacher. If you had taught the class what would you have done differently to improve the interaction in the students' experiences—what would you do to make that class better if you were the teacher?
A: I'd probably try to make it more interesting, more involved with your everyday life, and try to make it easier.
R: How could you make it easier?
A: Maybe just explaining more-not so much like the textbook words, but in your own words.
R: Uh-hum.
A: With your own experiences.
R: What do you think about kids explaining to other kids? Is that helpful for you as a student?
A: Sometime it's helpful, but sometimes the kids that are teaching don't even know-they are not doing it correct.
R: So you still like that back up by the teacher to give that support-like yes, he's right, or it's a little off or right on it.
A: Yeh.
R: So that you know you're right on it.
R: How will your science experiences influence your decision about taking future science classes, in other words, if you feel you've had a good experience, are you going to continue taking science classes?
A: Yeh.
R: Do you think you will take them beyond the required credits?
A: Well, since starting this year, um, I'm like really starting to like science. So I was thinking about, you know, taking science classes, even when I know I don't have to. I think I will.
R: Okay, I am glad you were the one I picked!
A: [laugh]
R: I think you have got a lot of potential. I am a Hispanic female myself. And I studied science-biology was what I loved to do. We find, and keep this in mind, a lot of the females like to study biology but you won't see too many of them going into physics and chemistry. So how are you with Math?
A: Real good.
R: Okay, then push the envelope there. Not just science, but think about physics and chemistry too if you're good at Math. You could probably write your ticket to whatever you want to do! That would be good huh?
A: Yeh! That's what my parents tell me.
R: Yes?
A: They tell me to be a doctor.
R: [laugh] They just want free medical treatment!
A: Yeh [laugh].
R: [laugh] Well Anna, I am so glad that you spoke with me today and I wish you the best and thank you for helping me with my study.
A: Thank you.

Pilot Study Transcription #2

"Jolene" HS#2
May 23, 2005

R=Researcher
J=Jolene, the Hispanic female student

R: Today is May 23rd, Apopka ninth Grade Center. I have "Jolene" here with me. Um, I'm' going to put this on the table if that's okay. It should pick up. You just want to speak up.
R: What's your name?
J: Jolene.
R: What grade are you in?
J: ninth.
R: What is your country of origin Jolene?
J: Um, my Mom's Puerto Rican and my Dad is from the Dominican Republic.
R: And how long have you been in this country?
J: I have always been here. I was born here.
R: What generation are you? Like, were your parents born here?
J: No, like my Mom was born in Puerto Rico
R. So you are first generation.
R. What language is spoken in the home?
J: We speak Spanish.
R: Spanish? Is that your predominant language at home?
J: No, English.
R: What is the first language you use when you speak and listen?
J: Um, English.
R: English? Okay. What is the first language you tend to use when you read and write?
J: English.
R: English. Can you count how many elementary schools you have been in the United States? [chuckle]
J: Four (4).
R: And how many middle schools?
J: One (1).
R: On the four that you did for elementary, where were they?
J: Um, they are in various places. You want the names of them?
R: No, but, were they all in Orlando?
J: Um, yeh.
R: Okay. And your middle school was in Orlando?
J: Yes.
R: And this is your only high school because you are here and a ninth grader?
J: Uh-huh.
R: Okay. This is the part that is real open-ended. So I might ask you some questions to expand on some ideas you may give me.

R: Please describe your past and present science experiences in general, in the past, and during this year, what's that been like?
J: Like when I was in eighth grade we did a lot of labs, lab experiments, and I'm doing it because I know what I'm doing. And now in ninth grade instead we do a lot of writing and I don't like that as much. (parts inaudible).
R: So you learn better by doing the labs and the experiments. Were the labs and experiments designed by questions that you all came up with, or were they coming from the book?
J: Um, they were coming from the book.
R: What experiences contributed to taking science classes in high school? Obviously, you have to take so many to get your high school diploma. Aside from that, anything else contribute to taking science in high school?
J: Um, no.
R: [laugh] You're going to have to take it! [laugh]
R: How were you influenced by others, like family, teachers, peers, and your culture?
J: My Dad is always pushing me to be in the medical field.
R: Are you aware that females are very underrepresented in science?
J: Yeh.
R: And are you aware on top of that, that Hispanic females are extremely underrepresented in science?
J: My Dad told me that.
R: Yes. That's what my study is trying to do a special focus on that. Which is why I am interviewing you today?
R: What do people, besides your Dad, say to you about studying science?
J: Um, my Mom is also pushing me, but besides that, no one really talks about it that much. Everyone in my family like says to do good in school but doesn't really push the science.
R: They don't really. Would they have a problem with you studying science if you decided to?
J: They would love it. They'd love it.
R: How would you describe your feelings and beliefs about science as you were studying it? Like while you are doing it? Do you like what you are doing, you get frustrated by what you are doing, you hate what you're doing?
J: Like when I'm doing it I love it.
R: What do you love about it.
J: What did I love about it-like, I don't k now, like, the whole things, like when I first learned what H_20 was water! [chuckle]
R: Like Wow! [laugh].
J: I know that water is H_20!
R: [laugh]. How old were you?
J: When I first learned that I was in elementary.
R: So you thought that was cool. So there's a lot of things that you don't see the insides to still know about them. Tell me one memorable story, I know the water one, but tell me another memorable story where it would help me to understand how you arrived at your feelings about science?

J: Probably like last year in eighth grade and we did like one lab that had to do with taking test tubes and we had to like mix them to have like some blue and green ingredients and we had to mix them and it created bubbles and it started coming out and it was so cool! It's kind of like you can mix things that can actually do stuff, you know?
R: Uh-huh.
J: It's kind of like WOW- so I like the whole things (inaudible)
R: So you actually like to learn by doing it and it really keeps your interest. So do you feel like you are going to try hard because you really want to know what is happening—
J: Yes! I want to know how that happened.
R: Yeh, it really piques that curiosity!
R: Did you feel like you were a curious child when you were little?
J: Yeh, I was like (inaudible)
R: Why do you think so few women and Hispanic women, pursue, or don't pursue science?
J: I don't think they really just don't like it. They avoid it [chuckle]
R: [laugh]
J: And in class the girls try to look all cute and—
R: Do you find in mixed lab groups that when you've got boys and girls in the same group, that the girls—are they trying to be cute, or are they challenged by the fact that they're with the guys and want to be as good as the guys?
J: Like when I am in an honors class, like, usually like, I try to beat the boys and try to get the right answers
R: Right.
J: But like when I was in regular class, the guys were just checking out the girls and the girls were like "hee-hee"
R: "hee-hee-hee" and let the guys do the work?
J: yeh.
R: What do you think would happen had you not done that and you actually were working hard at it—do you think the guys would have said anything?
J: I think they would have probably like depended on me to give them answers. Like I was the smart one in the group.
R: But that would be good.
J: Yeh!
R: That would be really good.
R: Think about your academic history. Is there anything that we as teachers or educators can do to change that experience or your perception of what is holding girls back?
Or even Hispanic girls back?
J: I guess teachers could like, like make people more aware of it, like tell the girls "you know (inaudible).
R: So you think if they shared that with you, it would encourage you more that you might ---like that you cute and you're like hey like "I can do work as good as you!" [chuckle]
J: Exactly. It's one thing to be pretty but also have brains.
R: Yes, yes. Got to have the brains. Guys really like that. Guys that you would want to marry [chuckle].
J: Yeh.

R: Now think about your academic history. If you could do anything different, what would that be?
J: Um, to try to focus more and actually listen. I would probably like more experiments to be done too.
R: But you don't have any control over that (experiments). But things you have control over, you're saying you could listen better. Is there anything else you could do?
J: Focus more and pay attention more.
R: If you could rank all your classes, where would science fit in?
J: I'd actually put it at the top.
R: Why do you think that is?
J: Because I am more interested in it, lava labs,
R: How are you at Math? Are you okay at Math?
J: Math, I am very good at Math. Math is actually one of my top things.
R: That's excellent.
J: I want to keep that up.
R: Yes, because a lot of women, if they do tend to go into science, tend to study biology because there isn't as much Math, which is what I did. And I'm proud of that, however, the physic and chemistry, there's not many women in there at all. And it's because of the Math so keep up your Math and that will help you with your physics and chemistry.
J: Yeh.
R: Pretend you are the teacher. I know what you're going to say but…
J: [laugh]
R: If you had taught the class what would you do differently to improve interaction in the student's experiences?
J: Um, real quick, I'd probably try to get to know 'them a little better (rest inaudible) I would interact with each one more.
R: Anything else you want to add to that?
J: Um, pretty much try to do better just so that teacher and students interact.
R: So if you create a more personal environment, you are thinking that people would become more interested in science. Okay, I can buy that!
R: How are your science experiences influencing your decision about taking future science classes?
J: Um, like, when I was younger I did the labs and now I am ready for a little more because as you get older you know, you learn harder things and try to keep up. It kind makes you like want to know more about it because there is so much I don't know.
R: So what are you signing up for next year?
J: Next year I am doing biology.
R: Are you going to do Honors biology?
J: Yes.
R: Excellent, excellent!
R: Do you think you will take any AP?
J: I know that you need to take some now to help you get into good colleges. So I will take some if I get a chance.
R: The nice thing is that if you pass that AP test, it saves you time and money when you do get to college because a lot of colleges take that as a college credit
J: Yeh.

R: which means you can save yourself a lot of money!
J: Yeh-[chuckle]
R: Well, that's pretty much it. Is there anything else you want to say?
J: Not really.
R: I want to wish you good luck. Even if you find that the next year things become more difficult, just remember, you are good at this, you hang in there, and maybe you'll do what your Dad is hoping that you'll do--.
J: Yeh.
R: Okay? Thank you!

APPENDIX O: PILOT STUDY EVENT LOGS

Pilot Study Event Log

May 23, 2005
Classroom #1:
HPHS
Grade 9

I was in the classroom when the students arrived. I greeted them at the door as the students walked in. One of the Black females recognized me from Corner Lake, the middle school she had attended in grade 7. I also had spoken with the teacher about my administration of the test and interviewing the one Hispanic female in the class. That student had brought a consent form. I spoke with the student and she agreed to be interviewed. The teacher showed me the room we could use, adjacent to the room near her desk. The teacher collected the signed parent consent forms. Out of 27 students, we received 19 back, a 70% return. The teacher had offered extra points on their final exam. The ones who either did not have their form or whose parents denied consent were seated in the back of the room studying for their final exam.

At 8:55 I began the Child Assent script and told the students about the purpose of the study. All consented to participate. At 8:58 the questionnaire time began. The students had no difficulties or frustrations answering the questions. I only had one student near the end of the administration ask if they had to put anything, responses in the box, as some of the other students were doing. I said no, that that too was also voluntary. At 9:16 (18 minutes), all 19 students had completed the questionnaire phase of the administration. I collected the questionnaires and handed out the answer sheets for the science test phase to come next.

I instructed the students to put their name on the top of the answer sheet as well as the period of their science class. When they received their test booklet, they were to note the number of the test booklet. I explained that the science test was a practice FCAT test like they would be taking in 11^{th} grade. They were warned that the test would have many items they would not know, but as in the real FCAT, they are to eliminate answers they were sure were not correct and to make well educated guesses, since the FCAT does not penalize for wrong answers. At 9:20 the students began the test phase. Within a few minutes I noticed a number of them had already skipped to the multiple choice portion of the test. I spoke with the teacher. She said that most likely they saw the words in the vocabulary portion and did not know a lot of them and most likely skipped. I urged the class to try to answer every question, even if they had to go back to them. At 9:45 the test phase was over.

The single interview phase began at 9:47. The student was held back while the rest of the class was dismissed to go to the next class. I explained again that the interview was voluntary. We went to an office located off the classroom. The interview lasted until 9:55.
I thanked the teacher and left the classroom immediately thereafter.

Pilot Study Event Log

May 23, 2005
Classroom #2
AHS
Grade 9

I was escorted to the classroom prior to the start of the class I was to use for the pilot study, 3rd period. I was in the classroom when the students arrived. I spoke with the teacher about my administration of the test and interviewing the one Hispanic female in the class. That student had brought a consent form. I spoke with the student and she agreed to be interviewed. The teacher showed me the room we could use, adjacent to the classroom. The teacher collected the signed parent consent forms. Out of 30 students, we received 21 back, a 70% return. The teacher had offered extra points on their final exam. The ones who either did not have their form or whose parents denied consent were seated in one row on one side of the room studying for their final exam.

At 12:21 I began the Child Assent script and told the students about the purpose of the study. All consented to participate. At 12:23 the questionnaire time began. The students had no difficulties or frustrations answering the questions. At 12:43 (20 minutes), all 21 students had completed the questionnaire phase of the administration. I collected the questionnaires and handed out the answer sheets for the science test phase to come next.

I instructed the students to put their name on the top of the answer sheet as well as the period of their science class. When they received their test booklet, they were to note the number of the test booklet. I explained that the science test was a practice FCAT test like they would be taking in 11th grade. They were warned that the test would have many items they would not know, but as in the real FCAT, they are to eliminate answers they were sure were not correct and to make well educated guesses, since the FCAT does not penalize for wrong answers. At 12:45 the students began the test phase. Students were deliberate in their attempts to answer all questions. At 1:30 the test phase was over.

The single interview phase began at 1:35. I explained again that the interview was voluntary. We went to an office located off the classroom. The interview lasted until 1:45. The class was dismissed.

I thanked the teacher and left the classroom immediately thereafter.

APPENDIX P: HISPANIC FEMALE ACHIEVEMENT MATRIX

Hispanic Female Achievement Matrix

Key to Point Values: SAT 9 Reading = National percentile rank score
SAT 9 Mathematics = National percentile rank score Science Grade: A=100, B=89, C=79, D=69 (Honors/Pre IB add 5 percentage points)

Matrix Score= SAT 9 Reading+SAT 9 Math + Grade = Science Achievement Matrix Score Earned

LEP Notations 3Q: 1) Lang other than English in home?
2)1st Lang other than English?
3) Other lang other than English most frequent language?

LEP Codes: ZZ-not tested LF-monitor TN-tested not elig
LZ-exited LY-current

HL=Home Language
NL=Native Language

Teacher	Pd	Student GPA SC course Math Where born	Age at test date (Oct 05)	F/R	504	LEP	ANI AIP IEP	2003 DRP Natl %	2005 SAT 9 Read	2005 SAT 9 Math	2005 Science Grade	Matrix Score	SE Score
LP	5	**Ayala**	14.9	Y	N	LF	AIP	11 12/02	25	41			
		Cruz	15.3	Y	N	LY	ANI	19 4/ 2002	48	31			
		Pena 3.0 Integ Sci I PreAlg Born NY,US	14.1 1	Y	N	LZ Tested out Y N Y HL-Sp NL-Sp	AIP	34	39	76	100	215	
		Penate 2.43 Integ Sci I Alg I BornColom	15.5	Y	N	ZZ NNN HL- Eng NL-Sp	No	85	72	82	79	233	
		Reyes 1.75 Integ Sci I PreAlg Born NY, US	15.9	Y	N	TN YYY HL-Sp NL-Sp	No	25	Level 1	Level 1	69		
	6	**Franco** 2.12 Earth/Space Alg IA Born FL, US	16	N	N	LY3+ YYY HL-Sp NL-Sp	ANI	30 04 score	34	41	35	110	

		Gomez 2.0 Integ Sci I Alg IA Born P.R.N	15.8	N	N	LY1+ YYY HL-Sp NL-Sp	ANI	--	12	34	69	115	
		Matos 1.69 Integ Sci I Alg IA Retained Prior to 7th gr? Born NY	17.1	N	N	LY3+ YYN HL-Sp NL-Sp	No	18	25	19	69	113	
		Medina 1.75 Integ Sci I Alg I BornColom	15.9	N	N	LY1+ YYY HL-Sp NL-Sp	ANI	--	15	45	69	129	
		Moreira 1.38 Integ Sci I Pre Alg Born NY	15.6	Y	N	TN YYN HL- Eng NL-Sp	AIP	32	17	31	69	117	
		Navia 1.33 Integ Sci I Cons Ma Retained 5th Born NJ	16.7	N	N	TN YYY HL-Sp NL-Sp	AIP	23	59	13	35	107	
		Salgado 2.75 Integ Sci I Alg IA BornColom	15.3	N	N	LY6+ YYY HL-Sp NL-Sp	ANI	27	55	65	100	220	
JG	1	**Rubero** 4.0 PreIB Bio I Geom I Hon 10/18/89 Born FL, US	16.0	Y	N	TN YYN HL-Sp NL-Sp	No	96	98	95	94	287	
	2	**Camilo** 3.36 PreIB Bio I Alg I Hon Born P.R.	14.1 1	N	N	LZ In 3+ Exit 8/00 YYY HL-Sp NL-Sp	No	69	58	71	94	223	
		Roman 4.0 PreIB Bio I Geom I Hon Born P.R.	15.6	N	N	LZ In 2+ Exit 4/00 YYY HL-Sp NL-Sp	No	91	78	87	94	259	
		Soto 4.0 PreIB Bio I Geom I Hon Born NY	15.6	Y	N	ZZ TN YYY HL-Sp NL-Sp	No	93 04 score	98	98	94	290	

	4	**Jimenez** 2.7 PreIB Bio I Geom I Hon BornColom	15.4	Y	N	LF In 2+ Exit 12/02 YYY HL-Sp NL-Sp	No	37	65	71	84	220	
		Martinez 4.5 PreIB Bio I Geom I Hon Born TX	15.4	N	N	TN NYN HL- Eng NL-Sp	No	99 04 score	98	82	94	274	
		Nieves 3.57 PreIB Bio I Geom I Hon Born P.R.	15.9	N	N	ZZ NNN HL- Eng NL-Sp	No	--	89	83	84	256	
		Ortiz 2.85 PreIB Bio I Geom I Hon Born P.R.	14.1 1	Y	N	LZ In 1+ Exit 11/99 YYY HL-Sp NL-Sp	No	63 04 score	91	59	94	244	
JA	4	**Alvarez** 2.16 Integ Sci I Alg 1 Born P.R.	16.3	Y	N	TN YYN HL-Sp NL-Sp	AIP	47	39	83	79	201	
		Casillas 2.46 Integ Sci I Pre Alg Born GA	15.8	Y	N	LF In 8+ Exit 05/03	IEP SLD	8	-- SSS Level 1	-- SSS Level 1	89		
		Jerez 3.29 Integ Sci I Alg IA Born Cuba	15.2	Y	N	LY4+ YYY HL-Sp NL-Sp	ANI	73 04 score	85	99	89	273	
		Jimenez 1.75 Phys Science Alg 1A Retained prior to 7^{th}? BornColom	17.7	N	N	LY4+ YYY HL-Sp NL-Sp	ANI	4 02 score	-- SSS Level 1	-- SSS Level 2	0		
		Lopez 3.08 Integ Sci I Alg IA Born NY	14.1 1	N	N	TN YYY HL-Sp NL-Sp	No	21	25	71	89	185	
		Rodriguez Rank 804/860 New OCPS Fr PR Born P.R.	14.9	N	N	LY New05 YYY HL-Sp NL-Sp	No	--	--	--	--		

		Torres 3.25 Integ Sci I Alg IA Born Ecuador	15.2	N	N	TN YYN HL-Sp NL-Sp	AIP	67	48	65	100	213	
	6	**Cabezas**	15.6	Y	N	LY	N						
		Estrada 1.77 Integ Sci I Alg IA Born NY,	15.3	N	N	ZZ NNN HL- Eng NL- Eng	IEP SLD , Spch	--	-- SSS Level 1	-- SSS Level 1	0		
		Gomez 2.83 Integ Sci I Alg IA Born NJ,	14.1 1	N	N	LZ In 1+ Exit 5/02 YYN HL-Sp NL-Sp	AIP	47	58	71	89	218	
		Gonzalez 2.0 Integ Sci I Pre Alg Born FL	16.0	N	N	TN YNN HL-Sp NL-Sp	AIP	62	34	31	79	144	
		Mejia 2.5 No course data Born NY	14.1 1	N	N	TN YNN HL- Eng NL-Sp	No	--	39	34	79	152	
		Prado 2.25 Integ Sci I Pre Alg Born P.R	15.1	N	N	LY2+ YYY HL-Sp NL-Sp	ANI	6	25	38	89	152	
		Tirado 2.33 No SCI taken Alg IA BornColom	17.0	Y	N	LY1+ YYY HL-Sp NL-Sp	No	--	7	34	--		
		Urena 1.93 Integ Sci I Hon Alg I Born Ecuador	16.9	N	N	LY New 3/05 YYY HL-Sp NL-Sp	No	--	-- SSS Level 1	-- SSS Level 1	84		
		Villalta 2.67 Born NJ	15.1 1	N	N	ZZ NNN HL- Eng NL- Eng	No	42	29	69	100	198	

APPENDIX Q: QUESTIONS, METHODS, INSTRUMENTS MATRIX

Research Questions, Methods, Instruments Matrix

Question	Methods	Instrument	Source	How data Are analyzed
1. What is the difference in science self-efficacy perceptions between Grade Ten Hispanic females and other Grade Ten student cohorts as measured by the Smist (1993) Science Self-Efficacy Survey (SSEQ)?	Survey	*Science Self-efficacy Questionnaire (SSEQ)*	Smist (1993) Permission to use the instrument granted. (See Appendix S)	Factor analysis using SPSS principal factor with oblique rotation (Promax) at .05 confidence level. ANOVA to test differences between multiple groups using SPSS.
2. Is there a significant correlation of science achievement as measured by (a) prior year reading achievement as measured by the SAT 9 standardized test; (b) prior year mathematics achievement as measured by the SAT 9 standardized test, and (c) prior year final science grades on the science self-efficacy in Hispanic females as measured by the Smist (1993) SSEQ?	Survey School district database	*Prior year final science grades* *SAT 9 Reading Scores Prior Year* *SAT 9 Mathematics Scores Prior Year*	School district data.	Multiple regression analysis using SPSS.
3. What are potential influences on students' perception of self-efficacy in the sciences?	Survey Interview Audio-taping	*SSEQ Questionnaire Structured Interview Transcripts*	Smist (1993) Researcher constructed Transcribed, interpreted by researcher.	Open Coding and analysis using hand coding, and the constant comparative process

APPENDIX R: PROJECT TASKS AND TIMELINE

Project Tasks and Timeline

Semester One **Spring 05**	• Develop Research Question(s) • Finalize Prospectus • Begin and complete IRB process (both UCF and OCPS) • Begin to construct the Proposal • Prepare invitation for participation in study (teachers) • Prepare invitation & documentation (students) for IRB and School district for dissemination • Identify a core of 10 science teachers (plan for attrition) Determine tentative schedule for classroom observations • Construct student questionnaire; pilot questionnaire with 2 classes students; validate if needed. • Create an appropriate interview instrument; pilot. • Purchase or acquire audio equipment • Purchase software needed for qualitative analysis (N*Vivo) • Test Crystal Report Online Data Access with OCPS to secure student achievement information.
Semester Two **Summer 05**	• Prepare proposal for defense; Continue research. • Contact Julianne Smist, Ph.D. for approval on SSEQ Questionnaire • Enter pilot data into SPSS • Transcribe pilot interview data • Revise Proposal for final submission • Prepare student questionnaires for fall study
Semester Three **Fall 05**	• Secure dates from committee when out of town this semester, and if possible, next semester as well. • Continue Revising Ch. 1,2,3) • Learn the rudiments of hand coding and qualitative research. • Seek the assistance of a statistics expert to help with analyzing both quantitative and qualitative data? • Continue to meet with KB, Chair • Meet/email/discuss with other committee members as needed. • Reinitiate contact with cadre of six tenth grade science teachers. • Establish which specific classes I will be conducting the research. • Secure class lists. • Call/email/write Principals at each of the schools to let them know about the study and address any concerns they might have about the research. • Prepare Parent consent letters specific to each student.

	• Establish specific timeline/dates for HIGH SCHOOL visitations to administer the questionnaire at each of the HIGH SCHOOL in the study. • Secure annual leave from my job on affected research days • Administer SSEQ Questionnaire to all identified classes • Interview and audiotape each of the four Hispanic female interviews • Enter all questionnaire data into SPSS • Transcribe interview data • Analyze both questionnaire and interview data • Continue revising Ch. 1,2,3 • Write up Ch 4 Results • Begin to write Ch. 5 Discussion • Run drafts by Dr. KB through meetings/email/phone as needed
Semester Four Spring 06	• Secure dates from committee when out of town this semester • By Jan 15, submit a draft of Chapters 1-5 to Dr. KB • Make revisions as per suggestions • By Feb 13, submit a defense copy to committee for review • Send approval to defend form to committee • Set date to defend and reserve room (Susan Stansinski) • Make revisions as per suggestions of the committee • By Feb 20, submit a defense copy and approval to defend form to dissertation examiner • By Feb 20, send announcement of dissertation defense • Defend sometime between Feb 27 and March 9 • Make revisions over spring break March 13-17 • Obtain committee signatures by April 3 • Final corrections due and submit deposit and approval form April 10 • April 17 Dissertation submission DEADLINE. Transmit final copy to library

APPENDIX S: WRITTEN CONSENT FOR USE OF THE SSEQ (Smist, 2005)

Yahoo! Mail

Yahoo! My Yahoo! Mail

YAHOO! MAIL Welcome, [Sign Out, My Account]

Search the Web | Search

Mail Home - Mail Tutorials - Help

Mail Plus | Addresses | Calendar | Notepad | What's New - Mail Upgrades - Mail Options

Check Mail | Compose | Search Mail | Search the Web

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This message is not flagged. [Flag Message - Mark as Unread]

Subject: Re: Doctoral candidate request for information

To: "Maria Miller"

From: Julianne_Smist@SPFLDCOL.EDU Add to Address Book

Date: Tue, 5 Jul 2005 11:49:31 -0400

Maria,

It was nice talking with you today.
I will see if I have a copy of the '92 paper.
Unfortunately I no longer have a computer that reads the 5.25 "flo
disks," so if I find a copy I will mail you a paper copy.
Feel free to call me again if you have questions.
You have my permission to use SSEQ in your dissertation research.

Good Luck,

Julie

Dr. Julie Smist
Professor of Chemistry
Springfield College
Springfield, MA 01109
413-748-3382 (voice)
413-748-3761 (FAX)

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APPENDIX T: PHONE CONVERSATION WITH JULIE SMIST

Phone Conversation with Julie Smist

July 5, 2005

Dr. Julie Smist called me back one afternoon after I had emailed her some questions and requested permission to use her instrument called the SSEQ (Science Self-efficacy Questionnaire). I also asked her questions about the validation of the instrument and told her of the difficulty I was having with my pilot to yield the same number of factors. She said that I would need at least 100 in my sample to begin to yield the same results. She also told me of the difficulty she had in finding Hispanic females, as she had made the mistake of taking upper level classes where she found out they did not reside. She thought me sampling tenth grade would yield better results regarding my sample size. She agreed to send me a copy of her initial papers written on the development of the instrument in case I could use any of the validation information. She extended an offer of assistance or discussion at anytime and would like to hear what results I gleaned. I thanked her and would await her email consent on the use of her instrument.

APPENDIX U: EMAIL COMMUNICATION WITH LEADERS IN THE FIELD OF GENDER RESEARCH IN SCIENCE EDUCATION

Date: Sat, 19 Mar 2005 20:01:07 -0500

To: "Maria Miller"

From: "Jane Butler Kahle" <kahlejb@muohio.edu> View Contact Details

Subject: Re: University of Central Florida Doctoral Dissertation Question

CC: hayessb@muohio.edu

Dear Maria,

It is cloudy in Hawaii today, so will take a little time to answer your thoughtful and appropriate questions. I will add comments to your email below. (Sara, AR)

>1) I want your honest opinion on the worth of such a study in
>today's field. In your most recent article (Will girls be left
>behind?) I read that it is your belief that the data on females
>needs to be further dissagregated. However, just my narrowing
>down my study to Hispanic females in both environments doesn't
>necessarily make a good study. Do you think this topic will add
>the field? If not, what direction would be more useful?

Your two experimental treatments (direct instruction and inquiry-based methodologies are very broad, so you may have troubl establishing attribution. You could select one aspect of each typ of instruction to narrow your focus. In either case (broad or narrowed), I think that the research has value--especially if you focus on Latinas. There are strong cultural issues that affect Latinas that have not been adequately studied.

>
>2) Can you offer any suggestions on what factor in the
>instructional environment would be of interest to measure?
>Questioning? Student interaction? Grouping practices?
>Self-efficacy and motivation? Visual-spatial abilities?

I think that self-efficacy and motivation may be the most critical factor to study.

>
>3) Which method(s) would yield more valid results? An empirical
>study? Student survey? Observation and protocols to measure (may
>even videotape)?

I would use a mixed methods design that includes a questionnaire (adapted from a tested one) as well as focus groups of students--perhaps, Latinas and white girls.

```
>
>4)  Is this a study which would merit funding so that I could
>conduct research full time?  If so, what agencies, in your opinio
>would be most interested?

The only group that I know of is AAUW (American Association of
University Women)--Check its website.

>Good Luck with your study!


Jane Kahle
```


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--
Jane Butler Kahle, Ph. D.
Condit Professor of Science Education
School of Education and Allied Professions
Billings Hall
Miami University
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www.ohioeval.muohio.edu
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Date: Tue, 22 Feb 2005 08:03:17 -0500

To: "Maria Miller"

From: "sue rosser" <sue.rosser@iac.gatech.edu> Add to Address Book

Subject: Re: On referral from Dr. Lucy Morse

Dear Maria,

I provide some limited answers to your questions, written in CAPS. Let me start by saying that I do think this is an important venue for research.

At 08:23 PM 2/21/2005 -0800, Maria Miller wrote:

> Dear Dr. Rosser:
>
> I appreciate any time you can offer to read my email and offer some scholarly advice. I met with Dr. Morse today and she mentioned you as an expert in the field of gender equity in STEM fields.
>
> As a doctoral student in Curriculum and Instruction at the University of Central Florida in Orlando, FL., I am nearing the end of my coursework and developing my research question for my impending prospectus this spring and proposal this summer. Having been a former secondary science teacher (B.S. Biology) in public education for 9 years prior to entering administration eight years ago, I find my interest topic for my dissertation topic is taking me back to my science roots.
>
> Currently, my study will compare direct instruction versus inquiry-based methodologies for teaching science and comparing how females are motivated to continue in the sciences within the two environments. Factors in the instructional environment will be explored to explain influence on the motivation and perception of self-efficacy of females to pursue a career in the sciences, engineering, and technology or influence females to deselect themselves OUT of higher level course work that would lead to such careers (This is what I did many moons ago). Because of my Hispanic background, I am giving serious consideration to limiting my analysis to Hispanic/Latino females.
>
> 1) I want your honest opinion on the worth of such a study in today's field. Do you think this topic will add to the field? If not, what direction would be more useful? I THINK IT WOULD BE USEFUL. AS YOU KNOW, THE PARTICIPATION OF HISPANIC/LATINO WOMEN IN STEM IS VERY LOW.
>
> 2) Can you offer any suggestions on what factor in the instructional environment would be of interest to measure? Questioning? Student interaction? Grouping practices? Self-efficacy and motivation? Visual-spatial abilities? I THINK ALL WOULD BE USEFUL, DEPENDING ON

WHICH AREA OF STEM YOU WILL CHOOSE AS YOUR FOCUS.

3) Which method(s) would yield more valid results? An empirical study? Student survey? Observation and protocols to measure (maybe even videotape)? I WOULD PREFER THE LATTER TWO, BUT ALL THREE COULD BE USEFUL, DEPENDING UPON HOW YOU DESIGNED THE EMPIRICAL STUDY.

4) Is this a study which would merit funding so that I could conduct research full time? If so, what agencies, in your opinion, would be most interested? NSF, DEPT. OF EDUCATION, POSSIBLY THE SLOAN FOUNDATION.

As you can see, I have much going around in my head and have engaged in numerous conversations with science faculty here at UCF (Dr. Morse is one of them). However, since you are a noted expert in the field, I felt it was worth trying to see if I could talk with you and "pick your brain" to get your most valued opinion.

Thank you for consideration of your time.

Sincerely,
Maria D. Miller
Doctoral Student
Curriculum & Instruction
Department of Educational Studies
The University of Central Florida

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APPENDIX V: INTERVIEW TRANSCRIPTS

Interview Transcript # 1: "Catherine"

High-ability Hispanic Female #1 (HA1)

October 04, 2005

Researcher: We are here with Catherine from Cypress Creek High School. I am going to have her hold the microphone so we can hear the responses. What grade are you in Catherine?

Catherine: 10th grade.

R: 10th grade. Where were you born?

C: Cuba.

R: Where were your parents born?

C: In Cuba.

R: Both of them?

C: Yes.

R: How long have you been in this country?

C: Four years.

R: Four years! You speak very good English. Are you the first generation in this country? You would be the first one.

C: No.

R: Because your parents have never been here.

C: Oh yeah, yeah.

R: Is that true? How about your grandparents? Have they been here?

C: No, *

R: So you are the first generation.

C: Yes.

R: You are the first. Parents are the first to come. What language did you first learn to speak? What is your native language?

C: Spanish.

R: Spanish. What language do you speak in the home?

C: Spanish, and English with my sister.

R: Which language do you most frequently speak, the Spanish or the English?

C: I don't know, both.

R: Both?

C: I would say Spanish with the family and friends.

R: Do you have any other languages spoken in the home?

C: No.

R: Just those two. Okay. When you tend to speak or listen, which do you tend to go to, the Spanish or the English?

C: Spanish.

R: Spanish. The first language that you tend to use when you are reading and writing, do you go to Spanish or English?

C: English.

R: English. Okay. That helps with FCAT doesn't it? Now, this is about the schools that you have attended. How many elementary schools have you attended in the United States?

C: None.

R: None. How many middle schools have you attended in the United States?

C: One.

R: One. Where is that?

C: Walker Middle School.

R: Okay. That was in Orlando. How many high schools?

C: One. This one.

R: This one. You have been at this high school how long?

C: Two years.

R: Two years. Okay now, this is where we start to really think about how you feel about science. Can you describe your past and present science experiences? Are they good, are they bad, what do you like, what don't you like?

C: My middle school one was good. You know, we used to go, like, to downtown with projects outside.

R: You did what?

C: Like projects outside.

R: You did outside projects?.

C: Outside projects. But here, like in * way, I don't know, it is not the same. We used to do labs and stuff like that, with the teacher, you know. I really didn't like her.

R: You didn't like the teacher?

C: No. I didn't like the way she teach.

R: What was it that she did that you didn't like?

C: I don't know. She was like, she didn't have fun in the class. She was very serious all the time.

R: (Chuckling) Science can be fun. Too serious.

C: Like this one, she is not like she is fun, but like you know we laugh and stuff like that, and we do projects here.

R: Do projects.

C: A lot of *. * and stuff like that.

R: That makes it fun doesn't it.

C: Yeah.

R: What experiences contributed to taking science classes in high school? Is it because you are forced to take them, or you are actually interested in science?

C: I am forced to take them.

R: You are forced to take it. (Chuckling)

C: I am not a big fan of science.

R: I would like to find out why.

C: Not really forced you know. Forced, because like I have to do it because of the school.

R: The credits.

C: But I am fine with it. I'm okay.

R: How are you influenced by others with regard to science? Like your family, your teachers, your friends, your culture. Do you feel like any of those influenced whether or not you like science. Because you said you are not a big fan, and that is okay.

C: No, I have to like science because I want to become a doctor, so I have to like it.

R: So you have to like it. (Chuckling) Now why do you want to be a doctor?

C: I like that, I don't know, it's fun. It is not that it is fun, like I like that, it's like, you know, like be a general doctor when they are, *

R: Are your family members, are they telling you should?

C: Yes. My parents.

R: Parents. What do they say?

C: "Catherine, they give you money".

R: Yes. (Chuckling) That is true, they'll give you money to go to school if you get to college, and you will get to college.

C: * career, you know I am taking medical skills, I think, and I love it.

R: What about it do you like?

C: What?

R: What do you like about it?

C: I don't know, what we learn, like the body, you know, what happens inside, and what are the functions.

R: I always found that really fascinating. I couldn't understand how nobody would want to understand how all of this works.

C: Ah, hmmm.

R: Kind of a miracle. So, what do people say to you about studying science? We know your parents have been real influential in getting you to study so you can be a doctor. What about teachers or friends?

C: I don't *comment that much with teachers. I don't know, like, they don't ask you that type of questions.

R: Do you think they should?

C: Yes.

R: Oooh. How about your friends? What do they think about …

C: "They give you money". That is really the thing about it.

R: Friends are saying, "Go, go, so you can be …"

C: Yeah, "Go, go, they give you money".

R: But in your culture, do you find many women actually studying science?

C: Yes.

R: You do?

C: Well like, what do you mean science, like doctors or something like…

R: Like doctors, or engineers, or physicists?

C: Oh yes.

R: This one is a little bit trickier. Think about when you are in science class. There are messages that people give you without actually saying anything. For instance, if you were actually to stick with science and let's say you are a senior, and you are studying science, but none of your friends are studying science. They are all doing other things in high school. Do you think that they would think that you were nerdy?

C: No.

R: No?

C: No.

R: How about answering questions in front of the boys?

C: What kind of questions?

R: Science questions, where you're smarter than them.

C: Oh yeah, that would be cool.

R: You would like that.

C: I'll *

R: (Chuckling) How would you describe your feelings and beliefs about science as you are studying it? When you are studying it do you find it difficult, do you find it easy?

C: I find it difficult.

R: You find it difficult.

C: Yes.

R: What part of it?

C: Except the * body or the *…

R: How about the math?

C: No, I am good in math.

R: Good at math. So does it make you feel like you're… I know when things are too hard for me, sometimes it makes me feel like, "Gosh, I'm stupid".

C: Ah, hmm.

R: Does it make you feel like you can't do it because it is hard, or do you just kind of work through it and you realize that you can do it, it is just hard.

C: I work through it.

R: You work through it.

C: But I don't like it.

R: Now how do you think you are going to go through years and years of studying to be a doctor if you don't like it?

C: I know. No one likes …I am still going to * when I open frogs and stuff like that. I don't like that.

R: I know.

C: Like the body how it works, I love that. The cells, that's cool.

R: I have a trick about the frogs. You let the guys pith the frog, you know how you have to pith it, while they are alive.

C: Oooh.

R: You have to stick a needle like right here. I don't ever touch the frog. I wait until it is anesthetized. I had to dissect a live frog while they were anesthetized.

C: Oh yeah.

R: But it is really fascinating because we got to take the heart and watch it beat, and we had to count the beats per minute, and study the systems, and stuff like that.

C: Oh.

R: But when it comes to touching it, I let the guys do that. (Laughing)

C: Did you hear her say we are going to do it? Something * some frogs.

R: Oh really. I wonder if it will be alive or dead? I have a few more questions. Tell me a memorable story that you would really help me to understand how you have arrived at your feelings and beliefs about science. Is there something that you remember in your science classes as you were going through school that said, "Wow, I think I like this", or "Wow, I think I hate this". (Chuckling)

C: Medicine.

R: Hmmm? Medicine?

C: Yeah.

R: What about medicine? Did you have a project to do? It's some memory of school.

C: Oh yeah. I have been doing like 6th, 7th and 8th grade. I have been doing like projects. My middle school they make us do, like, these * projects. Like we pick a topic and we look for the, like, the hypothesis, stuff like that. In one, we were talking about the body parts. That is where I started liking it, so I started looking about it, and finding all the …

R: So that is what kind of what got you interested?

C: Yeah.

R: Cool. Why do you think in all honesty that there are very few Hispanic women in the sciences? 2%, I am talking small.

C: Really?

R: Very small. That is why I am doing the study, and that is why people are studying it because we don't understand why Hispanic females are not staying with it, as opposed to other females or men. Men will stick with it; the females tend to not stick with it as much. So, why do you think that that might be true?

C: In my personal opinion?

R: Yeah.

C: It's like the Latin woman is more of a house women, like she is always in the house, like, with the kids, cooking, school and, you know, they will work for some *, to work if she needs the money and because *. Like I say she rather prefer to stay in the house, cleaning the house, making food for us, and stuff like that; not really liking studying for 8 years to be a scientist.

R: So how can we change that? How can people like us, educators, change this?

C: * us more. Give us, I don't know. I don't want to be …

R: How can we change the way someone like you, Catherine; how can we change someone like you, because if you're thinking that you have been socialized to think that women are supposed to grow up, get married, and have kids, take care of the house. How do we change someone like your thinking?

C: I don't think like that. I don't want to …

R: Then how do we change the other people who think like that?

C: Truly, I don't know. Waiting for more generations to come like me. I don't want to stay in the house, see my kids and stuff like that. Like I want to be married like 20 years, something like that. I want to party first, and have a degree, and all that stuff.

R: Well, you sound very goal-oriented. You stick to it. Considering your academic history, if you could do anything different what would that be? So, in other words, depending on the grades that you make, if you don't do medicine, what else would you consider doing?

C: I don't know because I am good. In this class I don't know what has happened to me, I have a C, because like my other grades, and my other years I still had an A. But like, I would rather be a teacher, psychology, but that is like medicine, too.

R: Yeah, a psychiatrist would be.

C: I love psychiatry. What else? I just have my head on the medicine thing. I'm not thinking of something else.

R: Okay.

C: But could be an engineer because my dad is an engineer.

R: Pretend you are Ms. A ; pretend you were the teacher.

C: Oh no.

R: If you had taught the class what would you do differently to improve the interaction between you and the students, and their experiences? How would you teach it different to make it …

C: Don't focus on, like… she is always talking to us like if you are late, if you do something wrong, like, focus on the study part and you know like make sure we do the homework, make sure we understand things. Don't focus on like if we're late or we are going home, she *.

R: Oooh. How will your science experiences influence your decision about taking future science classes? So, for instance, in 9th and 10th grade and all those middle school experiences, if they're good you might want to stay in it; if they're not so good you might not want to stay in it. So, tell me about how your experiences in science will influence whether or not you will stay. I probably know the answer to that because you have been telling me all through this.

C: I * like science, like the way they teach it, like some teachers, they are not good at it. I'm sorry, but they are not good at it, some teachers, and that is why you know people are going to go like "Oh my God." Like my 6th, 7th and 8th teacher, he was good.

R: What made him good?

C: Like he was funny, he was always telling stories about science and stuff like that. Like in 8th grade he turned boring. I didn't like him anymore. My 9th grade she was good really, she was boring, too, but she was a good teacher though. And this, she is good, but the one teaching right now is Ms. What is her name?

R: I don't know.

C: She is a Chinese girl. She is good, like, for very beginner she is good. I don't know about the other one. Yeah, she is good, too, but she is too serious.

R: (Chuckling) So you are basically saying that you have had good science experiences, because you want to stick with it.

C: Yeah.

R: Okay. Anything else you want to say because that is it?

C: No thank you.

R: Thank you. I wish you the best. So you will be Dr. *.

C: Yeah.

R: Good luck.

C: Good luck to you too, I hope you find …

R: Thanks.

Interview Transcript #2: "Stephanie"

Low-ability Hispanic Female #1 (LA1)

October 04, 2005

Researcher: This is Stephanie from Ms. A's class. I am going to put it right here, if you could hold that, just to make sure that we pick up on your voice. What grade are you in Stephanie?

Stephanie: 10th.

R: 10th grade. And where were you born?

S: New York.

R: New York. In New York City or New York?

S: Queens, New York.

R: Queens. Where were your parents born?

S: Colombia.

R: Colombia. Both of them?

S: Yes.

R: How long have you been in the United States?

S: Me? My whole life.

R: Your life. You're probably the first generation in this country. That means you are the first one actually from here because your parents are not from here, so you are the first generation in this country, and your parents were the first ones to come.

S: Actually my grandparents were.

R: Oh your grandparents. So you are second generation actually. And what language did you first learn to speak? What is your native language?

S: Spanish.

R: Spanish. And what is your home language?

S: Both.

R: Both?

S: Ah hah.

R: Spanish and English. And which one is spoken more frequently? If you had to * f home Spanish or the English, which one do you speak a little bit more of?

S: English.

R: English. Any other languages spoken in the home?

S: No.

R: No. When you are speaking and listening, which do you tend toward, the Spanish or the English?

S: What do you mean?

R: Because I know when you have two languages, sometimes you think in a particular language, like you might think in Spanish, but you might speak in English. So when you are speaking and listening do you tend to go toward the Spanish or the English?

S: To tell you the truth, both.

R: Both?

S: Yeah.

R: And then when you read and you write what does it tend to be?

S: Mostly in English.

R: In English. This is about your schools. How many elementary schools have you attended in this country?

S: Ummm, three.

R: Three. Where were they?

S: One in New York, and then one's in Atlantic City in New Jersey, and then one is here.

R: Oh. And how about middle schools?

S: One.

R: One, and that was here in Florida?

S: Yes.

R: And how many high schools?

S: One.

R: One, and is that this one?

S: Yes.

R: And you have been at this high school how long?

S: For two years.

R: Two years. Now we are starting to get into the science, and your feelings about science and your perceptions about science. Please describe your past and present science experiences; whether they were good, not so good, what did you like, what you didn't like. If you could describe some of that for me.

S: I don't know what you mean.

R: Well, when you took science last year, this year, 8th grade, 7th grade, 6th grade, did you like it? Were they fun? Were they boring? What subjects did you like? What subjects didn't you like in science?

S: They're boring if the only thing we are doing like taking notes or something, but like in 8th grade it was fun for me because the teacher always made it fun for us, but like last year…

R: What did she do to make it fun?

S: It was him, but he, I don't know, he would just like explain more, he had like the whole class involved in taking notes and stuff.

R: Did you do any experiments?

S: Ahh, not a lot that we did, but when we did they were really fun. Like we would have to like construct roller coasters when we were doing like friction and stuff.

R: Oooh. So the whole class did it, or you did it in groups?

S: In groups.

R: Oh that's fun. I like that. Did you get to go on a field trip to a roller coaster?

S: No.

R: No. Shucks. (Chuckling) What experiences contributed to taking science classes in high school? In other words because you liked it you're taking it, or are you forced to take them?

S: In a way I kind of do like science, but in a way I'm just kind of doing it because I have to take it for my high school.

R: For your credits. Do you think you'll take some after you don't have to take them?

S: Probably not.

R: Okay. How are you influenced by others in your decision-making about science? For instance, family, teachers, your friends, your culture?

S: In what they say about it?

R: Ah hah.

S: My mom just told me to do what I want, like, do what most I enjoy doing. My parents both say that actually.

R: So what do you think you'll do?

S: Like what I want to do after high school?

R: Hmmm.

S: I want to hopefully, like, go into accounting.

R: You like numbers?

S: Yeah.

R: Are you good at math?

S: I've gotten better since last year.

R: What do people say to you about studying science? So if you have ever talked about it with family or friends or teachers, do they say, "Ah, don't go into it", or "Oh, you should go into it", or "You would be good at that", or "You wouldn't like that."

S: To tell you the truth, I have never really got into that subject with my family or anything.

R: What messages did you receive from girlfriends or females about science careers? Do any of your girlfriends say anything about it?

S: No.

R: No? How would you describe your feelings and beliefs about science as you are studying it? For instance, as you are doing it, if it is easy you say, "Oh, I am good at this", or "I like this", or if it is hard, "Oh, I'm not good at this" or if it is hard, "This may be hard, but I can do this." Tell me about your feelings as you are doing all this stuff that the teachers tell you to do.

S: Well, if I am doing it and it seems easy then yeah I do, I say, "Wow, I am good at this", and then if it is hard then I say, "I …

R: I can't wait to get out of science class.

S: Yeah. (Laughing)

R: (Laughing) How does studying science overall make you feel? For instance, when I am having difficulty at something, sometimes I feel really stupid. "Am I the only one that's not getting something, I must be dumb" or I might say, "I might not get it, but I'm smart, I'll figure this out. I know how to figure this out." So the message is you kind of tell yourself, so when you are studying science, what kind of messages are you saying to yourself about how you feel about it?

S: Well, if I don't get something then I ask because I know if I ask it is going to make it better, it's going to help me understand it better, but I don't know, like basically if I don't get it I ask, but then if I get it, and there are other people who don’t get it, then I try to help them out, because I know that will make it easier for them also.

R: And that makes you feel …

S: It makes me feel better.

R: Yeah. We all like to do that. Maybe that’s why we teach. I was a science teacher. Tell me one memorable story that you remember from your science classes, elementary, middle, high school that will help me understand how you arrived at your feelings and beliefs about science.

S: Actually, like whenever I think of science it has always been of the roller coaster that we did. That was a lot of fun because we had to, like, do the advertising for roller coaster, we had to build the roller coaster, we had to make the little people and all the cars and everything, and we had to go into detail for it.

R: Well you know, the roller coaster is pure physics, all physics and math. That is all it is, like a golf swing. All sports use physics.

S: Yeah.

R: Even physics when a skater is going around in a circle and she brings her arms in, that’s physics, that’s science, kind of cool. Why do you think so few women pursue science careers? Hispanic women especially; only 2% of Hispanic women stay in careers in science. That means there are a lot of guys out there doing science and a lot of non-Hispanics.

S: * because it’s hard. I think it’s hard. As we go on each day it gets harder and harder, like, really there has been like one thing that I’ve found easy in this class.

R: What could be done to change that? What could be done to make it more understandable for you?

S: If, like, if the teacher spends more time on one thing instead of, like, Ms. S, she is great. Like, she has helped me a lot, and like in understanding things and just making me feel better, I guess, about science.

R: So if you think that they spent more time on one topic rather then less time on a lot of topics?

S: Yeah.

R: …you'd actually be more interested and it wouldn't seem so hard. That's a legitimate concern, actually it's a concern for teachers all the time. We have to plan because that's always the issue, "How much time can I spend on this?" Considering your academic history and you know what your grades are, I don't, if you could do anything different what would that be?

S: I have good grades. Like, if I have a bad grade I know it's because of tests because I am the worst test taker.

R: So, what could you do different?

S: Learn better study strategies, and like stuff like that because honestly, like the teachers, they've never really taught me how to study and if they do then it's never a way that I understand.

R: You could probably…they would all tell you something different, but you can kind of, we all kind of have to figure out how we learn, and you've been in a smorgasbord where you get to pick, like in your food line at the cafeteria. You kind of have to listen to what they say, some might say, "To outline", another might say, “Tape it and read it back, or do the questions”, so what might work for you might not work for the next person, but you can take from everything that everybody says and say, “Well, I like this. I think this will work for me and this will work for me, but that won’t work for me, that won’t work for me, that won’t work for me”, so you kind of develop your own style of studying.

S: Like most teachers tell me to outline and that’s like the most thing I ever learned. Like, my family, my cousin, she also goes to this school, and she tells me to like put it on index cards and stuff, but …

R: Now that’s a good study skill.

S: I don’t know. I haven’t seemed to find my strategy yet.

R: You have to keep trying.

S: Yeah.

R: Yeah. I am an old geyser, okay, and I’m in school and I still have to figure out how to study for that particular thing because everything is a little bit different. Pretend you’re the teacher. I am going to make you the teacher for a day. You had taught the class. What would you have done differently to improve the interaction and the students’ experiences? If you were teaching, what would you do to make it like the perfect class?

S: If I was teaching I would do more hands-on activities because that’s what I enjoy most. Whenever I’m in a class and we do something hands-on, like, even if it’s Ms. Shaffer, she tells us to like color the cell and things. That makes it so much easier for me, and I guess if I understand how I feel, I may understand how other people feel …

R: Then you might teach that way that you learn the best.

S: Yeah.

R: How will your science experiences influence your decision about taking future science classes? I think I know the answer to that, but …

S: Ask the question again.

R: All your experiences that you've had up today, how will that influence whether or not you are going to take any more science classes?

S: I honestly don't know yet, like, I am very indecisive if I want to go into science or any in particular or anything.

R: But, have you always got good grades at it? You saying so?

S: Yeah.

R: And you've got good grades in math, you said?

S: Yeah. Like right now I'm taking Accounting II because I took Accounting I last year, and just taking Accounting II has helped me a lot in my thoughts of …

R: Yeah, it will. My challenge to you is to give it a thought. Okay. Because there is a lot of funding for Hispanic females to go to college and if you stay in science the money is just waiting for you because there are so few Hispanic females in science-related careers that if you decided you like it…you have to like it because there is no sense doing something because the money is there because then you will be miserable for the rest of your life, but if you like it, the money is there and …

S: That's what my mom tells me all the time.

R: The ticket is waiting for you if you want it, so, that is just my little challenge to you. That's it. Is there anything else you want to say?

S: No thank you.

R: Okay. Thank you. We made it before the bell rang, which is a miracle.

Interview Transcript #3: "Paola"

High-ability Hispanic Female #2 (HA2)

October 04, 2005

Researcher: I am here in Mr. P's class at Cypress Creek High School with Paola. I am going to let you hold this so that your responses are heard. That is more important than me talking. What grade are you in?

Paola: I am in 10th grade.

R: Where were you born?

P: I was born in Colombia.

R: Colombia. Where were your parents born?

P: In Colombia.

R: Both of them?

P: Yes, both of them.

R: How long have you been in the United States?

P: I was six, like when I was six I moved to New York and I've been living here for three years.

R: So, are you sixteen?

P: I am fifteen.

R: Fifteen. So you have been in this country nine years. And, were your grandparents here or your parents the first ones to come from another country?

P: No, my dad's father first came here, and then he brought us all.

R: Grandfather. And what language is your native language?

P: Spanish.

R: Spanish. What language do you speak in the home?

P: Spanish.

R: Spanish. Which language is most frequently spoken? Some people have Spanish and English, so I would say that that would be Spanish. Any other languages spoken in the home?

P: English.

R: English. Which is the language that you tend to speak or listen? When you are speaking or listening, which language do you defer to, Spanish or English?

P: English.

R: English. And when you're writing or reading?

P: English.

R: English. How many elementary schools have you attended in the United States?

P: Two, no only one.

R: Which one?

P: One.

R: One, and that was up in New York?

P: Yes.

R: How many middle schools?

P: Two.

R: Two, and where were they?

P: In New York and over here in Florida.

R: In New York and in Florida. How many high schools?

P: One.

R: One, and that would be this one? And, how long have you been at this school?

P: Two years.

R: Two years. Okay, now I am going to get into really looking at your science experiences that you have had through school, elementary, middle school, high school.

P: Okay.

R: I want to get a sense of your experiences, so please describe your past and present science experiences; were they good, were they not so good, boring or exciting?

P: Mostly it sounds like I * (racing tape, unintelligible). Light up little light bulbs and stuff, you know.

R: So you like the experiments?

P: Yes.

R: That is what you like. How about science don't you like?

P: The whole formulas, like, you know.

R: Have you taken any chemistry?

P: No.

R: Did you do some of the formulas in middle school or last year?

P: Last year.

R: In physical science? Is that what you took?

P: It was integrated science, but you know it changes every nine weeks.

R: Right, so you are having some chemistry in there. So, you didn't like the formulas because of the math?

P: Yeah.

R: Is there another reason why you didn't like the formulas?

P: Because I don't know, because you got to memorize all that stuff and …

R: What experiences contributed to taking science classes in high school? Now I know you are only in tenth grade and you have to take some. If you didn't have to take them, would you have taken them?

P: Umm, probably.

R: Do you think you'll take science classes after the ones that are required?

P: No.

R: How are you influenced by others in science, for instance, what does your family say about you studying science? What do your friends say, what do your teachers say?

P: They just, you know, they don't motivate me to like, "Yeah do this".

R: They don't really influence you?

P: No.

R: What do people say to you about that? Like if you say you're getting ready to study for a biology test or a science test, do they go, "Oh yeah, that's really good" or …

P: They go, "Oh that sucks. It's boring."

R: Yeah, okay. So they don't really look favorably on science.

P: No.

R: Is that your friends or your family?

P: My friends mostly.

R: Specifically tell me about, because my study is going to take all these responses that you are giving here, but it is especially going to focus on Hispanic females, which is why you were randomly chosen from the Hispanic females that I had. I chose some and prayed that they brought their consent form in, but you did, so I was like “Yeah”. (Laughing) I am really trying to understand how Hispanic females feel and girls, so tell me, what do you think people think about girls in science?

P: I don’t know. The truth is I’ve always believed that people always look down on women when they want that…

R: Why do you think that is?

P: I don’t know. Because men are sexist. I don’t know; they think they can do anything.

R: So you are saying that people don’t look favorably on women who are in science. What do they think the women should be doing? If they are not in science …

P: Well, the Hispanic men they really think that the woman should be at the house just cooking and cleaning, and I don’t think it should be like that.

R: You’ve got to find yourself a man who does not think that, huh? (Laughing)

P: Yeah. (Laughing)

R: It doesn’t fit with you having a career in science and being an engineer, or a physicist, or a chemist, or anything like that.

P: No. I want to study forensics, right, but that has to do with science, so …

R: Yes it does.

P: I would, you know, I would probably be taking that because it's required.

R: You want to be, what's that girl, Jordan, Crossing Jordan? That is a T.V. show that has a girl who is a forensic scientist.

P: That's cool. I love that type of thing.

R: And that CSI; you watch the CSI?

P: Yes. My dad, he got me into it.

R: Did he? What does he think about you studying forensics?

P: Oh, he loves that.

R: Now he is a Hispanic male.

P: Yeah, but …

R: How do you think he thinks about that?

P: Well, that is different because fathers, like towards their wives they think one way, but when they have daughters they want even the best for them.

R: They want them to push forward. They don't think that that is someone else's wife someday.

P: Exactly.

R: Ohhh. Well, good for him. How would you describe your feelings and beliefs about science as you were studying it? For instance, as you are working through whatever your teachers are telling you to do, whether it is in class or homework, what kinds of things do you find yourself saying, like, "This is really cool" or "This stinks, man. I just want to get through this" or "This is hard" or "This is easy". I mean what kinds of things are you telling yourself as you are doing science?

P: Well, mostly like "How are you going to finish this?" you know, because …

R: Do you find it easy?

P: Some of the work, yeah, it depends on what it is, you know.

R: What part is easy and what part is hard?

P: I think it is mostly hard like the whole math and the formulas. You've got to memorize the formula in order to get this or something.

R: The math. Are you good in math?

P: Yeah, I think so.

R: What is easy?

P: Mostly like the theories. Like the theories that you have to know.

R: A few more questions. If you could tell me a story that would help me understand how you believe and feel about science, based on any experience that you had, elementary, middle or high, what would that be? Something that you remember happening that you went, "Oh man, I don't ever want to do this" or "This is so cool that I want to do this." Like you talk about forensics. Was there something in school that you said, "Wow, I love this"?

P: Well. Like in elementary or what?

R: It could be any experience from any of your past. It does not matter where from.

P: Oh, well last year when we were mixing the *, * make one.

R: You mean chemistry?

P: Yes. I thought it was really interesting.

R: You made something new?

P: Yeah, and when we were examining a cow heart.

R: Oh, I've done that with my class. Isn't that awesome, that …

P: Yeah.

R: I would take my pen and go "Oh look, and here's the aorta, and oops look where it came out." They would be, "Oh, oh".

P: (Laughing)

R: They loved it. They are expensive. I could only buy one of them and pass it around the room. Did you have more than one of them?

P: No. Like one, for the whole class.

R: Yeah, they are very expensive. Which did you like more, studying the biology with the cow's heart or the chemicals? I am just curious.

P: I think it was the cow's heart.

R: You know they say that females who do study science tend toward biology because they like plants and animals, but they tend to shy away from physics and chemistry, and that was me because I was a science teacher, but I studied biology, and that's what interested me, was the human body.

P: Yeah, it's cool.

R: I just think it's cool. Why do you think so few women pursue science-related careers? It can relate to something else that you have said, for instance you said that perhaps, especially in Hispanic culture, women are not really encouraged because of that perception that women should be in the home, raising a family and cooking the meals. Besides that, what do you think could be influencing so few Hispanic women going into science?

P: Like they can do it, but I don't think they have confidence.

R: That's interesting. I never heard that before. Why do you think they don't have the confidence?

P: Because they really weren't … they didn't grow up, you know, around that type of stuff.

R: Yeah.

P: So it makes them think they can't do it.

R: Oh. That's a good answer. I hadn't heard that before. Now you know your grades. I don't know your grades, your academic history. If you could do anything different what would that be? Your grades in general.

P: I have always dreamed of getting straight A's, so, you know, I …

R: Are you close to that?

P: Yeah, I am. I have B's and A's.

R: Good for you.

P: Finally.

R: So nothing really stands in your way if you are making A's and B's.

P: What do you mean, like?

R: If you make a B; whenever you do make a B what was the reason for it? Do you know?

P: Well now it's because I am mostly thinking of me, because like in my previous years it was all about friends and you know you want to do this because you don't want to look bad and all that kind of stuff. Like this year I have been mostly focusing on me.

R: That's good, and you're only in 10th grade, right?

P: Yeah.

R: So, that's good. If you do 3 solid years of focus you can write your ticket anywhere. Pretend you were the teacher, the teacher for a day, Ms. *. What would you do different to make your class exciting and good for the kids?

P: Well, I would probably like to do experiments because I know everybody loves that type of stuff, but not boring experiments. You know because experiments like they would be like, "Oh yeah, that's cool, let's do this", you know.

R: So you would do more of those. What else would you do?

P: Ummm, probably more class discussions, but like interesting ones, you know.

R: What would make them interesting?

P: Ummm, well, like I think that the tone that a teacher talks is really important because you don't want a teacher to be talking to you all low because it will, like, make you fall asleep. Like, if you're like talking to your students, making them participate, you're like, "Oh what do you think of this?" They will get even more into the class.

R: So maybe if the teacher is exciting, then the kids will get excited.

P: Yeah, because …

R: I believe that too. I remember when I was teaching, if I was bored, I knew they were bored. So when I started feeling bored I change it up because if I'm having fun, I know they'll have fun, because science can be a lot of fun. So that's important that you kind of picked up on that. How will your science experiences influence your decision about taking future science classes? Like all these things that we've talked about, what will influence whether or not you take any more? Now, you have told me two different things and they don't necessarily match up. You've told me you want to study forensics.

P: Hmmm.

R: But then you've also said you probably won't take anymore science unless you have to. The two don't match up. So, you are going to have to resolve that somehow.

P: Yeah, that's true.

R: Because you can't get to forensics without …

P: But I don't like, in a way I don't really see forensics as a science class because it is something that I'm interested in.

R: Right.

P: So.

R: But you are going to have to take some of these other higher level science classes…

P: That's true.

R: …to be able to study forensics in college. The first thing they're going to be looking at is what is your background in high school, and that is going to feed into how they look at you on your transcripts, too…when you go to apply for colleges. So if you, this is the sad thing, but a lot of girls just like you are deselecting themselves out of the higher science classes because like you they probably said, "I don't want to take any more", and then they realize, "Ah, I should have taken that". But once you don't take that, it is hard to go back, because you can't make the leap from a 10th grade biology class to a science class in college. It would be really hard; it can be done, but it would be hard. So, you really don't know whether or not you're going to take any science classes, more science?

P: Now that you tell me that, I probably will because of what I want to do.

R: Talk to your guidance counselor. Have you talked to your guidance counselor?

P: Yeah. A matter-of-fact I tried to get out of a class because not for anything, but in a way I felt like I wasn't being challenged enough.

R: Hmm, hmm.

P: So, I was trying to get into like a biology class instead of a physical science one, but they didn't let me because my grades from last year, but I tried and they said I couldn't. And they, like I went to my counselor and she told me not to think of the future because forensics is just an elective, so in order to take that I was supposed to take chemistry.

R: So you will need to take biology, you need to take chemistry, and whatever other science class they offer in your junior and senior year.

P: Yeah.

R: Because if you really want to do it…you need to ask her if you are going to study forensics in college, what sciences do you need. You need to really corner her on that because it is a science and they are going to expect some math and chemistry and physics with it. I mean if you're like the detective, because really that is what a forensic scientist is, you are trying to find the cause of death, and you have to be a detective, and what are your tools…chemistry, * (laughing). Really, even the physics, I mean as boring at it sounds, the angle of the knife cut can be calculated and you could find where it entered the body, I mean really you are going to have to use those, those are going to be your tools. So, you are going to have to have those under you. Anyway, I wasn't even planning on saying all that, but you seemed so interested in it, I hope that you get to where you want to go.

P: Thank you.

R: And that's it. Did you have any questions for me?

P: No, not really.

R: Good luck. Can I call you Dr. * (Laughing)

P: (Laughing) Thank you.

R: Thank you.

Interview Transcript #4: "E"

Low-ability Hispanic Female #2 (LA2)

October 04, 2005

Researcher: We are at Cypress Creek High School and we are talking with E. I am going to have E hold the microphone so your responses are heard because your responses are more important than my questions. Okay. What grade are you in?

E: I am in 10th grade.

R: 10th grader. Where were you born?

E: I was born in New York.

R: In New York. Where were your parents born?

E: In the Dominican Republic.

R: Dominican. Both of them?

E: Yes.

R: Okay, both. How long have you been in the United States?

E: My whole life.

R: Did any of your grandparents come to this country? We know your parents came to this country, but …

E: Yeah, my grandma.

R: Your grandma, but you are second generation.

E: Hmmm.

R: Okay. What is your native language?

E: Actually it is Spanish, but like, I was born in New York so my first language was English.

R: English. What is your home language?

E: Spanish, * you talk about.

R: And then of those two, which do you speak more frequently in the home?

E: Probably English.

R: English. Okay. Any other languages spoken in the home?

E: Spanish sometimes.

R: So you have English and Spanish. Anything other than English and Spanish?

E: No.

R: No, okay. Now when you think or speak or listen, do you think in Spanish or English?

E: In English.

R: English. And when you read and write, do you read and write in Spanish or English?

E: English.

R: English. Then next couple of questions are about your schools. How many elementary schools did you attend in the United States?

E: Ooohf.

R: You've got to think way, way back there.

E: I think around six.

R: Six of them. Were they all up in New York?

E: Yeah.

R: Did you go to any elementary schools in Florida?

E: No.

R: Okay. How about middle schools?

E: Middle school in New York?

R: Middle schools total. How many?

E: Oh, like, three of them.

R: Three of them, and how many were in New York?

E: Two.

R: Two in New York.

E: Yeah, and one here.

R: One in Florida. And then how many high schools have you attended?

E: One.

R: One, and that is this one?

E: Yes.

R: And how long have you been here?

E: Two years.

R: Now the next questions are really trying to dig deep about your feelings and experiences about science, and you can think back as far as you want to go; if you had science in elementary school, science in middle school, science last year in high school. Any of those years you can call on for your memories. Okay? Please describe your past and present science experiences.

E: Like good experiences that I had?

R: Good, bad, boring, loving it.

E: We had science, we had to do a project and we had to build a volcano.

R: What did you have to do?

E: A volcano.

R: Oh, a volcano.

E: That was fun.

R: That was fun?

E: Yeah.

R: Is that the thing you remember the most?

E: Yeah.

R: What grade was that?

E: That was like sixth grade.

R: In sixth. What experiences contributed to taking science classes in high school?

E: What do you mean?

R: Well, basically anything about your science classes that either made you want to take science in high school or made you not want to take science in high school?

E: The math that I have to use.

R: The math. Okay. That is always a big gatekeeper.

E: I'm not really good in math.

R: Not good? * and I was a science teacher. Do you feel like the math is going to prevent you from taking more science classes after 10th grade?

E: Yeah. It is making it difficult.

R: Makes it difficult. That is why the research shows that girls tend to take biology because this has less math. Maybe not because it has less math; they love plants and animals, but I think that it has something to do with it because that's what I did. I went into biology because I am not a whiz at math and so I don't know about that chemistry and physics. I love chemistry and physics, but the math is just really hard. How are you influenced by others, say your family, teachers, or your friends?

E: My teachers, my science teacher. I mean my aunt is a science teacher.

R: Here in Florida?

E: No, in New York.

R: And what does she tell you? Does she tell you to study science, or not study science?

E: She tells me that it is fun if I put my mind to it.

R: Fun if you put her mind to it. Do you think that's something you're going to want to do?

E: No.

R: No. And what do other people say about studying science? For instance, when you're studying science for school, do your friends say something, your parents…

E: They don't like it.

R: They don't like it? Why do you think they don't like it?

E: Because, I guess because of the math. It is really hard.

R: They don't like it either, huh?

E: And they worry. My mother says that I have to use this.

R: So, basically, they kind of reinforce your feelings about science. All of them kind of think the same thing.

E: Yeah.

R: Now let's look about girls in science. Because girls historically, there are not too many girls in science. Why do you think that is?

E: Maybe they don't have an open mind, like the guys.

R: Can you think of anything else that might be getting in the way?

E: They don't like to experience stuff.

R: Huh?

E: They don't like to experience stuff.

R: They don't have to experience stuff?

E: They don't like to experience, like, stuff.

R: Oh, do you think that's true of you?

E: Of me?

R: Uh, huh.

E: Yes.

R: You play it safe.

E: Yes.

R: As you're studying science, whether you're doing homework, or you're doing class work, or you are in the middle of an experiment, or a lab; as you are doing it, what do you think you are telling yourself? "Oh this is fun" or "I'm good at this" or "This is easy" or "This is hard" or "This is boring" or "This is …" You know, what are you saying to yourself as you are doing it?

E: It's fun sometimes. When you are in a group and you are doing a lot of experiments, but then when you're by yourself, when you have to do math work it gets boring and difficult, yeah.

R: So, if you work in a group you might be able to *. Do you think the stuff that makes it boring and difficult, like the math…if you did that in a group would that be better?

E: Yeah, because everybody has their own mind to it, so it will be easier.

R: Yeah. I think so *. I want you to tell me any story that you have, a memorable story that would help me understand how you feel about science. It could be an experience you had at any point in time in your school about science.

E: Hmmm. We had to do a bridge and then we had to do like cars to drive through it, and it never worked.

R: (Laughing) What grade was that?

E: That was sixth grade.

R: Sixth grade, too? Wow, that teacher sounds cool. You built a volcano, you did a bridge.

E: He was. Well, it was so hard. We couldn't do it. It was too difficult, so we quit.

R: But it was fun?

E: Yeah, it was funny though.

R: Why do think so few women, and Hispanic women especially are only 2% of all the scientists and science-related fields are Hispanic women? That is like out of every hundred, two.

E: Hmmm.

R: Why do you think that is?

E: They might not like science. Like, it is hard though. Not everybody has a mind for it. You've got to think a lot.

R: But, generally speaking, would you say … you are talking about everybody, you have to have a mind for it. But you would expect women and men to have the same kind of mind for it because they have the same…We would not want to say that the men are more intelligent than us, so what would make some have more of a mind for it than others? Given that everybody, Hispanic, Asian, whites, African-Americans; they all have equal intelligence. What do you think would make a difference?

E: Would make a difference? Like most of the * like me, *. It's not like * for science.

R: Okay, tell me more about that.

E: It's not like you were like, "Wow" for science. I don't know. It is my *

R: So, can you imagine telling others, "I am a scientist"? What do you think the reaction would be?

E: (Laughing)

R: You be honest.

E: If you were a scientist?

R: If you were a scientist. You were telling your peers, "I am a scientist".

E: They wouldn't believe me.

R: They wouldn't believe you? Why?

E: Because I don't like science. I am always complaining.

R: (Laughing) You know your grades that you've made in school. I don't know your grades. So think about your academic history. If you could do anything different, what would that be?

E: In science?

R: In any class.

E: In any class or in science I want you to read the book and do my homework, like to like know more about it and what I'm doing, and I would not be lost in class, science.

R: So you already know what you need to do to do better in science. Would that hold true for your other classes? Would that hold true for your other classes, too?

E: Nah, I only have that problem in science.

R: Only in science.

E: I enjoy my other classes.

R: Have you been able to make yourself do that this year?

E: Hmmm…just a little bit.

R: (Chuckling)

E: When there's like, when I actually enjoy it.

R: So, I am wondering and here is the question that I'm going to… it kind of blends what I'm thinking when you are saying that. If I could sprinkle you with dust and make you the teacher, how could you make science better for someone like you who doesn't like it?

E: Hmmm… I would do a lot of experiments.

R: A lot of experiments.

E: Yeah. I would make it fun.

R: What would you need to do to make it fun?

E: Hmmm… I would * That would make it easier for them to understand me.

R: Games?

E: Yeah.

R: What else?

E: Hmmm… I would talk to them about it; ask them their experience. Like what they think about it.

R: So you would tie in their past experiences. You know research says that that's a *. You should be a teacher.

E: (Chuckling) I want to be a detective.

R: Oh, cool.

E: Yeah. I like the action.

R: Yeah. But you are not a risk-taker in science? (Laughing) Just * in life. I think I know the answer to this, but I'm going to ask you anyway. How will your science experiences influence your decision about taking future science classes? Are you going to take more science?

E: No.

R: No.

E: If I don't have to I won't. That would be the last class I would take.

R: I was talking to a girl who wants to be a forensic scientist. Kind of like a detective, but in science. * all that. But, she doesn't want to take any more science classes. I was talking to her going, “Well you say you don’t want to take any more science classes, but you want to be a forensic scientist…”.

E: She has a lot to go.

R: That doesn’t match up. You need to talk to your guidance counselor so, anyway. That’s the end. Do you have any questions for me?

E: Do you like your job?

R: I love my job, and I loved teaching when I did it.

E: Was it fun?

R: Yes it is. Yes it is, in fact, there would be days I would drive to work and I would say, “Oh, I am bored today” and I would shake it up and I would do something fun like, one day, I even had my administrator observing me this day and I didn’t care, I changed up my lesson plan, and if you studied the human body you’ve got your blood vessels.

E: Yeah.

R: Well, I made different people in the room different parts of the blood and I took the aisles of the…I did this a lot, I would make the classroom like a *cell. We would have the * fibers would be big pieces of yarn, I mean I would just … I loved it. We did the cow eyes and heart and dissection. I just did, and I just loved science.

E: You should see this teacher so he could make it fun in class.

R: Is he not fun? I won’t tell him. He won’t know. No, I’m not.

E: (Laughing)

R: I figured if I was having fun, my kids were having fun, and if I was bored, they would be bored, so…

E: He seems good when he teaches, but it is not like… that people actually pay attention that you were like “Wow”. He just teaches and that’s it.

R: You don’t do labs?

E: No. Not a lot. Sometimes.

R: It depends on the teacher. It really does. You have to love what you do, so whether you’re a detective or something else, you spend 8 hours out of your day doing it, you have to love it. And now I am out of the classroom and I am an administrator and I just love kids. I don’t care how old you are, I just love being in the classroom today with you all. Just watching you all being in high school kids, you know, passing *… putting on makeup, I am thinking “Thank God I am not a high school kid anymore”, but I do love kids, so I do love my job.

E: I like it. I like being in school. Not to be a teacher.

R: I know, you have to have a mind for it. You have to actually have a heart for it because kids can drive you nuts if you don’t love them, and I did middle school for 17 years, so you didn’t really love them, you’d hate them, so I loved them. (Laughing) So it made it pretty good.

E: (Laughing) Ahh.

R: But thank you. Good luck to you.

E: Thank you.

R: Thank you.

APPENDIX W: CODING PROCESS: GROUNDED THEORY

GROUNDED THEORY CODING PROCESS

This study employed the grounded theory process (Glaser & Strauss, 1967: 5-6; Creswell, 1998: 56; Corbin & Strauss, 1990) :) of data analysis which is systematic and follows a standard format:

- Number each transcription for identification purposes.
- Remember to generate a new copy of each interview at each stage of coding. The original transcription is Generation #1.
- Set aside all theoretical ideas or notions to allow categories to emerge.
- Hold true to the systematic approach.
- Address if/when the theory is sufficiently saturated or detailed.
- The theory must have all specific components.

1) **OPEN CODING** (Corbin & Strauss, 1990): The researcher forms initial **categories** of information about the phenomenon being studied by segmenting information. Within each of the categories (themes), several **properties** (multiple perspectives about the category) are found and data is sought to **dimensionalize** the category and provide a continuum of properties. Using the **constant comparative** approach, continue to look for instances that represent the categories until all insights are exhausted/saturated. Highlight each new emerging theme with a commensurate coded color and generate another copy of the coded data as Interview Generation #2. All interviews are coded in the same manner, generating an Interview Generation #2 copy for each participant, with color coding. Review each coded interview for revisions. Have a second coder code for themes and cross-reference both codes for discrepancies. Resolve discrepancies between raters to increase rater reliability.

Emergent Themes:

➢ Content Rigor	Brown
➢ Cultural Influence	Gray
➢ Math influence	Purple
➢ Parent/Family Influence	Pink
➢ Peer Influence	Red
➢ Personal Motivation/Desire	Blue
➢ Projects and Labs	Green
➢ Suggested Changes in Teaching	Teal
➢ Teacher Influence	Aqua

2) **AXIAL CODING** (Corbin & Strauss, 1990). The researcher assembles the data by interconnecting categories in new ways after open coding using a **coding paradigm** in which (a) a **central theme**/category around the phenomenon are identified; (b) explores **causal conditions** that influence the phenomenon; (c) specifies the strategies or **interactions that result** from the central phenomenon; (d) identifies the **context**; (e) identifies the **intervening conditions** that influence the strategies or interactions; (f) and delineate the **consequences** or outcomes of the interactions for the central phenomenon. At this stage transfer all similar color codes, by theme to their own document. In looking for interconnections, create look for central themes, causal conditions, interactions, contexts, intervening conditions, and/or outcomes. There should be one document per new category showing comments from all 4 interviews for that category and organized by idea. These will be Generation #3 documents.

Newly Formed Interconnected Categories:

- Classroom Influences
  - Content is difficult
  - Perception of math ability as a factor
  - Presence of hands-on activities
  - Presence of learning strategies
  - Perceptions of Teacher

- Cultural Influences
  - Family & Peers

- Personal Influences
  - Future career and motivation

3) **SELECTIVE CODING** (Corbin & Strauss, 1990). The researcher will identify a **"story line"** and write a story that integrates the categories during the axial coding process. Conditional **propositions** or hypotheses are presented. This results in a **substantive-level theory** which is close to a specific problem or population of people, in this case, Hispanic female high school science students. This becomes the narrative in the Chapter 5 discussion.

4) CONDITIONAL MATRIX (optional). Researcher develops a visual portrayal that elucidates the social, historical, and/or economic conditions influencing the central phenomenon. (Table 22).

APPENDIX X: INTERVIEWS: EMERGENT THEMES & SUB THEMES

Sub Theme One: Perception that Content is Difficult

Operational Definition: Perception by students' on the level of effort required to meet the rigor of the science content, both subtle or explicit, that tend to promote or fail to promote a general interest in science learning and engagement.

CATHERINE:

C: I find it difficult. I work through it. But I don't like it. Except the [human] body. Like the body how it works, I love that. The cells, that's cool.

STEPHANIE:

S: Well, if I am doing it and it seems easy then yeah I do, I say, "Wow, I am good at this", and then if it is hard then I say, "I …I can't wait to get out of science class.

S: Well, if I don't get something then I ask because I know if I ask it is going to make it better, it's going to help me understand it better, but I don't know, like basically if I don't get it I ask, but then if I get it, and there are other people who don't get it, then I try to help them out, because I know that will make it easier for them also. It makes me feel better.

S: So few women pursue science careers because it's hard. As we go on each day it gets harder and harder, like, really there has been like one thing that I've found easy in this class.

PAOLA:

P: [I ask myself] "How are you going to finish this?" you know, because [it's hard]. Some of the work [is easy], yeah, it depends on what it is, you know.

P: I think it is mostly hard like the whole math and the formulas. You've got to memorize the formula in order to get this or something.

P: Mostly like the theories. Like the theories that you have to know [are easy].

"E"

E: When you're [working] by yourself, when you have to do math work it gets boring and difficult. In a group would that be better so it will be easier.

E: Well, it [building a bridge] was so hard. We couldn't do it. It was too difficult, so we quit.

E: They [Hispanic women] might not like science. Like, it is hard though. Not everybody has a mind for it. You've got to think a lot.

E: This doesn't hold true for [my] other classes, I only have that problem [don't want you to read the book and do my homework] in science.

E: Play games. That would make it easier for [me] to understand.

Sub Theme Two: Mathematics Ability Perception

Operational Definition: Perception by students' on their mathematics ability and/or achievement, that are either subtle or explicit, that tends to promote or fail to promote a general interest in science learning and engagement.

CATHERINE:

C: I am good in math

STEPHANIE:

S: I want to hopefully, like, go into accounting. like numbers. I've gotten better [at Math] since last year. Like right now I'm taking Accounting II because I took Accounting I last year, and just taking Accounting II has helped me a lot in my thoughts of [taking science]

PAOLA:

P: [I] didn't like the [chemistry] formulas because of the math.

P: [I think I am] good in math.

"E"

E: [I have to] use the math. These experiences contributed to taking science classes in high school. I'm not really good in math. It is making it difficult.

E: If you did that [Math] in a group would that be better.

Sub Theme Three: Presence of Hands-on Activities

Operational Definition: Enriching hands-on activities which involve students within the standard learning environment of the classroom.

CATHERINE:

C: We used to do labs and stuff like that, with the teacher. We do projects here. A lot of labs and stuff like that makes it fun: My middle school they make us do, like, these group projects. Like we pick a topic and we look for the, like, the hypothesis, stuff like that. In one, we were talking about the body parts. That is where I started liking it, so I started looking about it, and finding all the [information].

STEPHANIE:

S: When we did [do experiments] they were really fun. Like we would have to like construct roller coasters when we were doing like friction and stuff, in groups.

S: Actually, like whenever I think of science it has always been of the roller coaster that we did. That was a lot of fun because we had to, like, do the advertising for roller coaster, we had to build the roller coaster, we had to make the little people and all the cars and everything, and we had to go into detail for it.

PAOLA:

P: [I] like the experiments. I would probably like to do experiments because I know everybody loves that type of stuff, but not boring experiments. You know because experiments like they would be like, "Oh yeah, that's cool, let's do this", you know.

"E"

E: It's fun sometimes. When you are in a group and you are doing a lot of experiments. I would do a lot of experiments I would make it fun.

E: If you did that [Math] in a group would that be better.

Sub Them Four: Perception of Facilitation of Learning Strategies

Operational Definition: Perceptions that helpful learning strategies are being taught and tend to promote a general interest in science learning and engagement.

STEPHANIE:

S: It was him, but he, I don't know, he would just like explain more, he had like the whole class involved in taking notes and stuff.

S: I have good grades. Like, if I have a bad grade I know it's because of tests because I am the worst test taker.

S: Learn better study strategies, and like stuff like that because honestly, like the teachers, they've never really taught me how to study and if they do then it's never a way that I understand.

S: Like most teachers tell me to outline and that's like the most thing I ever learned. Like, my family, my cousin, she also goes to this school, and she tells me to like put it on index cards and stuff.

Sub Theme Five: Perception of Teachers

Operational Definition: Messages given by teachers, both subtle and explicit that tend to promote or fail to promote a general interest in science learning and engagement. Decision-making during lesson planning and instructional delivery are components of the communication system as well as student-teacher interaction.

CATHERINE:

C: You know. I really didn't like her. I didn't like the way she teach. She didn't have fun in the class. She was very serious all the time. Like this one, she is not like she is fun.

C: I don't *comment that much with teachers. I don't know, like, they don't ask you that type of questions. (regarding liking science) and [I] think they should?

C: Don't focus on, like… she is always talking to us like if you are late, if you do something wrong, like, focus on the study part and you know like make sure we do the homework, make sure we understand things. Don't focus on like if we're late or we are going home,

C: Some teachers, they are not good at it. I'm sorry, but they are not good at it, some teachers, and that is why you know people are going to go like "Oh my God." Like my 6th, 7th and 8th teacher, he was good. Like he was funny, he was always telling stories about science and stuff like that. Like in 8th grade he turned boring. I didn't like him anymore.

C: My 9th grade she was good really, she was boring, too, but she was a good teacher though. She is good, like, for very beginner she is good. I don't know about the other one. Yeah, she is good, too, but she is too serious.

STEPHANIE:

S: The teacher always made it fun for us, but like last year, he would just like explain more, he had like the whole class involved in taking notes and stuff.

S: Honestly, like the teachers, they've never really taught me how to study and if they do then it's never a way that I understand.

PAOLA

P: If the teacher is exciting, then the kids will get excited.

P: I tried to get out of a class because not for nothing, but in a way I felt like I wasn't being challenged enough.

P: I went to my counselor and she told me not to think of the future because forensics is just an elective.

"E"

E: You should see this teacher. He could make it fun in class.

Sub Theme Six: Family and Peer Influence

Operational Definition: Messages given by culture through family and peers, both subtle and explicit that tend to promote or fail to promote a general interest in science learning and engagement.

CATHERINE:

C: My parents are they telling me I should. They say "Catherine, they give you money". I could be an engineer because my dad is an engineer.

C: [I do not] find many women actually studying science. Like doctors, or engineers, or physicists.

C: In my personal opinion it's like the Latin woman is more of a house women, like she is always in the house, like, with the kids, cooking, school and, you know, they will work for some *, to work if she needs the money and because *. Like I say she rather prefer to stay in the house, cleaning the house, making food for us, and stuff like that; not really liking studying for 8 years to be a scientist. I don't think like that. I don't want to. I don't want to stay in the house, see my kids and stuff like that. Like I want to be married like 20 years, something like that. I want to party first, and have a degree, and all that stuff.

C: [My fiends say] "They give you money". That is really the thing about it. "Go, go, they give you money". [They would not] think that I was nerdy.

C: It [answering questions in front of the boys] would be cool.

STEPHANIE:

S: My mom just told me to do what I want, like, do what most I enjoy doing. My parents both say that actually. To tell you the truth, I have never really got into that subject with my family or anything [on what I would be good at]. My mom tells me all the time. [If I] decided I liked it…you have to like it because there is no sense doing something because the money is there because then you will be miserable for the rest of your life, but if you like it, the money is there …

S: So few women pursue science careers because it's hard.

S: [My girlfriends] do not say anything about it?

PAOLA:

P: They just, you know, they [parents] don't motivate me to like, "Yeah do this".

P: My dad, he got me into it, watch the CSI. He loves that.

P: Fathers, like towards their wives they think one way, that the woman should be at the house just cooking and cleaning, but when they have daughters they want even the best for them.

P: The truth is I've always believed that people always look down on women when they want that [science] because men are sexist. I don't know; they think they can do anything. Well, the Hispanic men they really think that the woman should be at the house just cooking and cleaning, and I don't think it should be like that. It doesn't fit with you having a career in science… influencing so few Hispanic women going into science

P: Like they [Hispanic girls] can do it, but I don't think they have confidence… Because they really weren't … they didn't grow up, you know, around that type of stuff. So it makes them think they can't do it.

P: They go, "Oh that sucks. It's boring." They [my friends] don't really look favorably on science.

"E"

E: My aunt is a science teacher. She tells me that it is fun if I put my mind to it. That's not something [I'm] going to want to do.

E: My mother says that I have to use this.

E: Maybe they [girls] don't have an open mind, like the guys. They don't like to experience stuff. [I] think that's true of [me]. [I] play it safe.

E: They [friends] don't like it. Because, I guess because of the math. It is really hard.

Sub Theme Seven: Career and Motivation to Persist

Operational Definition: Traits within the student that tend to promote or fail to promote a general interest in science learning and engagement.

CATHERINE

C: A lot of labs and stuff like that makes it fun.

C: I am forced (required) to take them. Not really forced you know. Forced, because like I have to do it because of the school.

C: I am not a big fan of science. I have to like science because I want to become a doctor, so I have to like it.

C: You know I am taking medical skills, I think, and I love it. [I like] what we learn, like the body, you know, what happens inside, and what are the functions. "Wow, I think I like this", [medicine]. That is where I started liking it, so I started looking about it,

C: I don't know because I am good. In this class I don't know what has happened to me, I have a C, because like my other grades, and my other years I still had an A. But like, I would rather be a teacher, psychology, but that is like medicine, too.

C: I love psychiatry. What else? I just have my head on the medicine thing. I'm not thinking of something else.

C: [I] have had good science experiences, because [I] want to stick with it.

STEPHANIE:

S: They're boring if the only thing we are doing like taking notes or something.

S: in a way I'm just kind of doing it because I have to take it for my high school.

S: Probably not take some after [I] don't have to take them? I honestly don't know yet, like, I am very indecisive if I want to go into science or any in particular or anything.

PAOLA:

P: [I] don't like the whole [chemical] formulas, like, you know, because you got to memorize all that stuff

P: [I don't] think I'll take science classes after the ones that are required.

P: I want to study forensics, right, but that has to do with science. I want to be, a girl who is a forensic scientist. That's cool. I love that type of thing. I don't like, in a way I don't really see forensics as a science class because it is something that I'm interested in. take any science classes, more science. Now that you tell me that, I probably will [take more science classes] because of what I want to do. [I] will need to take biology, need to take chemistry, and whatever other science class they offer in [my] junior and senior year.

P: Chemistry, I thought it was really interesting. And when we were examining a cow heart. [I]liked studying the biology with the cow's heart more. The human body. It's cool.

P: Well now it's because I am mostly thinking of me, because like in my previous years it was all about friends and you know you want to do this because you don't want to look bad and all that kind of stuff. Like this year I have been mostly focusing on me.

"E"

E: It's not like [I am] like, "Wow" for science. Because I don't like science. I am always complaining.

E: I want [to try] to read the book and do my homework, like to like know more about it and what I'm doing, and I would not be lost in class, science. I enjoy my other classes.

E: [I am not] going to take more science. If I don't have to I won't. That would be the last class I would take.

Interviewed Hispanic Female Students' Strategies and Suggestions

Operational Definition: Suggestions by students' on what changes could be implemented that would tend to promote a general interest in science learning and engagement by high school Hispanic females.

CATHERINE:

C: Truly, I don't know. Waiting for more generations to come like me

STEPHANIE:

S: If the teacher spends more time on one thing instead of, like, Ms. "S", she is great. Like, she has helped me a lot, and like in understanding things and just making me feel better, I guess, about science. [We] spent more time on one topic rather then less time on a lot of topics.

S: I have good grades. Like, if I have a bad grade I know it's because of tests because I am the worst test taker. [I need to] Learn better study strategies

S: Like most teachers tell me to outline and that's like the most thing I ever learned. Like, my family, my cousin, she also goes to this school, and she tells me to like put it on index cards and stuff. I haven't seemed to find my strategy yet.

S: I would do more hands-on activities because that's what I enjoy most. Whenever I'm in a class and we do something hands-on, like, even if it's Ms. "S", she tells us to like color the cell and things. That makes it so much easier for me, and I guess if I understand how I feel, I may understand how other people feel, teach [them] that way that [I] learn the best.

PAOLA:

P: [I would] probably like to do experiments, probably more class discussions, but like interesting ones, you know.

P: The tone that a teacher talks is really important because you don't want a teacher to be talking to you all low because it will, like, make you fall asleep.

P: If you're like talking to your students, making them participate, you're like, "Oh what do you think of this?" They will get even more into the class.

“E”

E: I would do a lot of experiments. That would make it fun.

E: I would play games that would make it easier for them to understand me.

E: I would talk to them about it; ask them their experience. Like what they think about it.

APPENDIX Y: TABLES

Table 1: Distribution of the Orange County Students by Racial/Ethnic Group, fall 2005.

Racial/Ethnic Group	Percentage
White	36.43%
Black	27.81%
Hispanic	29.30%
Asian/Pacific Islander	4.04
Multi-Cultural	1.99%
American Indian/Alaska Native	0.43%
Total percent	100%

Data source: OCPS Pocket Facts 2005-2006.

Table 2: Distribution of Florida Students by Racial/Ethnic Group, fall 2003.

Racial/Ethnic Group	Percentage
White	49.80%
Black	23.9%
Hispanic	21.7%
Multiracial	2.3
Asian/Pacific Islander	2.0%
American Indian	0.3%
Total percent	100%

Data source: Florida DOE Student Information Database, fall survey data for 2003-2004.

Table 3: Initial Survey Frequencies on Teacher Questionnaire Regarding Teaching Method.

Question #40: I prefer to teach using:

Type of Instructional Method	Frequency	Percentage
Direct Instruction	6	14.6%
Inquiry-based Instruction	14	34.1%
Both Direct and Inquiry-based	21	51.2%
Total percent	41	100%

Table 4: Reliability coefficient of the SSEQ Pilot Student Instrument.

RELIABILITY ANALSIS SCALE (ALPHA)

1.	Q39	Using a computer in science class
2.	Q40	Understanding concepts in a biology text
3.	Q41	Using chemical formulas and equations
4.	Q42	Doing well on a biology exam
5.	Q43	Doing chemistry homework problems well
6.	Q44	Doing physics lab experiments well
7.	Q45	Using a microscope
8.	Q46	Lighting a lab Bunsen Burner
9.	Q47	Winning a science fair award for a biology project
10.	Q48	Handling laboratory chemicals
11.	Q49	Doing physics homework problems well
12.	Q50	Taking essay tests in biology
13.	Q51	Performing lab experiments using electricity
14.	Q52	Getting good grades in biology
15.	Q53	Answering questions in biology class
16.	Q54	Asking questions in chemistry class
17.	Q55	Memorizing factual information
18.	Q56	Understanding concepts in a chemistry textbook
19.	Q57	Asking questions in biology class
20.	Q58	Learning about famous scientists
21.	Q59	Understanding concepts in a physics textbook
22.	Q60	Getting good grades in chemistry
23.	Q61	Understanding abstract chemical concepts
24.	Q62	Asking questions in physics class
25.	Q63	Getting good grades in physics
26.	Q64	Experiments with simple machines
27.	Q65	Doing science activities for fun

RELIABILITY ANALYSIS SCALE (ALPHA)

Item-total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Alpha if Item Deleted
Q39	93.0526	446.4296	.4176	.9485
Q40	93.3421	445.3663	.5495	.9465
Q41	93.3421	445.3663	.5082	.9470
Q42	93.5789	435.0612	.7195	.9447
Q43	93.8421	434.1366	.7213	.9447
Q44	93.1316	427.4687	.7653	.9441
Q45	92.7105	446.6977	.4926	.9472
Q46	93.0526	430.0512	.6665	.9454
Q47	93.8947	433.1778	.7065	.9448
Q48	93.0263	440.0804	.6530	.9455
Q49	93.5526	432.3620	.7297	.9446
Q50	93.7895	442.3329	.5012	.9474
Q51	92.9737	432.0804	.7529	.9443
Q52	92.8684	440.1714	.6752	.9453
Q53	92.8421	445.7582	.6187	.9459
Q54	92.7632	451.1586	.5810	.9464
Q55	93.1579	441.1636	.6344	.9457
Q56	93.4737	436.3642	.6918	.9450
Q57	92.7368	452.2532	.5425	.9467
Q58	93.2105	445.4680	.5045	.9471
Q59	93.3421	444.4474	.5682	.9463
Q60	93.1316	435.0363	.7627	.9443
Q61	93.5000	436.1486	.7264	.9447
Q62	92.7105	446.9139	.5297	.9467
Q63	93.2368	436.0775	.6723	.9452
Q64	92.5526	450.9566	.6223	.9461
Q65	92.3421	453.3663	.4480	.9474

Reliability Coefficients

N of Cases = 38.0 N of Items = 27

Alpha = .9477

Table 5: Total Variance Explained – Pilot Study

Factor	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings(a)		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumu-lative %	Total	% of Variance	Cumu-lative %
1	11.825	43.796	43.796	11.475	42.500	42.500	9.812		
2	2.731	10.113	53.909	2.378	8.809	51.308	7.832		
3	2.464	9.126	63.035	2.164	8.016	59.324	6.815		
4	1.497	5.543	68.578	1.120	4.147	63.471	4.300		
5	1.346	4.985	73.563						
6	1.224	4.534	78.097						
7	1.110	4.111	82.208						
8	.796	2.948	85.156						
9	.643	2.380	87.536						
10	.572	2.118	89.654						
11	.459	1.700	91.354						
12	.405	1.501	92.855						
13	.348	1.291	94.146						
14	.320	1.183	95.329						
15	.237	.877	96.206						
16	.181	.672	96.879						
17	.168	.621	97.500						
18	.159	.588	98.088						
19	.119	.442	98.530						
20	.102	.378	98.908						
21	.081	.299	99.206						
22	.064	.239	99.445						
23	.055	.205	99.650						
24	.044	.164	99.813						
25	.023	.084	99.897						
26	.020	.075	99.972						
27	.008	.028	100.000						

Extraction Method: Principal Axis Factoring
When factors are correlated, sums of squared loadings cannot be added to obtain a total variance.

Table 6: Factor Matrix – Pilot Study

	Factor			
Questions	1	2	3	4
Understanding concepts in chemistry textbook	.829			
Understanding abstract chemical concepts	.816			
Doing physics homework problems well	.791		.662	
Getting good grades in physics	.787			
Understanding concepts in a physics textbook	.775			
Memorizing factual information	.773			
Doing chemistry homework problems well	.768		.536	
Getting good grades in chemistry	.763	.643		.701
Doing physics lab experiments well	.735		.732	
Doing well on a biology exam	.684	.613		
Understanding concepts in a biology textbook	.571			
Taking essay tests in biology	.540	.519		
Answering questions in biology class		.871		
Asking questions in physics class		.849		
Asking questions in biology class		.820		
Getting good grades in biology	.548	.756		
Asking questions in chemistry class		.703		
Winning science award for biology project	.598	.631	.540	
Learning about famous scientists				
Using a microscope			.852	
Doing science activities for fun			.739	
Performing lab experiments using electricity	.581	.643	.728	
Using a computer in science class			.704	
Lighting a lab Bunsen Burner	.649		.688	
Handling laboratory chemicals	.539	.566	.659	
Experiments with simple machines	.530		.511	.807
Using chemical formulas and equations				.730

Extraction Method: Principal Axis Factoring. Rotation Method: Promax with Kaiser Normalization.

Factor Correlation Matrix Pilot Study.

Factor	1	2	3	4
1	1.000	.560	.495	.419
2	.560	1.000	.417	.338
3	.495	.417	1.000	.290
4	.419	.338	.290	1.000

Extraction Method: Principal Axis Factoring. Rotation Method: Promax with Kaiser Normalization.

Table 7: Overall student sample demographic breakdown by Racial/Ethnicity.

		Frequency	Valid Percent	Cumulative Percent
Valid	Asian/Pacific Islander	28	10.4	10.4
	Black	25	9.3	19.6
	Hispanic	152	56.3	75.9
	Native American	4	1.5	77.4
	White	59	21.9	99.3
	Other	2	.7	100.0
	Total	270	100.0	
Missing		2		

Table 8: Female student demographic breakdown by race/ethnicity.

Subgroup	Frequency	Valid Percent
Asian/Pacific Islander	14	9.7
Black Not Hispanic	14	9.7
Hispanic	80	55.6
Native American	3	2.1
White Not Hispanic	32	22.2
Other	1	.7
Total	144	100.0

Table 9: Female Sample: Limited English Proficient (LEP) Enrollment.

		Overall Sample		Female Sample	
	Category	Frequency	Percent	Frequency	Percent
Valid	TN=Tested Not Eligible	14	5.1	11	7.6
	LY=current LEP Student	10	3.7	10	6.9
	LF=Monitor	5	1.8	1	.7
	LZ=Exited	8	2.9	8	5.6
	LY2+=In LEP Program 2 yrs	2	.7	2	1.4
	LY3+=In LEP Program 3 yrs	2	.7	2	1.4
	LY4+=In LEP Program 4 yrs	3	1.1	3	2.1
	LY5+=In LEP Program 5 yrs	1	.4	1	.7
	LY6+=In LEP Program 6+yrs	1	.4	1	.7
	ZZ=Not tested	10	3.7	9	6.3
	Total	56	20.6	48	33.3
Missing		216	79.4	96	66.7
Total		272	100.0	144	100.0

Table 10: Racial/Ethnic Female Sample: Program Services Participation

	Percent of Overall Sample	Percent of Racial/Ethnic Female Sample
Limited English Proficient (LEP)	19.1	17.4
Academic Improvement Plan (AIP)	26	27.1
Special needs accommodations (504 Plan)	1.1	.7
Free/Reduced Lunch (poverty)	40.4	30.6
Exception Student Education (ESE)	18.5	15.3
Gifted	5.6	6.3
Specific Learning Disability (SLD)	10.4	9.1
Emotionally Handicapped (EH)	.7	0
Deaf/Hard of Hearing	.4	0
Other Health Impaired	.7	0
Educable Mentally Handicapped (EMH)	.7	0
Not ESE	81.5	84.6
Total	100.0	100.0

Table 11: Factor Analysis Descriptive Data

	Mean	Std. Deviation	Analysis N
Using a computer in science class	3.52	1.505	254
Understanding concepts in a biology textbook	3.13	1.079	254
Using chemical formulas and equations	3.05	1.269	254
Doing well on a biology exam	3.07	1.266	254
Doing chemistry homework problems well	2.83	1.272	254
Doing physics lab experiments well	3.46	1.198	254
Using a microscope	4.15	1.018	254
Lighting a lab Bunsen Burner	3.19	1.390	254
Winning a science fair award for a biology project	2.33	1.307	254
Handling laboratory chemicals	3.64	1.268	254
Doing physics homework problems well	2.96	1.246	254
Taking essay tests in biology	2.52	1.263	254
Performing lab experiments using electricity	3.50	1.278	254
Getting good grades in biology	3.77	1.184	254
Answering questions in biology class	3.48	1.198	254
Asking questions in chemistry class	3.08	1.384	254
Memorizing factual information	2.98	1.208	254
Understanding concepts in a chemistry textbook	2.84	1.212	254
Asking questions in biology class	3.50	1.199	254
Learning about famous scientists	2.90	1.274	254
Understanding concepts in a physics textbook	2.85	1.239	254
Getting good grades in chemistry	3.21	1.264	254
Understanding abstract chemical concepts	2.81	1.146	254
Asking questions in physics class	3.04	1.268	254
Getting good grades in physics	3.24	1.265	254
Experiments with simple machines	3.96	1.094	254
Doing science activities for fun	3.86	1.395	254

Table 12: Factor Analysis Total Variance Explained.

	Initial Eigenvalues		
Factor	Total	% of Variance	Cumulative %
1	10.551	39.0791	39.079
2	2.109	7.809	46.889
3	1.627	6.025	52.913
4	1.244	4.607	57.520
5	1.027	3.806	61.326
6	.963	3.568	64.894
7	.912	3.379	68.273
8	.789	2.923	71.196
9	.780	2.889	74.085
10	.750	2.776	76.862
11	.669	2.479	79.341
12	.616	2.280	81.621
13	.576	2.134	83.755
14	.525	1.945	85.700
15	.483	1.788	87.488
16	.420	1.555	89.043
17	.408	1.512	90.555
18	.368	1.364	91.919
19	.341	1.262	93.181
20	.319	1.183	94.364
21	.317	1.173	95.537
22	.288	1.065	96.602
23	.242	.896	97.497
24	.197	.730	98.227
25	.196	.725	98.952
26	.155	.574	99.526
27	.128	.474	100.00

Extraction Method: Principal Axis Factoring.

Table 13: Factor analysis Factor Matrix.

	Factor		
Questions	1	2	3
Using a computer in science class	.430	.411	
Understanding concepts in a biology textbook	.532		
Using chemical formulas and equations	.528		
Doing well on a biology exam	.675		
Doing chemistry homework problems well	.724		
Doing physics lab experiments well	.551		
Using a microscope	.445	.402	
Lighting a lab Bunsen Burner	.600	.457	
Winning a science fair award for a biology project	.548		
Handling laboratory chemicals	.585	.504	
Doing physics homework problems well	.687		
Taking essay tests in biology	.444		
Performing lab experiments using electricity	.626	.457	
Getting good grades in biology	.660		.443
Answering questions in biology class	.653		.518
Asking questions in chemistry class	.715		
Memorizing factual information	.586		
Understanding concepts in a chemistry textbook	.699		
Asking questions in biology class	.570		.376
Learning about famous scientists	.430		
Understanding concepts in a physics textbook	.684		
Getting good grades in chemistry	.704		
Understanding abstract chemical concepts	.690		
Asking questions in physics class	.693		
Getting good grades in physics	.738		
Experiments with simple machines	.665		
Doing science activities for fun	.381		

Extraction Method: Principal Axis Factoring.

a. 3 factors extracted. 7 iterations required.

Table 14: Factor Analysis Communalities.

	Initial	Extraction
Using a computer in science class	.420	.358
Understanding concepts in a biology textbook	.488	.347
Using chemical formulas and equations	.470	.337
Doing well on a biology exam	.616	.502
Doing chemistry homework problems well	.667	.607
Doing physics lab experiments well	.555	.363
Using a microscope	.474	.431
Lighting a lab Bunsen Burner	.596	.570
Winning a science fair award for a biology project	.375	.317
Handling laboratory chemicals	.586	.598
Doing physics homework problems well	.619	.523
Taking essay tests in biology	.344	.240
Performing lab experiments using electricity	.600	.600
Getting good grades in biology	.731	.651
Answering questions in biology class	.710	.730
Asking questions in chemistry class	.679	.522
Memorizing factual information	.468	.378
Understanding concepts in a chemistry textbook	.661	.638
Asking questions in biology class	.542	.501
Learning about famous scientists	.399	.222
Understanding concepts in a physics textbook	.658	.584
Getting good grades in chemistry	.703	.534
Understanding abstract chemical concepts	.596	.515
Asking questions in physics class	.644	.492
Getting good grades in physics	.749	.609
Experiments with simple machines	.561	.496
Doing science activities for fun	.269	.181

Extraction Method: Principal Axis Factoring.

Table 15: Factor Analysis correlation Matrix.

Factor	1	2	3
1	1.000	.587	.626
2	.587	1.000	.475
3	.626	.475	1.000

Extraction Method: Principal Axis Factoring.
Rotation Method: Promax with Kaiser Normalization

Table 16: Factor Analysis Extracted Factors Group Descriptives.

	N	Mean	Std. Deviation
Academic Engagement	258	42.5698	12.30660
Laboratory	266	25.4398	5.84115
Biology	269	19.3494	5.38141

Table 17: Factor Analysis Extracted Factors Group Correlations.

	Academic Engagement	Laboratory	Biology
Academic Engagement	1	.685**	.720**
Laboratory	.685**	1	.557**
Biology	.720**	.557**	1

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

Table 18: Reliability Statistics

Factor		Cronbach's Alpha
1	Academic Engagement	0.924
2	Laboratory	0.834
3	Biology	0.782

Table 19: Reliability Comparison between this study and original Smist (1993) study using Cronbach's Alpha.

Factors Extracted In This Study (3)	This Study	Factors Extracted In Original Study (4)	Original Study
Academic Engagement	.92	Physics	.93
		Chemistry	.85
Laboratory	.83	Laboratory	.90
Biology	.78	Biology	.87

Table 20: ANOVA Females and Racial/Ethnic Subgroups and Extracted Science Self-efficacy Factors.

	Race/Ethnicity	N	Mean	SD	*df*	F	Sig.
Academic Engagement					4, 130	5.055	.001
	Asian/Pacific Islander	13	.728	.798			
	Black Not Hispanic	13	.159	.941			
	Hispanic	75	-.253	.873			
	Native American	3	.766	1.199			
	White Not Hispanic	32	-.330	.847			
	Total	135	-.118	.923			
Laboratory					4, 130	3.428	.011
	Asian/Pacific Islander	13	.629	.598			
	Black Not Hispanic	12	.071	.919			
	Hispanic	75	-.154	.823			
	Native American	3	.664	.723			
	White Not Hispanic	32	-.259	.968			
	Total	135	-.066	.880			
Biology					4, 130	2.582	.040
	Asian/Pacific Islander	13	.590	.770			
	Black Not Hispanic	12	.176	1.092			
	Hispanic	75	-.216	.935			
	Native American	3	.532	.899			
	White Not Hispanic	32	-.113	.960			
	Total	135	-.063	.963			

Table 21: Multiple Linear Regression of NRT Reading and Mathematics Scores and Science Grade on Extracted Science Self-efficacy Factors for All Female Subgroups.

Science Self-efficacy Factor	Female Subgroup	R^2	*df*	F	Sig.
Academic Engagement	All	.227	4, 107	7.863	.000*
	Asian/Pacific Islander	.564	3, 8	3.445	.072
	Black	.678	3, 7	4.912	.038*
	Hispanic	.011	3, 51	.197	.898
	Native American	1.00	2, 0	**	**
	White	2.86	3, 27	3.611	.026*
Laboratory	All	.194	4, 107	6.453	.000*
	Asian/Pacific Islander	.288	3, 8	1.076	.412
	Black	.252	3, 7	.785	.539
	Hispanic	.091	3, 51	1.707	.177
	Native American	1.00	2, 0	**	**
	White	.254	3, 27	3.064	.045*
Biology	All	.127	4, 107	3.876	.006*
	Asian/Pacific Islander	.449	3, 8	2.173	.169
	Black	.525	3, 7	2.584	.136
	Hispanic	.026	3, 51	.462	.710
	Native American	1.00	2, 0	**	**
	White	.108	3, 27	1.093	.369

Predictors: (Constant), NRT Reading, NRT Mathematics, Prior Year Science Grade

* Statistically significant at .05 level.
** No data available as prior year science grade was missing and was deleted from the calculation.

Table 22: Emergent Theme Matrix

	IN CLASSROOM					OUTSIDE SCHOOL	PERSONAL
	Curricular		Instructional			Cultural	
	Perception that Content Is Difficult	Math Ability Perception	Presence of Hands on Activities	Perception of Facilitation of Learning Strategies	Perception of Teacher	Family & Peer Influence	Career & Motivation to Persist in Science Study
HA1	Y	+	N		-	Y &N	Y
HA2	Y	+	N		-	N	Y
Total HA	2Y	2+	2N		2 -	1Y, 1N	2Y
LA1	Y	+	N	N	-	N	N
LA2	Y	-	N		+	N	N
Total LA	2Y	1+, 1-	2N	1N	1+, 1 -	2 N	2N
Overall TOTAL	4Y	3 +; 1 -	4N	1N	3 -, 1+	3 N,1 Y	2Y, 2N

+ = perception is positive
- = perception is negative
NA = perception not given

Y = Yes
N = No

HA = High-Ability* Hispanic Female
LA = Low-Ability* Hispanic Female

*Ability defined as Reading Score, Mathematics Score, Prior Year Science Grade

Table 23: Interviewed Hispanic Female Suggestion Matrix

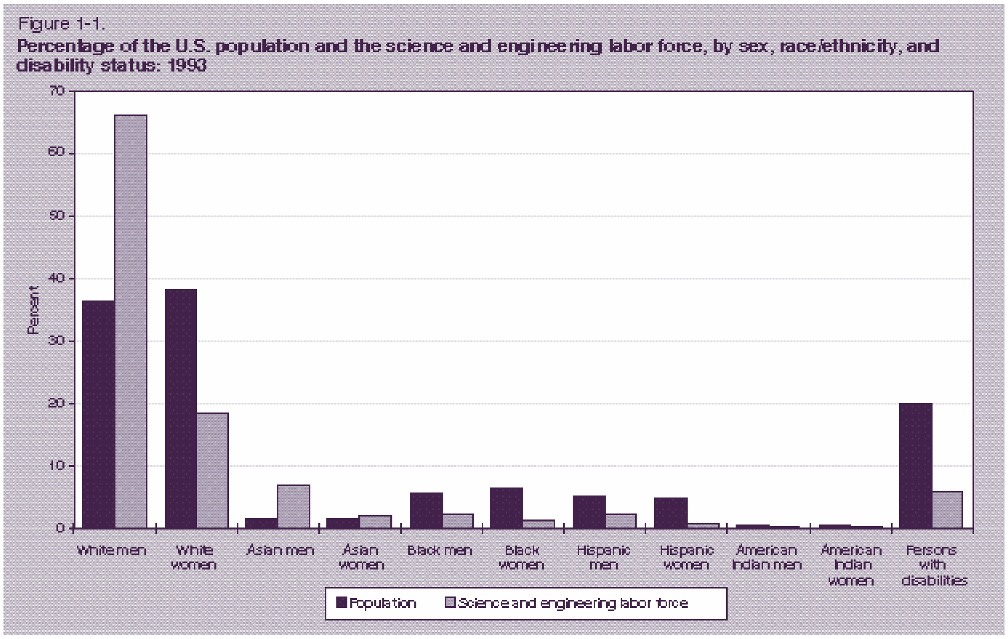
Interview Question: Pretend you were the teacher. What would you do to improve experiences for students in science?

	Less focus on tardies and behaviors	More Class Discussions & Questioning	More Hands on Activities	Teach Strategies to help	Improve Teacher Traits	Spend More time on fewer topics
HA1	X				X less boring more humor less serious	
HA2		X	X experiments		X speaking tone not boring make class more challenging help students build confidence	
LA1			X	X	X less boring more than taking notes make it fun more group projects teach how to study	X
LA2		X	X experiments games		X make it fun ask students about their experiences	
TOTAL	1	2	3	1	4	1

X = suggestion is present in this theme area
*Ability defined as Reading Score, Mathematics Score, and Prior Year Science Grade

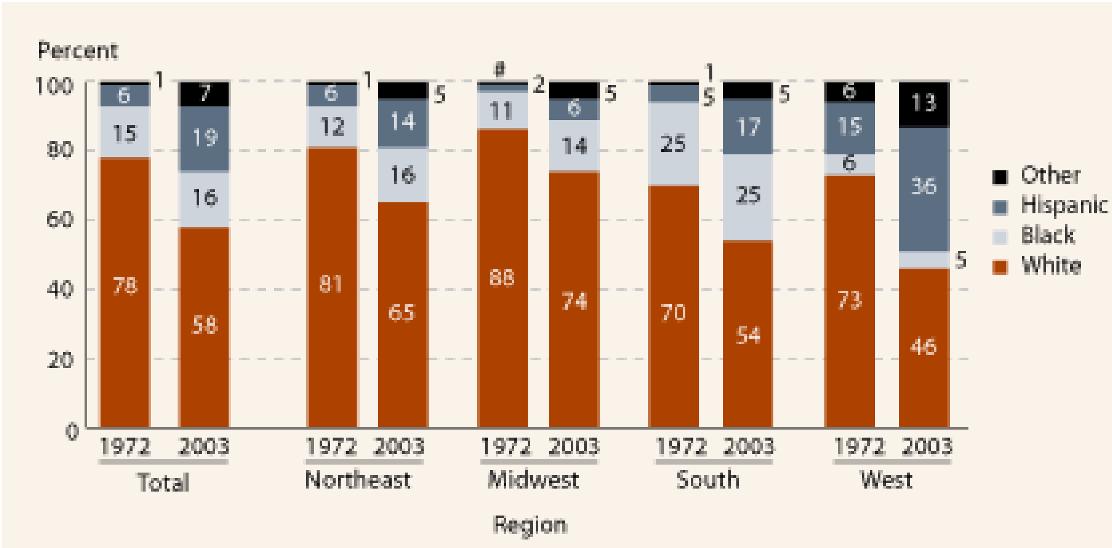
HA = High *Ability Hispanic Female
LA = Low *Ability Hispanic Female

APPENDIX Z: FIGURES



Source: National Science Foundation, 1996.

Figure 1: Underrepresentation of women and minorities in science and engineering.



Data Source: U. S. Department of Commerce, Bureau of the Census, Current Population Survey (CPS), October 1972 and 2003 Supplements, previously unpublished tabulation (December 2004).

Figure 2: Minority Enrollment: Percentage distribution of public school students in kindergarten through twelfth grade, by region and race/ethnicity, fall 1972 and 2003 (National Science Foundation, 2004).

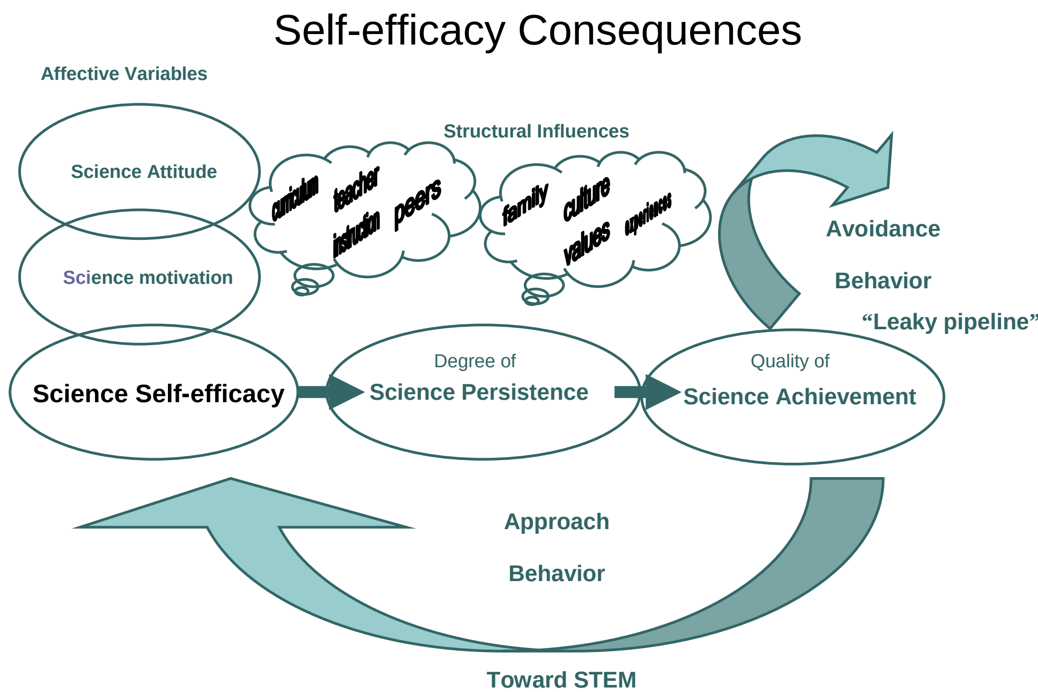
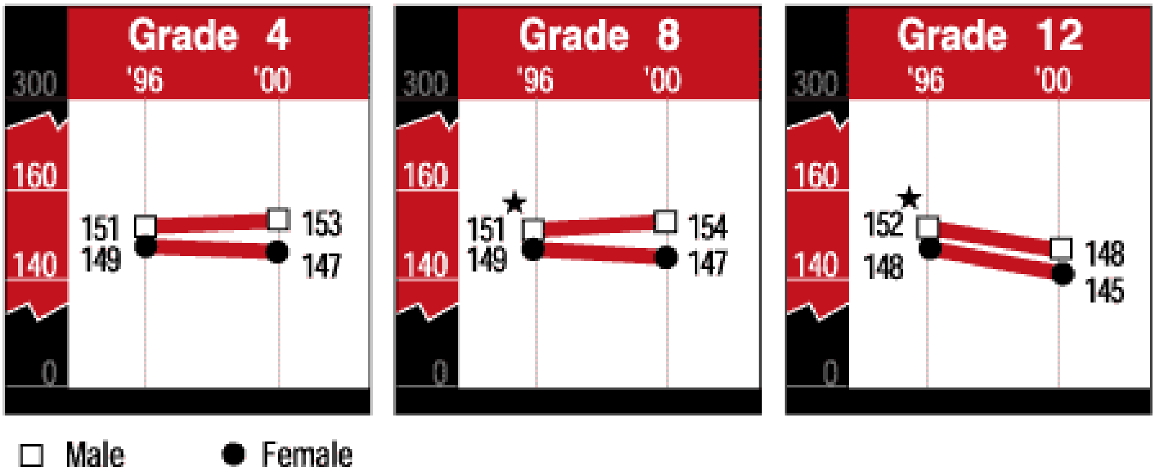


Figure 3: Self-efficacy behavioral consequences (Bandura, 1977, 1997).



★Significantly different from 2000.
NOTE: Results are based on administration procedures that did not permit accommodations.
SOURCE: National Center for Education Statistics, National Assessment of Educational Progress (NAEP), 1996 and 2000 Science Assessments.

Figure 4: Average science scale scores by gender, grades 4, 8, and 12 (public and nonpublic schools combined): 1996 and 2000.

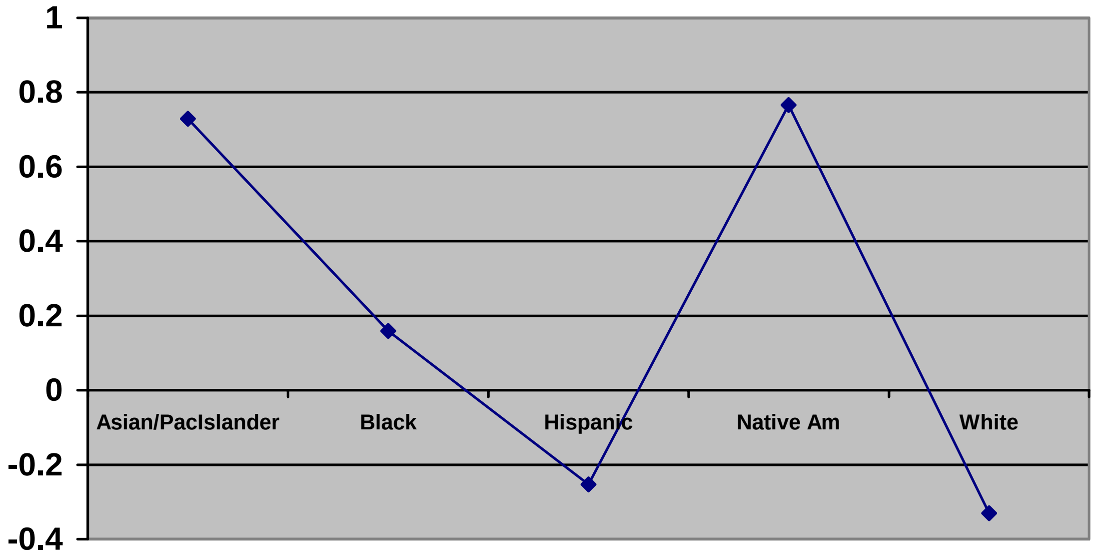


Figure 5: Comparison of female racial/ethnic subgroup means on Factor Academic Engagement.

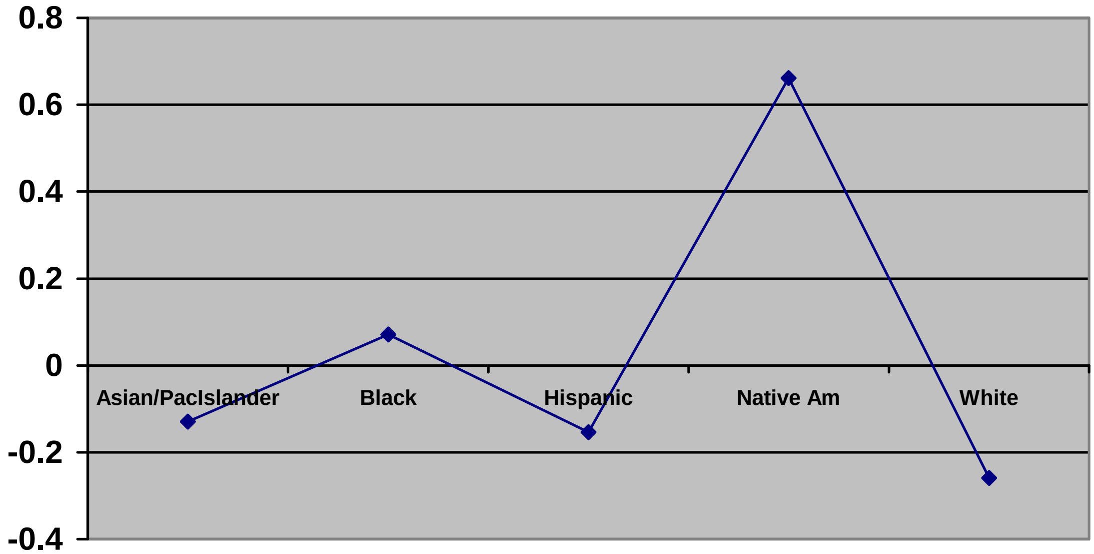


Figure 6: Comparison of female racial/ethnic subgroup means on Factor Laboratory.

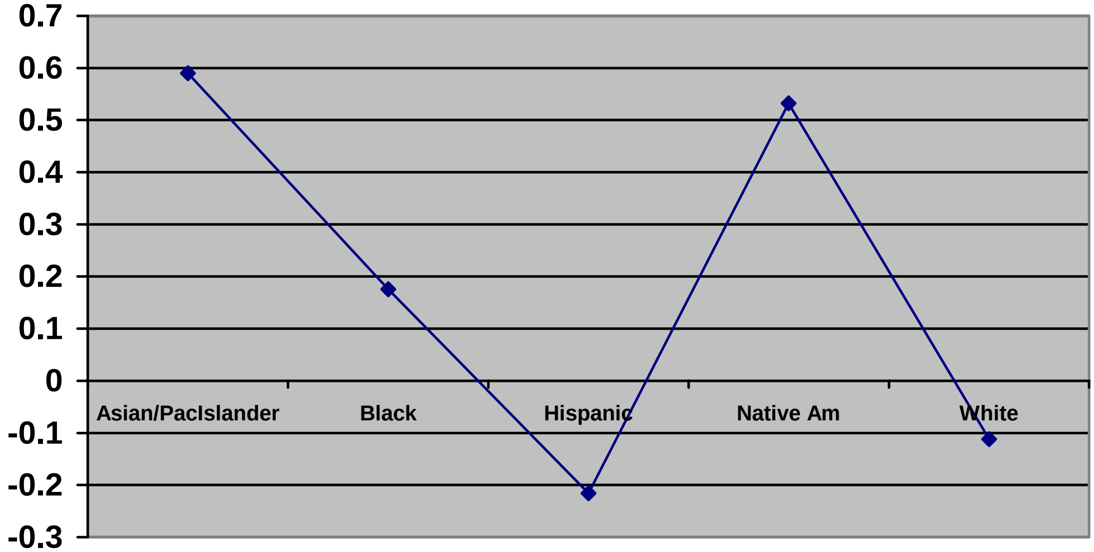


Figure 7: Comparison of female racial/ethnic subgroup means on Factor Biology

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