UCF Upward Bound Program promoting first generation in college, low income and multicultural students stem college success

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UCF UPWARD BOUND PROGRAM: PROMOTING FIRST GENERATION IN COLLEGE, LOW INCOME AND MULTICULTURAL STUDENTS’ STEM COLLEGE SUCCESS

by

CHRISTINA RESTREPO

A Thesis submitted in partial fulfillment of the requirements for the Honors in the Major Program in Science Education in the College of Education and in the Burnett Honors College at the University of Central Florida Orlando, Florida

Spring Term 2011

Thesis Chair: Rebekah McCloud, Ed.D.
ABSTRACT

The objective of this research is to explore the perceptions of UCF Upward Bound Program participants using focus groups and pre-posttest surveys in order to assess students’ level of understanding of Science, Technology, Engineering, and Mathematics (STEM) related coursework, secondary education preparation in science and mathematics, and their perceptions of barriers to a STEM college education. Also, this study centers on the summer 2010 science and mathematics residential portion of the Upward Bound Program. Program outcomes and effectiveness were evaluated based on the change in student insight of the Upward Bound Program’s stake in their secondary education. In addition, pre-posttest measures and interviews allowed a greater understanding of teacher and parent involvement in high school coursework success. Factors that involve self-efficacy, same or other group orientation and perceptions of student college environment were also analyzed. This research facilitated the understanding of first generation, low income and multicultural student’s perceptions and what they view as a benefit or a hindrance to entering and successfully completing degrees in post-secondary institutions, specifically in STEM-related disciplines.
DEDICATION

For my mother, my role model and best friend, thank you for all the hard work in raising me as a single parent. Your values have made me the successful woman I am today.

For my aunt, Sofia, thank you for being with me in absolutely every step of my life.

To my hometown of Passaic, New Jersey; one thing I will never forget is where I came from and the reason why I learned to appreciate a melting pot of cultures and ideas.

To Mr. Paul Schmidt, my biology teacher at Passaic High School, thank you for your time and dedication. You are truly an inspiration to me.

The seniors of the Senior Center of Passaic, thank you for all of your advice throughout my childhood.

UCF Upward Bound Program scholars, continue to excel in all of your endeavors. Without you this thesis would not have been possible.

Thank you
ACKNOWLEDGMENTS

Dr. Rebekah McCloud, your unconditional time and effort in giving me the opportunity to work on a topic that I am truly passionate about is priceless. Dr. Aldrin E. Sweeney, your advice and time in mentoring me in the field of Science Education is much appreciated. Dr. Bernadette M.E. Jungblut, thank you for always believing in me and guiding me towards success. Michael Aldarondo-Jeffries and the McNair Scholars Program staff thank you for all of your support. Dr. Gloria Laureano, thank you for all of the advice you gave me in difficult times. I admire your accomplishments and you will always be my role model. Dr. Sherron Killingsworth Roberts, thank you for your time, patience and insight. Mary Perdomo, thank you for always giving me advice about life.

I also want to thank my maternal family for supporting me unconditionally throughout these four years of my undergraduate career.
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INTRODUCTION

Generally, multicultural students are underrepresented in post-secondary education (ASHE-ERIC, 2003; Gandara, 2001). There is a shortage of minority students in Science, Technology, Engineering and Mathematics (henceforth referred to as STEM)-related disciplines and post-secondary institutions have failed to prepare sufficiently for this issue (Gandara, 2001). Seymour & Hewitt (1997) concluded that ability is not a determining factor in the attrition of minority students in STEM-related disciplines. Students who drop STEM courses had almost the same grades as those who persisted. Previous research indicates that minority students observe a “chilly climate” in their classroom experiences (Cabrera, Colbeck, & Terezini, 2001 as cited in University of Wisconsin Madison, 2008, p.3). These students also experience greater barriers in degree attainment, lack of mentoring and prejudice and discrimination on campus (Seymour & Hewitt, 1997).

According to Fullerton & Toossi (2001), African Americans, Latino/as, South East Asians, and Native Americans (henceforth referred to as ALANA) groups will have the largest labor force participation in the next ten years. In 2008, Latinos had the highest labor force participation rate (U.S. Department of Labor, 2010). Business Roundtable (2005) said the United States is in “fierce contest with other nations to remain the world’s scientific leader” (p. 4). By 2010 more than 90 percent of all scientists will be living in Asia, and, an increasing reliance for foreign talent to work in the United States has colleges and universities awarding approximately 50 percent of all engineering doctoral degrees to foreign nationals (Business Roundtable, 2005). We are educating students from other countries, and they return to their
home country, leaving us without a stable talent pool. Although the U.S. has implemented measures such as No Child Left Behind Act (NCLB) and the Action Agenda for Improving America’s High Schools to reduce the achievement gap between minority and majority students, these challenges need to also include specific measures to increase STEM education for all students in the United States (Business Roundtable, 2005). According to Microsoft (2010), “many technology jobs went unfilled in 2009” (p. 1). This issue may pose a threat to U.S. national security, since we need to obtain domestic human resources elsewhere (Microsoft, 2010). Also, by considering early intervention strategies in secondary education that may lead to more career choices amongst youth, we can train our own nationals to serve in these STEM-related jobs in the future (Subotnik, Edmiston & Rayhack, 2007).

Student STEM success at the post-secondary level is in need of reform, especially for First Generation in College (henceforth referred to as FGIC), low income and multicultural students. The highest level of attrition occurs between high school graduation and college admission, leading to a decrease in the enrollment of students in STEM disciplines (Seymour, 2001). This concern focuses on the quality of education that is offered to students at the secondary level and how this can affect post-secondary enrollment, persistence and retention in STEM fields. Variations in secondary education success and subsequent enrollment in post-secondary institutions for underrepresented students may be due to less quality education resulting from disparities in race, gender, location, school funding, facilities, classroom resources and the shortage of quality teachers in mathematics and science fields in K-12 (Seymour, 2001).

Current research in STEM retention and persistence has been conducted with students in post-secondary institutions. A study done by the Center of Education and Work at the
University of Wisconsin-Madison (2008) surveyed and interviewed underrepresented college students in order to assess their mathematics and science self-efficacy, interest, and outcome expectations once obtaining a STEM college degree. ALANA students have similar intentions as white students to enter STEM fields, but they are less likely to persist and drop out once they declare a STEM major. The study’s findings concluded that predicting STEM interest was indicative of their self-efficacy and performance during their degree program (University of Wisconsin-Madison, 2008). Also, “positive outcome expectations about the payoffs of a STEM degree and its usefulness to future employment were predictive of intent to graduate with a STEM degree” (p. 3). Other important factors were the ability to cope with other cultural groups which helped ALANA students perceive a more positive climate and in addition to viewing short term goals more positively in relation to completing their program (University of Wisconsin Madison, 2008).

The study explored the perceptions of students in the summer residential program science camp at the University of Central Florida’s (UCF) Upward Bound Program. The research focuses on self-efficacy, same/other group orientation, cultural and social barriers in secondary education as well as the stake teachers hold in students’ mathematics and science success. The purpose of this research was to suggest effective ways to address student needs through already existing early intervention STEM programs for both high school and post-secondary levels. This study also examined the effects the Upward Bound Program on group processes using students’ perceived campus environments through the use of depictions.
LITERATURE REVIEW

THE CURRENT STATE OF MATHEMATICS AND SCIENCE EDUCATION

In 1989 President George H.W. Bush assembled with the nation’s governors to discuss how to better the U.S. education system. In regards to science and mathematics education they concluded that “by the year 2000, United States students will be the first in the world in mathematics and science achievement,” (Vinovskis, 1999). Unfortunately, this goal has yet to be met.

There has been much public concern for the future of mathematics and science teaching and learning. In 1989, the National Council of Teachers of Mathematics (hereinafter referred to as NCTM) revised the previous framework of K-12 mathematics education concentrating primarily on the application of engaging curriculum, investigative learning, technological advances in the classroom, seeking connections to previous curriculum, and allowing students to become mathematical achievers and thinkers (NCTM, 1991). Previous mathematical teaching and learning included using teachers as “filters” and knowledge spreaders. Usually, students who follow a traditional approach may only develop procedural knowledge that is not usable in non-traditional classroom settings in comparison to students who learn in an open inquiry based classroom. These students developed conceptual understanding and showed advantages in many varied assessments (Boaler, 1998). Before the NCTM standards, students were not taught in varying viewpoints necessary to achieve a well-rounded knowledge of a subject area. Much dependence on textbooks and less dependence on self-inquiry and student thinking did not allow for the improvement of student learning (Brooks & Brooks, 1993). Modern mathematics and
Science educators desire students to gain competitive skills, reflect similar to mathematicians and scientists, and also desire students to view mathematics as a goal-oriented activity that can help solve real-world problems (Carpenter & Lehrer, 1999).

It is important to discuss the major shifts that have occurred in mathematics and science education that can benefit student learning and pedagogy. It is imperative to have students working together to make sense of their curriculum, and allow them to question their own process of arriving at a conclusion (NCTM, 1991). Students must engage in asking questions that will aid them in arriving at an answer (Brooks & Brooks, 1993). In a study done by Carpenter, Franke, Jacobs, Fennema, & Empson (1998), it was found that students who invented strategies rather than learning standard curriculum gained a deeper conceptual knowledge of a subject matter, had more flexibility with abilities and variety problem solving methods while showing fewer errors in solving problems. In making these connections, it is critical to value the importance of constructivism and cognitive development. It is suggested that teachers’ understanding of students’ cognitive development allows for an improved student educational experience (Ma, 1999; Trends in International Mathematical and Science Study, 2007). In international mathematical comparisons, China has outperformed the United States in multiple examinations; yet, Chinese educators have less formal schooling than American educators (Ma, 1999; Gonzalez, Williams, Jocelyn, Roey, Kastburg, Brenwald, 2009). The contradiction of teacher formal schooling and student achievement is a result of a teacher’s vast understanding of mathematics and science and the developmentally appropriate tasks of mathematics education that continue during a child’s life combined with teacher efficacy and teacher intentionality in the classroom (Hoffman, 2007; Ma, 1999).
The National Science Teachers Association (NSTA) developed the National Science Education Standards and provides standards for science teaching, professional development for teachers and standards for assessment in science education and science content. The National Science Education Standards push science educators to engage students in scientific literacy and scientific inquiry and states that “it has become a necessity for everyone” (Center for Science, Mathematics, and Engineering Education, 1996).

“Scientific literacy also is of increasing importance in the workplace. More and more jobs demand advanced skills, requiring that people be able to learn, reason, think creatively, make decisions, and solve problems. An understanding of science and the processes of science contributes in an essential way to these skills. Other countries are investing heavily to create scientifically and technically literate work forces” (Center for Science, Mathematics, and Engineering Education, 1996).

It has become increasingly important that our nation’s students be prepared for the necessity we have for science and technological advances. We need a nation of scientifically literate children.

According to the National Center for Education Statistics (henceforth referred to as NCES) (2009), 34 percent of 4th-graders, 30 percent of 8th-graders and 21 percent of 12th-graders performed at or above the proficient level in science in 2009 (NCES, 2009). Furthermore, scores were higher for White, Asian/Pacific Islanders and males. Also, students in urban schools scored lower on average than students in suburban locations (NCES, 2009). The national science report card also showed that higher levels of parental education were associated with higher science scores. Students who reported that at least one parent graduated from college (49 percent for all twelfth graders), scored higher on average, while students whose parents did
not finish high school scored the lowest (NCES, 2009). Also, for the 8th grade science assessment, even though overall, Florida scored below the national average, Hispanic students in Florida scored above the national average for all Hispanic students in the nation as referenced in Figure 1 (NCES, 2009).

Figure 1: Percentage of students and average scores in NAEP science for public school students in grade 8 in the nation and Florida: 2009
(National Center for Education Statistics, 2009)

* Significantly different (p < .05) from the nation.
NOTE: Hispanic includes Latino.
CONSTRUCTIVISM IN SCIENCE AND MATHEMATICS EDUCATION

The best way to define the strategies of developmentally appropriate tasks of children is to review concepts of constructivism. In mathematics and science, schemes, concepts, and structures are no different than in other disciplines. As children begin to grow, they begin to manifest strategies in converting abstraction into tangibility (Piaget, 1952). As students begin to change their knowledge of the surrounding environment, schemes cause students to categorize, understand, and solve problems while they experiment with the world around them (Piaget, 1952).

Cognition can also be described by the emergence of concepts which are caused by relation of objects, which in turn, can become a form of class inclusion and relation between two different objects. While schemata development can occur at any age, concepts occur primarily at a more developed age as the concepts of reversibility and seriation begin to take effect (Inhelder & Piaget, 1964; Hoffman, 2007). Once the organization of ideas take place they are referred to as a structure. As these ideas assemble, the constructivist model asserts that as children begin to see problem structures when interacting with their environment; this constructs a “mental precursor” to formulate new ideas based on previous experiences, through assimilation and accommodation of new thoughts which are products of structure, conception, and schemata (Hoffman, 2007).

In mathematics and science, higher-order thinking skills are necessary for the understanding of future concepts. Although abstraction and logic becomes increasingly important when observing higher-order thinking skills; the abstraction of logic is visibly evident in mathematics and science teaching and learning (Piaget & Inhelder, 1964). Variables are a
common form of abstraction. Even though it is not visibly evident, once a child can replace a thought with a symbol, it is automatically pursued they have acquired the concept of abstraction. Although, children achieve abstraction before learning variable concepts in Algebra; it is necessary to have “ample experiences” prior to entering a new concept in order to produce a successful parlaying of learning for children (Hoffman, 2007). As logical thinking increases, children develop a prospective model for formal operational stage in Piaget’s Theory of Cognitive Development. During this stage, students can formulate possible conclusions in potential or hypothetical situations, but if students have not acquired necessary knowledge in previous cognitive stages, their ability to produce a hypothetical conclusion will be either difficult or nearly impossible (Piaget & Inhelder, 1958). It is possible that students use meta-cognition to apply knowledge of one’s own methods of constructively obtaining an answer to circumstances; which in turn may also help in producing a higher-order thinking environment in the classroom (Sternberg, 1985). In mathematics it is important to be aware when teaching a new lesson, students may filter out necessary information based on their level of cognitive development. This is described as “student mediated instruction”. It is also important to emphasize that successful cognitively guided instruction and knowledge of “student mediated instruction”, in combination may allow for a more successful learning experience (Brophy & Good, 1974).

Teachers need to also recognize the value of the “zone of proximal development” and value instruction as much or more than curriculum and standards in their everyday teaching (Brophy & Good, 1974). According to Vygotsky, the “zone of proximal development” is the “hypothetical” area between the individual’s learning and mastery of a concept through the aid
“Intellectual growth” may be fostered through the use of scaffolding in a student’s zone of proximal development. Teachers act as scaffolding envoys in the classroom. They do this through using clues or examples in order to further student knowledge and produce higher level thinking skills, but through the knowledge of the existing developmental stage of children (Byrnes, 2007; Hoffman, 2007; Wood, Bruner & Ross, 1976). Vygotsky’s theory also implies that teachers should communicate the scientific background of any concept or idea taught in the classroom. This may help in making preexisting knowledge parallel with newly obtained knowledge and form concepts from these differing structures (Byrnes, 2007).

In a study by Fraivillig, Murphy, & Fuson (1999), students were engaged in a new in depth form of pedagogical framework called Advancing Children’s Thinking (ACT). This new form of teaching mathematics allowed for basics in instructional strategies including: eliciting, supporting and extending. All of these are supported by the new National Council of Teachers of Mathematics Standards which emphasizes proficiency, “reproducing existing solution methods” and a personal and meaningful approach to mathematics (Fraivillig, et al., 1999). This allowed for more elaborate answer from the student which allows conveying attitudes, knowledge and methods to arriving at a conclusion while allowing for collaborative classroom problem solving. Supporting allows for more background knowledge and listening skills and extending allows for maintaining large student expectations, mathematical engagement and reflection s well as trying alternative solutions (Fraivillig, et al., 1999). This essentially allows believing that by probing, students may benefit more from the lesson.
The NCTM (1991), declared the importance of implementing problem solving techniques in the classroom (NCTM, 1991), while the NSTA wants to add upon scientific literacy (NSTA, 2009). In mathematics education, it is important to emphasize the significance of problem solving techniques. Problem solving techniques may work hand in hand with memory performance (Byrnes, 2007). Cognitive processes that are viewed positively in problem solving include: the selection of important information from a particular situation, organizing that information into the working memory and integrating that information with existing information (Byrnes, 2007; Mayer & Wittrock, 2006). Along with improving problem solving techniques through the use of advanced organizers and processing of new information to reiterate previous information, one can also increase the retention of student knowledge through the use of external memory support (Hoffman, 2007; Newell & Simon, 1972). Learning can occur in problem-inquiry based instruction which facilitates a student’s theory building by the use of instructional materials such as worksheets (Newell & Simon, 1972). Inquiry based learning can be confusing, especially in answering scientific problems because teachers may lack knowledge in subject area (Byrnes, 2007) These important aspects are vital in the success of a constructivist classroom. While low SES students perform lower on standardized test scores, they can perform higher in problem solving skills if they were given more support and time when teachers propose new forms of teaching (Byrnes, 2008). General intelligence scores and mathematics achievement scores are not predictors of cognitive abilities, but are positively correlated (Brooks & Brooks, 1993).

Constructivism is essential in the progress of student information retention. Constructivist forms of pedagogy may allow students to internalize and transform information (Brooks &
Brooks, 1993). Also, constructivism allows students to use connections outside of the classroom in order to improve learning (Brooks & Brooks, 1993). Essentially, constructivism values new knowledge, knowledge that students bring into the classroom, and considers group interactions as part of the success of student learning.

Relevance is also an important part of constructivist thinking. Although some scholars believe that relevance inhibits the full potential of student learning, building an environment based on student interest may increase student motivation in learning (Brooks & Brooks, 1993; Byrnes, 2007; Hoffman, 2007). Also, constructivist classrooms should allow teachers to see student knowledge and learning as their own. Teachers need to know how they obtained a certain answer to a problem and allow students to also gain that knowledge (Cobb & Steffe, 1983). According to Joel Greenberg (1990) as noted in Brooks & Brooks (1993), there are five steps educators should take in order to consider if a situation may be a good problem solving one:

1. Allow students to make a testable prediction.
2. Use of relatively inexpensive equipment.
3. Elicit multiple responses.
4. Use of beneficial group effort.
5. “Viewing the problem as evident.”

Although constructivist teachers are prescribed to become fully engaged in their subject area and pedagogical environment, time is always a constraint. As noted in Byrnes (2007), time can interfere with students’ understanding of complex concepts and meaningfulness, appreciation of subject matter, and inquiry of new knowledge that may contribute to understanding. In the study “Using Knowledge of Children’s Mathematics Thinking in the
Classroom Teaching: An Experimental Study”, students’ individual mathematical thinking skills were assessed. First graders were examined over a month long period in which an individuals’ knowledge of problem solving was measured. The teachers in the experimental group were to use constructivist approaches to problem solving. Constructivist forms of learning were directly correlated with the individual’s increase of mathematical knowledge and retention as well as teacher knowledge of student learning. The students in the control group experienced less learning while the teachers had less knowledge of subject area and less knowledge of their student’s learning (Carpenter, Fennema, Peterson, Chiang, & Loef, 1989).

**MOTIVATION AND KNOWLEDGE IN SCIENCE AND MATHEMATICS**

Although some children lack the mathematical skills to solve everyday problems, it is noted that yearly assessments do highlight the fact that “children graduate high-school with insufficient knowledge of math” (Byrnes, 2007 p. 258). Although these students do not acquire the necessary skills, what information do we know of these children enough to be able to make a profound change in their future learning? The NCTM noted that mathematics teaching should engage students in inquiry learning and investigation, and allow for student value of mathematics. Romberg & Kaput (1999) as noted in Byrnes (2007) stated that mathematics should also be a goal-directed activity. Dweck (1986) as cited in Hoffman (2007 p. 268), described two theories of intelligence: “entity theory of intelligence” (fixed intelligence) and “incremental theory of intelligence” (intelligence is malleable). Students who favor mastery of a subject, and self-worth in investigating how they arrived at a given solution are usually students who have intrinsic motivation. Learning goals help “increase competence” and allow students to seek challenges and have high persistence (Hoffman, 2007). If students feel that knowledge
comes from approval of parents and teachers in a given subject area they may have extrinsic motivation in achievement or performance goal orientation. The goal is to gain positive attitudes and or avoid negative opinions (Hoffman, 2007). Typically, students who feel motivated by a performance goal may show high or low confidence, while learning goals usually increase competence with high or low confidence. Depending on the persistence of positive/negative judgments students may present high confidence and continue mastery, but until a negative judgment is shown they feel “helpless, avoid challenges and have low persistence” (Dweck, 1986 in Hoffman, 2007 p. 270). According to Middleton & Spanias (1999); motivation can be influenced by: learning of motivation, motivation has an effect on student success and failure, intrinsic motivation has more engagement than rewarding motivation, teachers matter, and “inequities are influenced by how different groups are taught to view mathematics”(Middleton & Spanias, 1999). Can mathematics and science be viewed the same for all students?

“The Value (and Convergence) of Practices Suggested by Motivation Research and Promoted by Mathematics Education Reformers,” the study examined 4th-, 5th-, and 6th-grade children in 24 classrooms in districts located in a large urban area. The students represented were of diverse racial and ethnic backgrounds. All the schools in the study served primarily low income households and more than 25 percent of the students and approximately 32 of the students’ first language was Spanish. The results indicated that students who believed that their mathematics competency was higher, focused more on learning and mastery, and developed more enjoyment while learning. Also, students who were concentrated on learning, experienced more positive experiences learning mathematics while those who believed that they needed to perform well claimed to have fewer positive emotions. Instructional practices that favored
positive motivation helped student’s conceptual learning. Environments where learning was emphasized encouraged independence while students retain greater knowledge autonomy (Stipek, Salmon, Kazemi, Saxe, & MacGyvers, 1998).

**MOTIVATION AS PERTAINING TO SELF-EFFICACY IN GENDER AND ETHNICITY**

Self-efficacy is one’s own self-judgment of capabilities to perform certain tasks (Bandura, 1986). Self-efficacy holds much power when speaking about academic potential and the capabilities a student believes they have in an academic setting (Center for Positive Practices, 2006). According to the social cognitive theory postulated by Bandura (1986), a students’ academic performance can be influenced by how learners are affected by instructional practices and instructional strategies, thus teaching has much to do with learning and how students perceive their learning. Also, in mathematics, confidence relates closely with how one perceives to do well in a domain-specific task, thus negative stereotyping may produce a negative effect in domain-specific tasks like doing mathematics (Center for Positive Practices, 2006). In a study done by Fennema & Sherman (1997), they concluded that there is no gap between male and female learning, but as time and age progressed self-efficacy for females decreased more than males forming a gap because females give up easier at the face of difficulty (Pajares, 1996). The greatest gap occurred at the high school level, thus social constructs of male overpowering females in mathematics has a negative effect on self-efficacy in females as time progressed. This has clearly been translated to post-secondary education.

Self-efficacy can also be translated to the extent of ethnic barriers. Academic self-efficacy beliefs as a function of familial and schooling influences can contribute much to how
these different ideals can impact a student’s success. Graham (1994 p. 103) summarized that black students maintained “undaunted optimism and positive self-regard even in the face of achievement failure.” Although sometimes it is difficult to assess student motivation and self-efficacy pertaining to race, class and ethnicity; studies have proven that there is a stratification in the belief of student performance and that cultural and parental influences are a factor in their motivation (Pajares, 1996).

These points of self-efficacy can translate to self-efficacy to perform tasks that can lead to career placement or careers one would like to consider. “Process efficacy or perceived ability to manage tasks necessary for career preparation, entry, adjustment, or change across diverse occupational paths” is important because of the social implications race and ethnic gaps have on STEM retention (Brown & Lent, 1996).

COMMUNICATION, TEACHER CONTENT KNOWLEDGE AND PEDAGOGY
According to Hiebert, et. al. (1998) in Steele (2001), students develop understanding once they can develop relationships and connections within their mathematical framework. Hiebert, et. al. (1998) claimed that “communication involves talking, listening, writing, demonstrating, watching… participating in social interaction, sharing thoughts with others, and listening to others share their ideas” (p. 5) The communication process also facilitates in building meaningful ideas (NCTM, 2000 p. 60 in Steele, 2001). Verbal and visual representations are valid forms of communication, and are strongly emphasized in mathematics classrooms (Steele, 2001). Also, teacher’s need to be aware of the differences in social-cultural contexts because student’s can receive different forms of mathematical learning through cultural experiences (Steele, 2001).
Through experience, students can provide a relation to a conceptual representation and provide a counterexample to refute it. Also, incoherence of knowledge can result from potential cognitive conflict (Steele, 2001). In a study that was centered on socio-cultural understanding where second-grade classrooms were assessed in improving mathematical learning through perceptions of student achievement, and student interest in mathematics. Students who were in the socio-constructivist groups had increased mathematical learning and higher mathematical efficacy as compared to the control group. Also, teachers reported to have understood their students more through using the socio-constructivist vs. teachers who were in the control group (Steele, 2001).

According to Steele (2001), teacher content knowledge is the essence of mathematical learning in students.

“In order for teachers to reflect on the mathematical learning of their students, they must understand the content knowledge they teach, without content knowledge it would be difficult for teachers to understand how to guide students in helping them to effectively communicate. It would be difficult for teachers to understand what their students know and provide appropriate questions to take students from the familiar to the unfamiliar – form present understanding to potential understanding. Without content knowledge it would be difficult to provide the rich problems needed for students to develop meaningful understanding of mathematics”

In mathematical pedagogy, research indicates that there is much contradiction in teaching how students begin to perceive a problem on their own to how the teacher believes it should be solved. It also seems to be a predictor of countering the goals of the task to be completed. In
mathematics education, student’s constructive task orientation is regarded to have a very high learning rate. These tasks can build tensions between the teacher’s goal of instruction and that sometimes the perceived outcome is shifted negatively because of the teacher’s intervention (Herbst, 2003).

**SOCIAL LEARNING**

Social learning is an aspect which takes into account group processes to solve particular issues in education (Tobin, 1993). Von Glasserfield (1992) as in Tobin (1993) refers to group learning as the following:

1. Students who work on a problem together have to articulate how they see the problem and purpose to solve it thus they generate reflection together.
2. Explaining to peers leads students to see a picture more clearly.
3. Knowing that those you work with have no ready-made answer increases everyone’s courage to find an answer.
4. Explaining inconsistency of “error” by a peer is far less painful than to have the teacher say it is wrong.

Thus, having social interactions is more comforting to a student so that they become more knowledgeable of a particular subject area, while working with other students can provide a sense of hope rather than a sense of push towards a particular goal. In a study done by McRobbie & Tobin (1997), they concluded that students have more understanding in science when discussing with peers about subject matter relevance. Teachers and students interact continuously in the classroom; and these dialogues should lead to a mutual agreement when both parties understand a particular subject with a greater death of knowledge.
FIRST GENERATION STUDENTS-RETENTION, PERSISTENCE, AND GRADUATION & STUDENTS OF COLOR PURSUIT OF STEM MAJORS

The U.S. Department of Education’s TRiO programs define FGIC as students whose parents have not earned a bachelor’s degree or equivalent regardless if they have some postsecondary experience (Nunez & Cuccaro-Alamin, 1998). Graduation rates for colleges and universities have been declining for several years and may be influenced by rising college costs and diminishing financial aid resources (Thayer, 2000). According to Richardson & Skinner (1992), FGIC students lack time management and budget management, while Willett (1989) found that they have limited access to information about the college experience. According to Engle & Tinto (2008), FGIC students tend to be older, female, have a disability, come from minority backgrounds, be non-native English speakers born outside of the U.S., have dependent children or be single parents, have earned a GED, and be financially independent from their parents. Also, low-income, first generation students are most likely to have delayed entry into post-secondary education, attend a college closer to home, live off-campus, be a part-time student and work full-time while enrolled (Engle & Tinto, 2008). According to Engle & Tinto (2008), there are many approaches to increase the number of minority-low income students that pursue a bachelor’s degree. Firstly, they can improve academic preparation for college by taking rigorous high school curriculum, including advanced mathematics and science courses (Engle & Tinto, 2008). Some of these students do not have the sufficient preparation when entering post-secondary institutions and that is why they fail when entering this climate. Also, providing financial aid for college and expand options in respect to college can also help in retaining students. Unfortunately, Federal Pell Grant and work-study programs have not kept pace with dramatic increases in tuition and fees in recent years (Engle & Tinto, 2008). Increasing transfer
rates from community colleges can also help in retaining FGIC and minority students (Engle & Tinto, 2008). Promoting engagement on college campuses by providing events that allow for students to participate and interact with other students, faculty and staff can help them become acclimated to the environment and the available resources (Engle & Tinto, 2008). According to Glenn (2008), among students who enrolled in 4 year colleges, the FGIC students had a graduation rate of 44.9 percent in comparison to non FGIC students 59 percent. Graduation rates for minority students are much lower than those who are non-minority students. At the same institution, black students, for example, graduate at a lower rate than their white peers (Glenn, 2008). Minorities make up 24 percent of the U.S. population, but only 7 percent of them work in science and engineering (NACME, 2008). Also, the inclusion of people from different groups may contribute as a driving force in the generation of new products and ideas in engineering and technology as society is going through rapid demographic shifts (NACME, 2008). In the case of minority students, selection and persistence in STEM majors has been correlated with academic preparation in high school (Grandy, 1998). Also, students who foster relationships with faculty members and reported supportive educational experiences outside of the classroom have been more likely to achieve levels of college satisfaction and persistence towards graduation (Cole and Espinoza, 2008).

THE UNIVERSITY OF CENTRAL FLORIDA UPWARD BOUND PROGRAM

In 2008, it cost the United States Department of Education four thousand, eight hundred nineteen dollars to serve a student in the Upward Bound Program (henceforth referred to as UB) (Department of Education, 2008). Since the implementation of UB, funded by the Department of Education in 1966, it has been designed to prepare first generation college-bound high schools
students for post-secondary experiences (ED, 2008). The desired results of the UB program are that every student has the opportunity to pursue a post-secondary education while continuing its primary objective of increasing high school graduation rates. UB also has four major objectives including: academic improvement on standardized testing, program retention, postsecondary enrollment and postsecondary persistence (UCF Upward Bound, 2010). UB program is measured using effectiveness evaluation and impact evaluation, the first measures the extent to which a program meets its goals and objectives while the latter measures whether the program made a difference compared to those not in the program (Schalock, 2001). According to McCalley (1969), students in UB were pursuing more college-preparatory classes, and those UB graduates enrolled as freshman were performing better academically than the average freshman at the respective colleges. In 1973, Burkheimer reported that high school retention of UB students was higher than those not in UB: 98 percent vs. 93 percent respectively. Also, Myers and Schrim (1999) reported that students with lower educational expectations benefitted more from the program. Now it is harder to determine whether or not the UB program is effective because more programs exist to target these minority groups such as Gear-up, and other school or community programs (Calahan, 2009).

The UCF Upward Bound Program is housed at the main campus of the University of Central Florida. Currently there are 50 participants who receive support services in achieving high school graduation and post-secondary education enrollment. The director of the Upward Bound Program describes her program in the following manner:

“Through comprehensive, holistic, co-curricular and academic programs, the UCF Upward Bound Program provides low income, potential first-generation high school
students with the tools necessary to access postsecondary education as full participants. We support students as they push beyond barriers to college access by engaging them in tutoring, mentoring, academic workshops, academic counseling, academic instruction, assistance with standardized testing, life skills workshops, cultural events, college visits, assistance with the college admissions and financial aid processes, financial literacy, information fluency, career exploration, leadership development, and a summer residential program. Upward Bound is a unique experience that affords our 50 scholars with opportunities they would not have but for the program. Our scholars have made tremendous gains and have had numerous experiences that have positively impacted their lives. This is the fourth year of our federally-funded program and we’ll have our first graduating class in June 2011. We are proud of our Scholars and their accomplishments” (UCF Upward Bound, 2010).
HYPOTHESES AND METHODOLOGY

HYPOTHESES

The methodologies used in this study were a combination of focus groups and pre-and post-test surveys. Focus groups were used to capture nuanced, qualitative data regarding students’ perceptions. The surveys captured both qualitative and quantitative information relating to students’ experiences, demographics, socioeconomic status, prior academic preparation and other factors. The surveys were conducted using the data collection web site www.zoomerang.com. A total of 26 students completed pre-posttest surveys. In the qualitative study, a sample of 26 students was separated into focus groups based on gender, background and ethnicity.

The following research questions were addressed in the following study:

1. What do potential first generation in college, low income and multicultural students believe of their science and mathematics success?

   **Hypothesis 1**: Potential first generation in college, low income and multicultural students believe that science and mathematics are difficult and attribute their success to self-efficacy or believing they are successful.

2. Do potential first generation in college, low income and multicultural students in the Upward Bound Program show an interest in STEM related disciplines?
**Hypothesis 2**: Potential first generation in college, low income and multicultural students in the UCF Upward Bound Program show an interest in STEM related disciplines and believe that successful and well-paying careers are in these disciplines.

3. How can first generation in college, low income and multicultural students remain interested in STEM related disciplines, enroll, persist and graduate from post-secondary institutions?

**Hypothesis 3**: Potential first generation in college, low income and multicultural students that are interested in STEM related disciplines have a variety of stakeholders that contribute to their success including teachers, self-efficacy and same group orientation.

4. Do potential first generation in college, low income, and multicultural students see themselves in a college environment, and how?

**Hypothesis 4**: Potential first generation in college, low income and multicultural students see themselves successful in college, but with the right knowledge and resources including support services. The Upward Bound Program is also a stakeholder in terms of achieving a post-secondary education for this group of students.
METHODS

Participants

Participants were students enrolled in the UCF Upward Bound summer residential program. A total of 26 students were recruited to participate in the pre- and post-test survey and focus groups. They were assigned numbers 1-26 to protect their identities. The students that participated in this study did not receive any compensation for their time. All students were minors whose parents or legal guardians consented to allow their child be part of this research study. IRB approval was granted for this study.

Materials and Procedure

Materials included computer access to www.zoomerang.com for both pre-posttest measures. The pre-test was scheduled on 28 June 2010 at 12:30 p.m. and the post-test was scheduled for 27 July 2010 at 12:30 p.m. both in Classroom Building I at the UCF Main Campus. The data was then entered into an Excel spreadsheet where it was separated based on pre-posttest participants and then individually assessed in number of repetitive responses and also, individually segregated to show important statistical data.

The focus groups were scheduled between 28 June and 27 July 2010. 26 students were divided among 11 focus groups based on gender, race and ethnicity. A computer was used to read the questions while the interview was digitally recorded for quality assurance, then transcribed and analyzed.

ANALYSIS AND RESULTS
There were a total of 22 students who took the pretest survey. Their ethnicities are broken down below in Figure 2. The majority of the students were Hispanic. 50 percent of the students were male and 50 percent of the students were female. 59 percent of the students were in school C (with a state grade of a B) and 41 percent of the students were in school U (with a state grade of a C). According to GreatSchools.org (2010), in 2010 School C has approximately 3459 (grades 9-12) students total. The school demographics were the following: 65 percent Latino, 21 percent White, 10 percent African American, 3 percent Asian/Pacific Islander, 1 percent Multiracial and less than 1 percent were American Indian/Native American. Also, in regards to eligibility for free or reduced price lunch, 46 percent of the students receive these services. 19 percent are students with disabilities, 3 percent are gifted and 18 percent are ELL (GreatSchools.org, 2010). School U on the other hand has a student population of 2750 with the following demographics: 46 percent are Latino, 34 percent are White, 11 percent are African American, 6 percent are Asian/Pacific Islander, 2 percent are Multiracial and less than 1 percent is American Indian/Native American. 30 percent of the students are eligible for free or reduced lunch, 14 percent are students with disabilities, and 6 percent are gifted students while 12 percent are ELL.
FCAT RESULTS

School C had the following Florida Comprehension Assessment Test (henceforth referred to as FCAT) scores in 2009-2010, for grade 9, 34 percent are at or above grade level in reading and 53 percent in mathematics. Grade 10 had 28 percent of the students at or above grade level in reading and 61 percent in mathematics. Grades 11, 32 percent of the students were at or above grade level in science. Grades 9 in School U, 53 percent of the students were at or above grade level in the reading and 71 percent in mathematics. For grade 10, 40 percent were at or above grade level in reading and 75 percent in mathematics. 38 percent were at or above grade level in science.

100 percent of the students surveyed took the Mathematics and Reading Florida Comprehension Assessment Test (henceforth referred to as FCAT). In regards to the mathematics FCAT, most of the students answered that it was easy. Student 5 answered “easy because math has always been my strong subject in school”. Also, student 2 answered “yes because my teacher made us students rewrite the equations”. Student 6 in contrast responded, “I
felt a bit prepared but not fully prepared”. Student 4 stated “the math part of the FCAT was of medium difficulty. I knew most of them but I didn’t know some of the questions that they asked”. Student 8 responded that “The math FCAT was not hard at all. I felt prepared. I felt the math test was very easy”. In regards to the science FCAT, 66 percent of the students surveyed did not feel prepared to take the science FCAT. Student 3 stated “I did not attempt to study science at all.” Student 4 said, “I did not feel prepared to take the science FCAT because science is not my strong area and I did not have a good science teacher the first nine weeks”.

**HYPOTHESIS 1:** Potential first generation in college, low income and multicultural students believe that science and mathematics are difficult and attribute their success to self-efficacy or believing they are successful.

Potential first generation in college, low income and multicultural students generally believe that they can do more advanced math and science. Throughout the interviews and pre-posttest analysis the overall result was that they believe they have the potential, but they chose not to. Some students attribute their failure to teacher interest in their science and math success, especially if the material is not applicable to them in the real world. Student 2 in the interview when asked “do you feel happy that what you learned in class you can apply to the real world.” The pupil answered “I feel very happy that what I learned in class helps in real life because that way I know ok, I am getting older now and being a grown up means you have to take responsibilities and some of your responsibilities obviously have to be math and science and college”.

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In regards to survey questions, 35 percent stated they felt they can do more advanced math or science, while 18 percent disagree. 35 percent of the students feel that teachers feel they can do more advanced math or science. 41 percent of the students are inclined to agree that teachers encourage them to study more advanced math and science. When asked about doing difficult science homework, most of the students answered that they felt neutral or inclined to disagree. 47 percent of the students stated that they feel stressed when taking a math test. 59 percent of the students feel that science is important for the world around them.

Students also mentioned that their degree of comfort-ability in their science classes and/or math classes revolved around applying the information learned. Student 2 discussed “probably the most conformable was, throughout the whole year I felt was when I was dissecting things, like some people were like I don’t want to do that, and I was one of the people that was actually comfortable with it and actually remembered the body parts and people were like she knows what she is doing kind of like helping people out and stuff”.

**HYPOTHESIS 2:** Potential first generation in college, low income and multicultural students in the UCF Upward Bound Program show an interest in STEM related disciplines and believe that successful and well-paying careers are in these disciplines.

Most students if not all the students interviewed believe that science and mathematics careers are needed to obtain well-paying jobs, but not all stated an interest in STEM related disciplines. Many students believe that science and mathematics are boring, or not interesting. Student 6 was asked the following “Have you done any experiments of interest in your science
class? Like you said “hands on” have you done any experiments of interest? “Yes, dissections”. The interviewer asked “do you remember what you did when you dissected?” “No, we did a lot, but I don’t remember because they were boring”. There were other students who stated that they only remember experiments they did in class. Also, 50 percent of the students stated that they needed math for at least one aspect of their lives. The interviewer asked “have you guys ever talked about anything in mathematics that was not related to the lessons taught in class.” Student 2 stated “yes when my parents give me money and tell me to buy something and I don’t know how much it is, I pull out a calculator to see if I have enough money to buy myself something. My sisters bug me to help her with her homework even if though she is really good at math, I have to remember the equations by looking at what she is learning”.

Students through the interview were asked to draw a picture of how they see themselves in college. Student 3 described her drawing (see Appendix F) as the following

“I drew a girl with a stethoscope and a lab jacket. I drew in the back this is pediatrics and I drew a bag with money, because I will be making good “moolah”. I drew a wall. On one side its dirt and the other side its grass like the grass is greener on the other side. As in I need to go to school, because it’s better than to be a little drop out, I drew a sun to symbolize the bright side”.

**HYPOTHESIS 3**: Potential first generation in college, low income and multicultural students that are interested in STEM related disciplines have a variety of stakeholders that attribute to their success including teachers, self-efficacy and same group orientation.
All Upward Bound students surveyed stated that they have a career path they want to take. Not all stated that they want to enter mathematics or science fields, but through the course of the Upward Bound summer residential program, students were exposed to more science and mathematics than in their respective high schools increasing the knowledge base and inquiry of these fields. Also, 14 percent knew their GPA’s in the pre-test while 65 percent of the students answered they knew their GPA by the post-test. In the focus group interviews it was apparent that through time and exposure their ideologies were changing in response to the summer residential program. Student 20 stated

“I just don’t really know how to apply it [math and science] unless I am here [Upward Bound]. I will apply what I learned in my math class here. Like she said, we were building a robot and [UB teachers name] tells us that we do need math and our measurements need to be right and that is what it takes to do a robot and if anyone else is interested in doing a robot, then they also have to apply what they learned”.

Student 15 stated “In Upward Bound, this year we are actually going into more engineering things so we need a lot of math for that especially if we are going to build a robot we have to make sure that the measurements are correct and it involves a lot of math in it”.

Student 2 was able to give me a detailed explanation on how to dissect DNA out of a strawberry:

“I put the strawberry in a bag and I had to crush it up, but I think we put soap in it before we crushed it up. We mushed it until it was really soft and we put some substance into a tube and then we put the strawberry stuff in it, into a filter and then she gave us this thing that froze [alcohol]. It kept it thick. It kept the DNA from the strawberry”.
According to Figure 3, 35 percent of the students feel that teachers feel they can do more advanced math or science. Also, in the interviews approximately 50 percent of the students interviewed answered that if teachers had more communication with them regarding their mathematics or science progress they would be more inclined to improve their participation.

65 percent of the students interviewed believe that teachers have a moderate effect on increasing their interest in science, while 59 percent of the students believe that teachers have an extremely important effect on increasing interest in math. 29 percent of the students extremely believed that teachers value them when they arrive at a correct answer in their mathematics classes. In regards to memorizing facts or information 65 percent of the students believe teachers emphasize memorization in general.

In regards to assessment, students indicated that most of the examinations are done with an equal emphasis on multiple choice and open ended questions, but seem to feel neutral about teacher’s originality in teaching with a 55 percent of students believing so.
Students throughout indicated that their parents have a very high influence on their college success. Some students even indicated that the parents are more interested in their children attending the Upward Bound Program than the students themselves and according to the children; parents seem to be very involved in the program as are the students. In regards to parents’ implications, qualitatively, students indicated that generally math and science is not a priority in regards to parental involvement. Only 17 percent of students have an immediate family member that is employed in a STEM related discipline. Student 17, a male indicated something important about his parent’s involvement. He stated that “at my father’s job, I met a person who are engineers and that is where I learned that I wanted to be an engineer”. This particular student placed great emphasis when he went to his father’s job to visit fellow coworkers. When asked what his father’s job specifications were the student declined. Also, many students want to get an education to not be “stuck” in the same life their parents have, such is the example with student 16 “my family supports my college dream. My mom didn’t go to college and my dad really doesn’t have an education. My mother wants me to live a life where I can live comfortably and not have to worry much. By just looking at my parents I can tell than they don’t want me to live the life they used to live”. Figure 4 shows that 38 percent of the students surveyed agree that parents understand what students want out of their education, 9 percent strongly disagree.
"My parents understand what I want to get out of my education"

![Pie chart showing responses to the statement about parents understanding one's education.]

**Figure 4: Parents' understanding of children’s' education**

In regards to same-group or other-group orientation, students did not feel this was important in their post-secondary success. When asked about having preference towards people of the same ethnic or racial group more than 50 percent of the students indicated that they are not “racist”. Also, they believe that teachers just because they are in the same ethnic or social group as a particular student did not give preference to those students. When asked if being in a larger college classroom and only a small amount of students are of their same ethnic or racial origin they would prefer to join them more than students of other races or ethnicities. Most students automatically associated on-campus groups and support services once asked this question.

Student 4 stated that she wanted to go to Florida Agricultural and Mechanical University (FAMU) because “with black people I feel more comfortable” and “I feel more comfortable going to a university with more people of color”. Throughout the interview she referenced her desire to go to FAMU and only FAMU because of this ethnic connection (see Appendix G).

Although students did not place great emphasis on same or other group orientation, they
did place emphasis on group work. Students are eager to work in groups and even some stated that teachers emphasize group work. Student 5 was asked “do your teachers group you randomly or with people who are more like you in your class?” The student responded, “randomly, if we are studying for a test it is random, but sometimes she lets us stay in our own groups.”

**HYPOTHESIS 4:** Potential first generation in college, low income and multicultural students see themselves successful in college, but with the right knowledge and resources including support services. The Upward Bound Program is also a stakeholder in terms of achieving a post-secondary education for this group of students.

Potential first generation in college, low income and multicultural students see themselves successful in college with the right resources, contacts, and support services. Many students alluded to having an equivalent version of the Upward Bound program on campus where they can have information about college, and support. When asked if students would find study groups or tutoring sessions they all answered yes, especially if they “really needed help,” as stated by Student 4.

When students were asked what three things they would look to succeed in a college environment most answered a place to study, a place where people will conjoin to learn the same information, and the library. Others stated that they would look for fraternities or Greek life.

Most students also did not know that lecture halls can reach the number of students in the hundreds. Many students questioned how their interaction with teachers or professors can hinder their success in class.
In regards to support systems, many students alluded to siblings or family members who have been in college that they know can help them. Student 2 stated:

“my brother is in college right now and he has been telling me all about college and since he is my older brother I am really close to him and he tells me his experiences too because that is how you are going to get your job and get your money and going to start your life and I think this is a good experience also. I find college not only a dream but a necessity”.

In regards to Upward Bound and its implications on students’ success, it is very important to the majority if not all the students. Student 24 stated “if it were not for the Upward Bound Program, I would not be thinking about going to college”. Other students stated that the Upward Bound Program helps them with homework, tutoring, and support with college. Figure 5 shows how valuable Upward Bound has been for the education of the students surveyed.

![Pie chart showing response to "I feel Upward Bound has helped me gain valuable experience for my education"](image)

Figure 5: Upward Bound experience
"I feel Upward Bound has helped me become a better math and science student"-pretest

- Strongly Agree: 28%
- Inclined to Agree: 38%
- Neither: 29%
- Inclined to Disagree: 5%
- Strongly Disagree: 0%

Figure 6: Upward Bound helping students with mathematics and science pre-test
Throughout the course of the summer, students’ perceptions of the Upward Bound Program helping scholars become better science and math students went from a 28 percent to 53 percent according to Figures 6 and 7.
DISCUSSION AND FUTURE RESEARCH

Overall students displayed key themes relating to science and mathematics success. Most if not all students believe that science and mathematics fields are ones that are difficult to accomplish, but have monetary benefits. Although this research was a very interesting one, unfortunately we cannot generalize any of the findings due to the limited number of participants. Also, many of the students that took the pre-test unfortunately did not take the post-test leaving only nine participants for comparisons which moderated many of the research objectives for the study.

Throughout the course of the summer, students seemed to be appreciating the science and mathematics component of the UB program. Especially when asked about the application of concepts learned or reinforcement of previous material. Many of them stated that during the summer they were learning more about other careers in engineering and technology fields that they never knew existed.

Important aspects to emphasize in regards to stakeholders in college readiness are parents, teachers, and self-efficacy. All students believe that they have a definite plan and career choice and are choosing all the resources possible in continuing to foster the growth. According to Bandura (1986), people’s judgments of their skills to organize and “execute courses of action required to attain designated types of performances” and feeling allow them to picture themselves surviving in challenging situations and allow for self-efficacy. Many students discussed the hardships endured by their families and the necessity to obtain a college education. Those who felt that they wanted to enter a STEM related discipline specified their interest. In
general students in all areas that picture themselves surviving through the hardships of a challenging environment have self-efficacious attitudes that may gear them towards success. It would be an area of future research to track these students and how they compare their perceptions of high school going into college and what they actually experienced upon entering a post-secondary institution. Although it is hard to predict persistence of high school students in post-secondary education, most of them felt prepared. But, they still need to be educated on important aspects of college life. Including class sizes, exactly what they need to do in order to fulfill specific requirements for their major, academic counseling and where to look for these opportunities.

In this study, same and other group orientation did not seem to be something of great emphasis. One student felt the need to join a group of students that had a similar cultural background. Most students felt offended when asked the question about joining people of the same group or other groups in school. They feel that any friend they have of any race is equal. An important implication to look for in the future is seeing how this perception changes upon entering a college campus. Not all students will be of similar racial, cultural and ethnic backgrounds. The majority of the students that attend the high schools where these students attend are minority students and school C is eligible for title I funding although they chose not to receive the funding.

In the study done by the University of Wisconsin, Center on Education and Work which was referenced earlier in this study, found that students that leave the sciences have similar grades in STEM than those that persist, but they find that they have chilly classroom experiences (Cabrera, et al., 2001). Also, greater barriers such as lack of mentoring and prejudice on campus
were an important factor in the attrition of minorities in STEM (Brown, Morning, & Watkins, 2004; Seymour & Hewitt, 1997). When UB students were asked important questions regarding to chilly climate, barriers and prejudice relating to other group orientation, they did not feel that they were victims of this, but more research has to be done as students enter post-secondary institutions. According to the Center on Education and Work at the University of Wisconsin Madison (2008), STEM retention of ALANA or minority students begins by the following:

1. Strengthening and maintaining students confidence in their academic ability
2. Address decline in academic self-efficacy and examine competition among peers
3. Address students’ beliefs about career and academic expectations
4. Explore factors that address commitment to STEM careers
5. Affirm students’ experiences and culture
6. Attend to students’ bicultural competence and coping skills
7. Address students’ perceptions of unreceptive campus climate (p. 4)

One of the most important implications is addressing students’ beliefs about career and academic expectations. The Upward Bound program not only is a support system, but there is also guidance in academic preparation and tutoring that addresses these cultural and academic difficulties and boost confidence when challenged with the task of entering post-secondary education.

Hopefully, future research may include doing a similar study on minority undergraduate students pursuing STEM related disciplines. This can be done by following a cohort year-by-year to examine specific cultural and social changes that may have led to the attrition and/or retention of such students once entering a college environment.
APPENDIX A: IRB APPROVAL LETTER
IRB APPROVAL LETTER

University of Central Florida Institutional Review Board
Office of Research & Commercialization
12201 Research Parkway, Suite 501
Orlando, Florida 32826-3246
Telephone: 407-823-2901 or 407-882-2276
www.research.ucf.edu/compliance/irb.html

Approval of Human Research

From: UCF Institutional Review Board #1
FWA00000351, IRB00000138

To: Rebekah McCloud

Date: October 07, 2010

Dear Researcher:

On October 7, 2010, the IRB approved the following modifications until 01/03/2011 inclusive:

Type of Review: IRB Addendum and Modification Request Form
Modification Type: Protocol revision including additional objectives and survey, addition of Christina Restrepo as co-investigator
Project Title: The UCF Upward Bound Program: Student Performance, Persistence & Impact
Investigator: Rebekah McCloud
IRB Number: SBE-09-06534
Funding Agency: U.S. Department of Education/TRIO (USDOE)
Research ID: 104526

The Continuing Review Application must be submitted 30 days prior to the expiration date for studies that were previously expedited, and 60 days prior to the expiration date for research that was previously reviewed at a convened meeting. Do not make changes to the study (i.e., protocol, methodology, consent form, personnel, site, etc.) before obtaining IRB approval. A Modification Form cannot be used to extend the approval period of a study. All forms may be completed and submitted online at https://iris.research.ucf.edu

If continuing review approval is not granted before the expiration date of 01/03/2011, approval of this research expires on that date. When you have completed your research, please submit a Study Closure request in IRIS so that IRB records will be accurate.

Use of the approved, stamped consent document(s) is required. The new form supersedes all previous versions, which are now invalid for further use. Only approved investigators (or other approved key study personnel) may solicit consent for research participation. Participants or their representatives must receive a copy of the consent form(s).

In the conduct of this research, you are responsible to follow the requirements of the Investigator Manual.

On behalf of Joseph Bielitzki, DVM, UCF IRB Chair, this letter is signed by:

Signature applied by Janice Tuchin on 10/07/2010 09:47:04 AM EDT
APPENDIX B: PARENTAL CONSENT FORMS
The Upward Bound Program Research Study

Parental Consent Form

1. Please read the following statement:

The UCF Upward Bound Program will include your child as part of a research study. The purpose of this study is to learn perceptions as well as the interest your child has in his/her mathematics and science classes. This study will also help in identifying key factors that will promote his or her success in mathematics and science as part of the Upward Bound Program. The study is permitted under Section 402H of the Higher Education Act of 1965, 20 U.S.C. 1070a-18.

We would like you to allow your child to participate in this important study. If your child participates, we will collect survey information in the beginning and end of the summer component of Upward Bound. During the summer, students will be interviewed in a series of focus groups that will be audio-taped to further elicit responses pertaining to science, technology, engineering and mathematics (STEM) interests. Also, we will use College Placement Test scores and grades in science and mathematics courses. The information gathered on him/her will be kept strictly confidential and will be used by the UCF Upward Bound Program and its contractors ONLY for the purpose of this study, except if required by law.

2. After reading the above statement, do you agree to allow your child to participate in the UCF Upward Bound STEM study, as described above?

☐ YES, my child

First Name ___________________________ Last Name ___________________________

has my permission to participate in the UCF Upward Bound Program STEM study.

☐ NO, my child

First Name ___________________________ Last Name ___________________________

DOES NOT have my permission to participate in the UCF Upward Bound Program STEM study.

Print Your Name ___________________________

First Name ___________________________ Last Name ___________________________

Signature ___________________________ Date ___________
El Estudio Investigativo del Programa Upward Bound

Formulario de Consentimiento de los Padres

1. Por favor, lea la siguiente declaración:

El Programa Upward Bound de la Universidad de la Florida Central incluirá a su hijo como parte de un estudio de investigación. El propósito de este estudio es conocer las percepciones, así como el interés que su hijo tiene de las matemáticas y ciencias. Este estudio también ayudará en la identificación de factores claves que promoverán su éxito en las matemáticas y la ciencia como parte del Programa Upward Bound. El estudio está autorizado por la Sección 402H de la Ley de Educación Superior de 1965, 20 USC 1070a-18

Nos gustaría que permita que su hijo participe en este importante estudio. Si su hijo participa, recopilaremos información de la encuesta al principio y al final del componente de verano de Upward Bound. Durante el verano, los estudiantes serán entrevistados en una serie de grupos de enfoque que además serán audio-grabados para obtener aún más las respuestas relativas a la ciencia, tecnología, ingeniería y matemáticas (STEM) y sus intereses. Además, vamos a utilizar resultados del CPT y las calificaciones en ciencias y matemáticas. La información recogida de él/ella se mantendrá estrictamente confidencial y será utilizada por el programa Upward Bound y SOLO sus contratistas con el propósito de este estudio, excepto si es requerido por la ley.

2. Después de leer la declaración anterior, ¿está de acuerdo en permitir que su hijo participe en el estudio Upward Bound STEM, según lo descrito anteriormente?

☐ SI, mi hijo/a

<table>
<thead>
<tr>
<th>Nombre</th>
<th>Apellidos</th>
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<tbody>
<tr>
<td></td>
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</tr>
</tbody>
</table>

tiene mi permiso para participar en el estudio Upward Bound STEM.

☐ NO, mi hijo/a

<table>
<thead>
<tr>
<th>Nombre</th>
<th>Apellidos</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

NO tiene mi permiso para participar en el estudio Upward Bound STEM.

Imprimir su Nombre

<table>
<thead>
<tr>
<th>Nombre</th>
<th>Apellidos</th>
</tr>
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<tbody>
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<td></td>
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</tbody>
</table>

Firma _______________ Fecha _______________
APPENDIX C: PARENT NEWSLETTER
WHAT: The Upward Bound Program STEM Research Study

For those who participate, we will ask some survey questions in the beginning and end of their summer 2010 Upward Bound component. We will also conduct focus groups in order to elicit more detailed responses in regards to your interest and motivation to pursue STEM disciplines in the future. All the questions are important to the study, but you can decide not to answer any question you do not like. If you agree to be part of the study, we will also obtain copies of your school records including (CPT placement scores and grades in science and mathematics courses).

WHEN: During the summer of 2010.

WHY: This study will help us know if your students are interested in math and science and if they feel self-worth in entering STEM fields in the future. It will also help Upward Bound in devising a program to help students with science and math.

WHO IS INVOLVED?
UCF Upward Bound scholars, you are not required to participate in this study. Whether you are a part of the study or not, it will not affect whether you are eligible for any program or service. You may decide not to continue in the research study at any time. Withdrawing will not be held against you and will not impact your participation in the Upward Bound Program nor in your receipt of program services.

QUÉ: El Estudio de Investigación del Programa Upward Bound sobre sus impresiones de Science, tecnología, Ingeniería y Matemáticas.

Para los que participen, vamos a hacerle algunas preguntas de encuesta al principio y final de su semestre del Verano 2010. También llevaremos a cabo grupos de enfoque con el fin de obtener respuestas más detalladas en cuanto a su interés y motivación para seguir las disciplinas STEM en el futuro. Todas las preguntas son importantes para el estudio, pero usted puede decidir no responder a ninguna pregunta que no quiera. Si usted se compromete a formar parte del estudio, también vamos a obtener copias de sus registros escolares, incluyendo (CPT, resultados de colocación y las calificaciones en ciencias y matemáticas).

CUándo: Durante el verano de 2010.

POR QUÉ: Este estudio nos ayudará a saber si sus estudiantes están interesados en las matemáticas y la ciencia y si se sienten autoestima para entrar en los campos de STEM en el futuro. También ayudará a Upward Bound en la elaboración de un programa para ayudar a los estudiantes con la ciencia y las matemáticas.

¿QUIÉN PARTICIPA?

Estudiantes de UCF Upward Bound. Usted no está obligado a participar en este estudio. Si usted es una parte del estudio o no, esto no afectará si usted es elegible para cualquier programa o servicio. Usted puede decidir no continuar en el estudio de investigación en cualquier momento. Su retiro no será usado en su contra y no afectará su participación en el Programa Upward Bound, ni en sus beneficios y servicios del programa.
APPENDIX D: PRE-POSTTEST SURVEY
PRE-POSTTEST SURVEY

We would like your opinion about your interest in Math and Science!

Directions: Please answer all the questions carefully. This is an assessment of your interest in science, technology, engineering, and mathematics (STEM) fields. Your individual responses will be kept confidential. Your teachers WILL NOT see your survey answers. Completing this survey has NO effect on your course grades or your participation in Upward Bound.

This survey will help to establish data on high school student’s perceptions of STEM and it will also help the UCF Upward Bound program to create specific strategies for potential programs in math and science.

Please be honest with your answers since they will be for your benefit for future programs.

Code #

Grade:

Years in Upward Bound:

For the following questions please check one:

1. Gender: [ ] Male [ ] Female

2. Race/Ethnicity: [ ] White [ ] Black [ ] Hispanic [ ] Native American [ ] Asian/Pacific Islander [ ] Other

3. I know my GPA: [ ] Yes [ ] No [ ] Yes, it is __________

4. I have taken the following FCAT tests (check all that apply):
   [ ] Math (go to questions #1 and 6)
   [ ] Reading
   [ ] Science (go to question #7 and 8)
   [ ] Writing
   [ ] Other

5. Did you feel prepared to take the FCAT test? 

6. How easy or difficult was the FCAT test for you? Please explain.

7. Did you feel prepared to take the Science FCAT? 

8. How easy or difficult was the Science FCAT for you? Please explain.

List jobs you would like to have when you grow up:

[ ] __________

[ ] __________

[ ] __________

[ ] __________

Please indicate how interesting the following jobs are to you: Only choose ONE answer for each profession.

<table>
<thead>
<tr>
<th>How interesting are the following jobs to you?</th>
<th>Extremely</th>
<th>Moderately</th>
<th>Not at all interesting</th>
<th>I don’t know what this job is</th>
</tr>
</thead>
<tbody>
<tr>
<td>Science Teacher</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
</tr>
<tr>
<td>Civil Engineer</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
</tr>
<tr>
<td>Biologist</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
</tr>
<tr>
<td>Engineer</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
</tr>
<tr>
<td>Computer Programmer</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
</tr>
<tr>
<td>Geologist</td>
<td>[ ]</td>
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<td>[ ]</td>
<td>[ ]</td>
</tr>
<tr>
<td>Geologist</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
</tr>
<tr>
<td>Pharmacist</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
</tr>
<tr>
<td>Physician</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
</tr>
<tr>
<td>Nutritionian</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
</tr>
<tr>
<td>Dentist</td>
<td>[ ]</td>
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</tr>
<tr>
<td>Dentist</td>
<td>[ ]</td>
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</tr>
<tr>
<td>Dentist</td>
<td>[ ]</td>
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</tr>
<tr>
<td>Lawyer</td>
<td>[ ]</td>
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<td>[ ]</td>
</tr>
<tr>
<td>Medical Doctor</td>
<td>[ ]</td>
<td>[ ]</td>
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<td>[ ]</td>
</tr>
</tbody>
</table>

Please indicate one answer for the following questions regarding your teacher’s effects on your math and science performance.

<table>
<thead>
<tr>
<th>Strongly Agree</th>
<th>Moderately Agree</th>
<th>Neither Agree</th>
<th>Strongly Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>Math teacher</td>
<td>Science teacher</td>
<td>Math teacher</td>
<td>Science teacher</td>
</tr>
<tr>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
</tr>
<tr>
<td>My math teacher allows me to work with others that are at the same level</td>
<td>[ ]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>My science teacher allows me to work with others that are at the same level</td>
<td>[ ]</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Indicate the answer that best describes your opinion about the following statement. Also, PLEASE ANSWER EACH QUESTION CAREFULLY.

For example: If you really enjoy science, you would indicate STRONGLY AGREE.

Circle (25) for each sentence:
<table>
<thead>
<tr>
<th>Circle (25) for each sentence:</th>
</tr>
</thead>
<tbody>
<tr>
<td>I feel my course work is more advanced than other science classes.</td>
</tr>
<tr>
<td>[ ] Strongly Agree</td>
</tr>
<tr>
<td>My teacher helps me do more advanced work with others.</td>
</tr>
<tr>
<td>My teacher helps me do more advanced work with others.</td>
</tr>
<tr>
<td>Code #</td>
</tr>
<tr>
<td>-------</td>
</tr>
<tr>
<td>I can talk to my teacher about future career in math or science.</td>
</tr>
<tr>
<td>My teacher encourages me to do more math and science.</td>
</tr>
<tr>
<td>I like doing difficult math problems.</td>
</tr>
<tr>
<td>I have been told of a career in STEM.</td>
</tr>
<tr>
<td>I feel strongly about math.</td>
</tr>
<tr>
<td>I enjoy doing math homework.</td>
</tr>
<tr>
<td>I enjoy doing my science homework.</td>
</tr>
<tr>
<td>I am not interested in science experiments.</td>
</tr>
<tr>
<td>I look forward to going to my science class.</td>
</tr>
<tr>
<td>I believe math and science are fun activities.</td>
</tr>
<tr>
<td>I feel prepared for math class.</td>
</tr>
<tr>
<td>I got very nervous when I took a science test.</td>
</tr>
<tr>
<td>I got very nervous when I took a math test.</td>
</tr>
<tr>
<td>I like to explore scientific explanations for things in the natural world.</td>
</tr>
<tr>
<td>Research questions about science and math are clear to the students.</td>
</tr>
<tr>
<td>I enjoy discussing science and math with my friends.</td>
</tr>
<tr>
<td>I enjoy discussing science and math with my friends.</td>
</tr>
<tr>
<td>I believe math and science classes are important.</td>
</tr>
<tr>
<td>I feel confident in my math and science classes.</td>
</tr>
<tr>
<td>My teachers think I need help in math and science.</td>
</tr>
</tbody>
</table>

**List 5 of the most UNFAVORABLE factors in your science success:**
1. 
2. 
3. 
4. 
5. 

**List 5 of the most IMPORTANT factors in your mathematics success:**
1. 
2. 
3. 
4. 
5. 

**List 5 of the most UNFAVORABLE factor in your mathematics success:**
1. 
2. 
3. 
4. 
5. 

**List 5 of the most IMPORTANT factors in your science success:**
1. 
2. 
3. 
4. 
5. 

---

Thank you for filling out this survey!

This survey was adapted from University of Minnesota's State Systematic Initiative's Program Study (1998-2009), University of Arkansas-Morris' HS-12 Outreach Program, and the University of Central Florida's Upward Bound Student Performance, Persistence and Impact Survey Questionnaire (2009).
APPENDIX E: INTERVIEW QUESTIONNAIRE
INTERVIEW QUESTIONNAIRE

Code: ______________________

UCF Upward Bound Science, Technology, Engineering and Mathematics (STEM) Interest Focus Group Questions

1. What is your favorite color?
2. Why is this your favorite color?
3. Do you know your GPA?
4. Do you know where to go to find out your GPA at your school?
5. Have you taken the Math FCAT?
6. Did you feel prepared to take the Math FCAT?
7. Have you taken the Science FCAT?
8. Did you feel prepared to take the Science FCAT?
9. What careers would you pursue if you were to go to college tomorrow?
10. Do you feel interested in science?
11. Does your teacher talk about careers in science?
12. Have you done any experiments of interest in your science classes?
13. Do your teachers value your work in your science classes?
14. Do your teachers talk about math careers?
15. Have you done anything in mathematics that was not related to the lessons taught in class?
16. Do you feel your math teachers value your work in mathematics?
17. Do you feel interested in technology careers?
18. Do you feel interested in engineering?
19. Do you feel interested in anything involving math?
20. Can you please tell me what race/ethnicity your teachers fall under?
21. If your teacher is of the same race/ethnicity as you, does this make you feel more comfortable?
22. Is this any different from a science and math class as from a social studies or English class?
23. Do you work in groups in your math classes?
24. Do you feel more inclined to work with students of the same race/origin as you?
25. Do you have friends of different races?
26. Do you have more friends who are the same origin/race as you then other?
27. Do you feel your teacher values your work in your science classes?
28. Do you feel your teacher values your work in your math classes?
29. Do your teachers encourage group participation?
30. Do you feel your teachers group you randomly or with people who are more like you in your class?
31. Does this feel different in your science and math classes?
32. Tell me how you feel being in a class with the amount of students you have now?
33. If you were in the same class with 400 other students how would you feel?
34. Would you feel inclined to befriend people who were of the same origin or race as you in that situation?
35. Would you find study groups or go to tutoring sessions?
36. If you were in a college environment which three things would you look for in regards to your success?
37. Are your parents involved in your education?
38. Do you feel they support your college dream?
39. Do you know anyone who has a STEM career?
40. Do you feel that they may give you support?

41. Please describe a scenario where you felt uncomfortable in any of your math classes during high school?

42. Please describe a scenario where you felt more comfortable than ever before in a science class?

43. Please describe a scenario where you felt uncomfortable in any of your science classes?

44. Please describe a scenario where you felt more comfortable than ever before in your science classes?

45. Finally, please draw a picture of how you picture yourself in college? Please include any surroundings, important people, if you would like you can draw a professor and how you picture the way they look, skin color, hair, dress, etc.

Thank You!
APPENDIX F: STUDENT 3 SELF-PORTRAIT
STUDENT 3 SELF PORTRAIT
APPENDIX G: STUDENT 4 SELF-PORTRAIT
STUDENT 4 SELF-PORTRAIT
REFERENCES


#hl=en&source=hp&q=2009%2C+thousands+of+%E2%80%9Ctechnology+related+jobs+went+unfilled%2C%E2%80%9D+and+in+the+U.S.+%2C+students+graduating+with+degrees+in+STEM+fields+are+declining.&aq=f&aqi=&aql=&oq=&gs_rfai=&pbx=1&fp=f3e5fd81ca62ccc2.


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