Community College Students' Attitudes toward Postsecondary Science Education

by

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Abstract

Students in the United States are avoiding taking the higher level science courses in secondary and postsecondary academic institutions (Ball, 2000; Braund & Reiss, 2006; Lee & Frank, 1990). There are many careers that do not require students to take those higher level science courses; therefore, students avoid registering for those classes (Madigan, 1997). Many students are pursing science-related degrees and/or certification from community colleges; however, they lack the academic foundations to succeed in science. The purpose of this study was to identify community college students' attitudes and perceptions toward postsecondary science education and the relationship of their attitudes and perceptions toward their academic achievement in postsecondary science.

This study examined community college students that were registered in community college science course. Community college students were examined by answering 47 questions on the instrument, *Attitudes Toward Science/ Learning Science*. The instrument was composed of thirty-eight Likert items, eight demographic items, and one closed-ended item. The study investigated the relationship of community college students' attitudes toward their intended academic major, ethnicity, gender and academic achievement.

A 6x5x2 Factorial ANOVA revealed that no significant relationships existed between community college students' intended major and their attitudes toward science education, $F(5, 158) = 0.646$, $p = 0.665$. The results of the 6x5x2 Factorial ANOVA revealed that there were no statistically significant differences between the community college students' ethnicity and

attitude toward science, $F(4, 158) = 1.835$, $p = 0.125$. The results of 6x5x2 Factorial ANOVA revealed that no statistically significant differences existed between the community college students' gender and attitude toward science, $F(1, 158) = 0.203$, $p = 0.653$. The Pearson's R Coefficient provided results that indicated that there were no statistically significant relationships between community college students' academic achievement (GPA) and their attitudes toward science education, $R = -0.065$, $p = 0.362$.

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CHAPTER I. INTRODUCTION

"Students, this is an examination. Keep your eyes on your own paper. If you know the material, it won't take long … if you don't know it, then it won't even take that long!" -- Mr. L. A. Robinson

Science education involves asking research questions, doing background research, constructing a hypothesis, testing hypothesis by doing experiments, analyzing data and drawing a conclusion and reporting that conclusive evidence through communication (Hochberg & Gabric, 2010; Latta, Buck, Leslie-Pelecky & Carpenter, 2007; Lee & Frank, 1990). Interestingly, Latta et al. (2007) also proposed that the art of comprehending science objectives is based on the professionalism and quality of instruction and the practicing of learning science objectives. Hochberg and Gabric (2010) argued that science education is an essential part of secondary and postsecondary education that instructs the students' ability to comprehend scientific procedures and objectives (Hochberg & Gabric, 2010). With students from many countries measuring higher in sciences and pursuing more science-related careers than students in the United States (Novak, 1990), the need to investigate why American students are not interested in science subjects should be the initial step to eradicate this problem (Parker, 1983). Novak (1990) indicated that when students are introduced to science objectives at early ages, they are more inclined to pursue science-related careers at the postsecondary level. Therefore, there is a need for students to acquire scientific knowledge at early ages so that they may continue to learn as they progress through their educational systems.

Historically, the significance of science has been addressed by philosophers and educators, such as Plato and Aristotle. They developed scientific processes to enhance the understanding of factual representation and separated those factual concepts from superstitious beliefs (Cohen, 1998). Carlos Linnaeus continued scientific processes by investigating plants and developing a system for naming and classifying plants (Parker, 1983). Charles Darwin's contributions to scientific investigations also provided evidence that by natural observations, the investigator may find ways to sustain the quality of life on earth (Novak, 1990). Today, science teachers at elementary, middle and secondary schools as well as two-year community colleges and four-year colleges and universities have begun to implement strategies into science curriculums that involve students comprehending and interpreting data, to include separating the factual from the fictitious (Braund & Reiss, 2006). A fundamental background in science is considered mandatory and serves as a major component to STEM (science, technology, engineering and mathematics) degrees in all levels of education (Lee & Frank, 1990). Science education is taught in all levels of public and private education; however, the more specific science education takes place in secondary and postsecondary schools, such as physical science, biology, environmental science, anatomy and physiology, marine biology, chemistry and physics, biochemistry and genetics (Ball, 2000). The more advanced science classes are taught in graduate and professional schools, such as immunology, hematology, comparative vertebrate anatomy and molecular and cellular signal transduction (Hart, 1998).

Madigan (1997) also suggested that science has been a typical part of education at all grade levels of learning. Science education in public schools was first observed during 1867 (Thorndike, 2005). Thorndike (2005) noted that during this time, Dr. Thomas Rice, a medical physician who first introduced science into public schools, proposed that teachers were spending too much time on using rote learning techniques with spelling words instead of cognitive learning with scientific inquiries. Limited scientific and investigative skills were being taught, thus causing gaps within science-related content. Thorndike implied that these students lacked the ability to use scientific skills for human sustainability and communal living. These results were based on the students' limited skills learned and inadequate teaching of new scientific materials.

Some of the identical problems that existed in the mid-1800s are present today in American science classrooms (Rhoton & Bowers, 2002). The National Science Foundation (NSF; 1996) provided evidence to suggest that many problems that exist are based on student perceptions of science and is not limited to their inabilities to comprehend science at all educational levels in schools. The 1996 national report on science education by the NSF indicated that many countries are academically farther advanced in science than the United States. The 2008 national report by the NSF indicated that students in American schools ranked 12^{th} in the world in science, which was an improvement from 23^{rd} place in 1996. These data, obtained by the NSF, were based on norm-referenced and criterion-based tests from students attending schools in the United States and in grades 3 through 12. Even though the age of students and their plan of study varies from one country to the other (Kennedy, 2000), the United States relies on mandatory exams with limited instructions toward learning science skills (Dolton, 1990).

Poor performance on norm-referenced and criterion-referenced batteries, inadequate guidance for students in science, and inadequate curriculum structure in science education classes has become one of the leading reasons for student successes and failures (Brown, 2000). Many of the problems involving science perception among students in the United States are that their performances in science are insufficient when compared to other first world countries (Meichtry & Smith, 2007). Meichtry and Smith (2007) suggested that students generally will not perform well if they do not have a desire to learn new science objectives. Ascher (1985) indicated that successful student achievement was measured by student performance on standardized examinations; therefore, when students are interested in learning science objectives, they perform better on standardized examinations. Flannery (2007) further suggested that science teachers are also being held accountable for student performances on standardized tests, and, although most are teaching the test, the results are still unacceptable for most schools.

Lee (2003) implied that student's attitudes and perceptions toward science may result low performance on tests in science classes. Lee's study also indicated that student's negative perceptions toward science education are due, but not limited to, the inabilities of administrators to make decisions that would provide leadership to support science education curriculums. Lee further contended that postsecondary science students were not completing the advanced high school requirements needed for successful academic achievement at the postsecondary level. Students were entering community college and postsecondary schools by completing assessments such as state regulated general education programs and receiving diplomas; however, these same students were deficient in science and science-related subjects. Lee concluded that when students are introduced to competitive secondary science academic objectives, these students' perceptions were enhanced at the postsecondary level. Snow (2001) agreed with Lee and proposed that community college students' perceptions can be identified and measured by the student's new and/or previous experiences in science.

Students' attitudes and perceptions toward science education have a significant impact on the results of academic achievement. Balfanz, Ruby and MacIver (2002) conducted a study to investigate the academic achievement and attitudes of students toward science education. Balfanz et al. (2002) observed that the students that had not received adequate science coursework did not perform well on the national science standards. Balfanz et al. suggested that elementary and secondary students' perceptions and attitudes may have negatively influenced students in postsecondary science classrooms, including apprehension toward learning new science content.

Many processes have been introduced into high school and postsecondary classrooms to enhance the student's science skills. For example, Bandiera and Bruno (2006) used cooperative learning to enhance student skills in a science classroom. Their study suggested that test scores of students in their sample improved significantly when students' perceptions and attitudes toward science were positive. When the students began to feel confident in their abilities in science, their approaches to science classes were proactive. Bandiera and Bruno argued that the success of students in science was based on a cooperative learning science classroom and was linked to students being placed in peer groups and collaborating with their teacher. Bandiera and Bruno placed students in groups of five to seven (depending on the class size), prearranged by their previous academic performances. Student groups were also arranged to be culturally diverse. Students were observed working with peers and independently with limited questions to their instructors. The results of this study involving cooperative learning identified students that were involved and interacted with their instructor in a cooperative learning environment, had encouraging attitudes and perceptions toward science classes, and were proactive in learning new science objectives.

The study performed by Bandiera and Bruno had a positive effect on students working in groups in postsecondary science class groups. Many of these students' interests later pursued science-related careers. Even though some of the students had previous negative perceptions toward science, Hewson (1996) observed that unenthusiastic views may have developed from previous under-achievements in science at the middle and secondary education levels. Hewson noted that the attitudes and perceptions toward science that were developed at the primary and secondary level were also prevalent among the same students at the community college level. Hewson observed that community college students had negative attitudes and perceptions toward science at community colleges, and the same attitudes were perpetuated across other disciplines, such as mathematics and engineering. Hewson indicated that students' potential to perform well academically, especially in science and mathematics, was extremely low at the postsecondary level due to insufficient skills. Hewson's study noted that many science curriculums are not aligned with national standards of science education.

Blanc and Ballenger (1999) implied that students that take fewer science classes develop a negative perception toward postsecondary science. Therefore, students with limited science skills and content that enter community colleges from secondary institutions will not pursue careers in science or mathematics, due to their apprehension of these subjects (Blanc & Ballenger, 1999; Henson, 1996; Kennedy, 2000).

Student's perceptions of science in postsecondary education have produced both positive and negative concerns (Harlen & Holroyd, 1997). Students can develop positive attitudes toward science when they are engaged in rigorous science curriculums at the secondary level; therefore, most are motivated and become effective learners at the postsecondary level. Negative attitudes may develop toward science when students are not provided the same circumstances (Blanc & Ballenger, 1999; Kennedy, 2000). Students attending community colleges want to learn (Brock, 2007). There are, however, many problems with science curriculum development and organization in that they may not include essential components that are needed by students for a postsecondary education in science (Carter & Kravits, 1996). Blanc and Ballenger (1999) suggested that many students become apprehensive to science and mathematics, doing only enough to barely pass. In a similar study, Kennedy (2000) indicated that students eventually become apprehensive when they possessed inabilities to comprehend scientific content and pass examinations in their classroom environments. Kennedy examined the perception of students with failing test scores and observed that the attitudes toward science became proactive when their grades were enhanced by remediation. To measure the effectiveness of students' attitudes and perceptions toward science education at the postsecondary level, Kennedy suggested reporting how the community college students performed on science pre-test and post-tests.

Rhoton and Bowers (2002) study revealed that there were significant changes in the perception of community college students' attitude toward science when they were able to comprehend the scientific knowledge, thus creating higher academic achievement in postsecondary science education classes. Rhoton and Bowers implied that with the incorporation of technology in postsecondary science laboratories, instructors and professors have begun to use a more preparatory method to enhance the students' abilities to comprehend new and engaging science content. Neild (2001) suggested that an enhanced and creative curriculum that supports modified engagements for students' comprehension toward science objectives reduces student attrition by sustaining their interests and providing successful student attitudes and perceptions toward science.

Seki and Menon (2003) suggested that students should be presented with processes that continuously add on to the science knowledge that has previously been obtained. Novak (1990) believed that those students should not be allowed to participate in certain degree seeking professions, such as nursing and other medical fields, until those deficiencies have been strengthened in science.

Students' perceptions toward comprehending postsecondary science are highly influenced by their ethnicity (Reyna, 2002; Wenner, 2003). Werner (2003) noted that educational disparities influenced how students perceived science at the postsecondary level. Werner's study suggested that minority students were not pursuing science or related degrees and careers because of their academic background. Students were asked to perform well on nursing and medical technology program entrance exams but did not move beyond the application process because they lack the academic background and experience to perform successfully in that area. Many of these students were from secondary schools that lacked enhanced instruction for students to be successful in science and science-related programs (Wenner, 2003).

Farkus (2003) also conducted a similar study that observes disparities and discrimination in postsecondary education and evaluated the attitudes and perceptions of these students toward science. Farkus suggested that the ability of community college students to become academically successful in community college science classrooms is linked to their previous educational experiences.

Statement of Research Problem

The primary focus of this study was to identify the community college students' attitudes and perceptions toward postsecondary science education. Since limited data exists on the perceptions of community college students and their attitudes toward science education, results ascertained in this study will provide evidence that may be used by federal, state and local agencies on how adult students perceive science education.

Purpose of the Study

The purpose of this study was to identify community college students' attitudes and perceptions toward postsecondary science education and the relationship of their attitudes and perceptions toward their achievement in postsecondary science courses. Wyss et al. (2007) observed that the students' attitudes and perceptions are major determinant in learning science objectives in postsecondary science education. By examining the attitudes and perceptions of students in postsecondary science classes, future studies can be conducted to enhance the reliability in the way students' attitudes and perceptions are involved with the academic achievement of students in postsecondary science education. Ansalone (2003) also suggested that when students have clear and comprehensible perceptions of postsecondary science objectives, the student's performances in the area of study are enhanced considerably. This study investigated the implications of perceptions toward achievement in a postsecondary science education by measuring the students' attitudes and motivation toward their achievement.

Research Questions

The following research questions were used in this study:

1. What is the relationship of community college students' intended academic major and attitude toward science education?

2. What is the relationship of community college students' ethnicity and attitude toward science education?

3. What is the relationship of community college students' gender and attitude toward science education?

4. What is the relationship of community college students' academic achievement and attitude toward science education?

Significance of the Study

The perception that students have about postsecondary science education has a significant impact on their comprehension and performances in prior science classes as well as the current postsecondary science classes (O'Neill & Barton, 2005). O'Neill and Barton's indicated students that performed well academically in science education at the secondary level generally had a positive perception of science at the postsecondary level. O'Neill and Barton also noticed that students who did not perform well in their secondary science classes were perceived as having negative attitudes toward their postsecondary science classes. This study examines and measures the differences in perceptions and attitudes of students toward science education and their achievements in postsecondary science. Findings from this study may be beneficial for teaching strategies and curriculum modifications in secondary and postsecondary science education. Teachers and administrators may also use the findings to implement strategies to incorporate the development of positive attitudes and perception of students toward postsecondary science. The results from this study may help students become more competitive in postsecondary science courses.

Bandiera and Bruno (2006) suggested that further studies should be accomplished to examine the perceptions of students and their behaviors toward science education in postsecondary school. Bandiera and Bruno also compared postsecondary science scores from other first-world nation students to American students. Their results indicated that American students are only superior to most second and third world countries. Students that typically do not perform well in postsecondary science classes, including teacher-made examinations and standardized examinations, generally do not have proactive views toward those classes (Flannery, 2007). In order for postsecondary students to become proficient in science education classrooms, Flannery suggests that a quantitative view is needed to significantly evaluate and determine why students have these views toward the science.

The significance this study may also be to identify for students with negative perceptions toward postsecondary science education. By investigating the negative reason(s) that some students hold toward postsecondary science education, it may provide information that will enhance other students' perceptions and strengthen their achievement in science education. When community college students can identify and comprehend the postsecondary science objectives by making average to superior marks in school, their perceptions toward postsecondary science may be enhanced. This study investigated attitudes and perceptions of community college students toward postsecondary science education, and may serve to revise and/or strengthen curriculums in secondary and postsecondary science education. Implications from this study may also enhance educational agencies on how to review and evaluate data to determine the perception of students and their attitudes toward science education.

Limitations

Limitations of this study may be influenced by the extent that students who will participate in this study are representative of students in postsecondary science education courses in a two-year community college in Alabama. Another limitation to this study may be influenced by the extent that the instrument in this study measured the perceptions of students that may attend these two-year colleges but resides in other states besides Alabama. Different states have curriculums that may be more suitable for two-year colleges. These students may have higher perceptions due to their previous preparations in secondary schools. Students living in other states but attending this two-year college will be allowed to participate in this study. There are no online students participating in this study; therefore, the study is limited to students taking science classes on-campus.

Delimitations

Due to the consent law in the State of Alabama that specifically describes adults as being 19 years of age and older, any participants under the age of nineteen in this study will automatically be eliminated by the researcher. In addition to the above statement, participants will be obtained only from one community college, located in the southeastern part in the state of Alabama.

Assumptions

Assumptions to this study include the following:

1. All participants in this study will respond to the questionnaires honestly.
2. The Conceptions/Nature of Science (revised with permission and formatted for this study) instrument is a valid instrument to measure the attitudes and perceptions of students toward science.

Definition of Terms

Abiotic: Non-living conditions and factors in an environment.

Adult students: Students that are attending a community college and are at least 19 years of age and older.

Andragogy: The art of helping adults in learning.

Biotic: Living conditions and factors in an environment.

Community college: Used interchangeably with “postsecondary school”, a community college is a two-year institution that provided services to students that sustains a community by supplying qualified workers to the workforce with skills and service.

Community college science students: Used interchangeably with “adult students”, these students are enrolled in a community college and officially taking science classes at that postsecondary institution.

Pedagogy: Teacher-centered instruction used primarily for adolescence and teenagers.

Postsecondary school: A two-year community college and/or four-year college and/or university.

Secondary school: A school consisting of grades 9 through 12 and composed of students pursuing high school training.

Organization of the Study

Chapter 1 introduced the study, presenting the problem, the need, the purpose, the research questions, significance of the study, limitations, delimitations, assumptions, and definition of terms. Chapter 2 includes a review of related literature concerning perceptions and attitudes of community college students toward science education. Chapter 3 reports the procedures used in this study, including description of methodology, design of study, and the instrument *Attitudes Toward Science/Learning Science*. The findings of the study are presented in Chapter 4. Chapter 5 includes a summary of the study, conclusions, implication, and recommendations for further practice and research.

CHAPTER 2. REVIEW OF LITERATURE

"Son, I wanna love you but you're damn sure making it hard for me to do that right now!" -- George Rodgers, Sr.

"Son, don't you let nobody tell you nothing 'bout your family. Folk will lie and tell you anything just to see you unhappy. There are times, however, when the truth hurts the soul. Be a man and deal with the truth." -- Cal Foster, Sr.

Introduction

Chapter 1 introduced the study, presented the problem, purpose, research questions, significance of the study, limitations, delimitations, assumptions, definitions of terms, and organization of the study. Chapter 2 provides the review of literature, research questions and the assumptions to this study. To address the community college students' attitudes and perceptions toward postsecondary science, the review of literature provides a historical aspect and a paradigm about the perspectives on issues and factors impacting community college student's success. This chapter covered the following topics: science education, postsecondary student's attitudes and perceptions of science, community college students in science, pedagogy and andragogy, adult learners, andragogical needs in biological science, the relationship between intended academic major and student's attitude, the relationship between ethnicity and student's attitude, the relationship between gender and student's attitude, and the relationship between academic achievement and student's attitude.

The purpose of this study was to identify community college students' attitudes and perceptions toward postsecondary science education and the relationship of their attitudes and perceptions toward their achievement in postsecondary science courses. Wyss et al. (2007) observed that the students' attitudes and perceptions are major determinant in learning science objectives in postsecondary science education. By examining the attitudes and perceptions of students in postsecondary science classes, future studies can be conducted to enhance the reliability in the way students' attitudes and perceptions are involved with the academic achievement of students in postsecondary science education. Ansalone (2003) suggested that when students have clear and comprehensible perceptions of postsecondary science objectives, the student's performances in the area of study are enhanced considerably. This study investigated those perceptions by achievement in a postsecondary science environment.

This study did investigate the implications of perceptions toward academic achievement in postsecondary science education. Ansalone (2003) suggested that when students have clear and comprehensible perceptions of postsecondary science objectives, the student's performances in the area of study are enhanced considerably. This study did investigate those perceptions by measuring the attitudes of students and motivations toward their achievement in postsecondary science education.

Research Questions

The following research questions were used in this study:

1. What is the relationship of community college students' intended academic major and attitude toward science education?

2. What is the relationship of community college students' ethnicity and attitude toward science education?

3. What is the relationship of community college students' gender and attitude toward science education?

4. What is the relationship of community college students' academic achievement and attitude toward science education?

Science Education

Pedagogy and andragogy concepts can be found in science education. Science Education involves comprehending facts and engaging in research of abiotic and biotic conditions in our environment (Rice, 2005). Science education was first introduced in public schools as early as 1867 by Joseph M. Rice, a medical physician (Thorndike, 2005). During this time, Dr. Rice felt that teachers were spending too much time on using rote learning techniques with spelling words instead of cognitive learning with scientific inquiries. Over a century later, problems that existed in science education in the mid-1800s (such as inquiry-based learning and scientific investigations) are still prevalent today in American classrooms (Rhoton & Bowers, 2002). Philosophers such as Plato and Aristotle developed scientific processes to enhance the understanding of factual representation and separated those factual concepts from superstitious beliefs (Cohen, 1998). Today, many students in elementary through four year institutions have negative perceptions toward science and were not interested in pursuing science-related careers (Ramsden, 1998). The National Science Foundation (NSF; 1996) provided evidence to suggest that some of the same problems that exist in learning postsecondary science content are due to the lack of comprehending science education in the K–12 setting.

Madigan (1997) implied that science has been an integral part of learning and assists students in the transitions from lower levels to higher levels of science education. Poor performances on norm-referenced and criterion-referenced batteries and meager guidance counseling at the secondary school level involving science, and poor curriculum structure in science education classes has become one of the leading reasons for either student success or failures (Meichtry & Smith, 2007). Investigators concur that students are not performing well in their classrooms involving science (Asher, 1985; Blanc & Ballenger, 1999; Meichtry & Smith, 2007). In order to be successful in science, Meichtry and Smith's (2007) suggested that student achievement must be attained from learning experiences gained in the science classroom. In similar research, Ascher (1985) indicated that successful student achievement was measured by student performance on standardized examinations. Flannery (2007) further suggested that science teachers are also being held accountable for the perceptions that students encounter during their educational process.

Balfanz, Ruby and MacIver (2002) also conducted a study to investigate the results of students' perceptions toward science education. Balfanz et al. (2002) suggested that community college students' attitudes and perceptions toward science may be negative and will influence how students perceive postsecondary science. Further examinations of students' attitudes and perceptions toward science indicated that students are not performing well in other science-related subjects and may also have negative beliefs (Ascher, 1985; Flannery, 2007). Blanc and Ballenger (1999) suggested that many students become sensitive to science and mathematics because of their lack of interest. Kennedy (2000) indicated that students eventually become timid and lack the abilities to comprehend scientific content, avoiding science-related courses and forming negative attitudes and perceptions toward science.

Science education can be found in secondary and postsecondary adult education curricula and involves comprehending objectives that include the abiotic and biotic conditions in our environment (Thorndike, 2005). The aim of science education was originated by Plato and

Aristotle, who developed scientific thinking of students and enhance critical reasoning (Cohen, 1988). The prospect of elementary students learning science and matriculating that knowledge to higher grade levels, including postsecondary levels, is extremely low (Haste, 2004; Weiss, 1994). Weiss argued that many elementary teachers were not qualified to teach science to their students. Ironically, more studies specified a decline in science assessments from students in elementary and middle school scores (United States Department of Education, 2007). The National Assessment of Educational Progress [(NAEP) also known as the Glenn Commission] revealed that the level of preparation that involves science for students in elementary, middle and secondary schools reflect the students' limitations and capabilities on how they will be prepared at the postsecondary level, and will identify future attitudes about science.

One of the most important goals in science is to produce future scientists (Braund & Reiss, 2006). Braund and Reiss noted that many science curriculums have been enhanced to intrigue students and produce more research scientists or other types of professional scientists. Nevertheless, Braund and Reiss noted that some aims of science are more contradictory in theory than practice. For example, Braund and Reiss noticed that new science courses that lack the essential components of scientific inquiry tend to not meet the needs of students. Therefore, there are limitations and concerns the quality of a course being taught. And though science courses are taught at community colleges, four year colleges, and universities, Braund and Reiss indicated that other sources such as industry do not place much emphasis on the amount of science courses that adult students have obtained from a college setting. Industries rely on the students' completing degrees and certifications, maintaining a competitive grade point average and developing the ability to learn with social skills (Hart, 1998). Hart (1998) further argued that science courses are not essential in preparing students for a future in science or science-technician related fields. Hart suggested that science curriculums at the postsecondary level will eventually become diversified and may be given an opportunity to choose from a science-centered or non science-centered program.

The learning of science content by adults is also an aim of science. Graber and Bolte (1997) denoted that scientific literacy is an essential medium that focuses on adult comprehension of science content. The fundamental perception of science literacy is that science education should enhance understanding of key concepts that are based on the temperament and practice of science (Hildebrand, 2001). Hart (1998) noted that many countries in the world, including the United States, undergo difficulties when science curriculums are involved. Student attitudes toward science have consistently declined while pursuing science courses at the higher levels, especially in the physical sciences (Haste, 2004). Haste (2004) suggests that many science educators have a major concern with most science classes being irrelevant in content and boring in context, including outdated laboratories and textbooks at the community college level. Rennie and McClafferty (1996) advised that science aims should be readjusted and the emphasis on science should be accomplished to enhance students' interest toward science. Rennie and McClafferty implied that cognitive gains toward science will eventually enhance student's perceptions toward science by cultivating their learning attitudes.

Issues existing in science education, such as weak science curriculums and lack of student understanding of science concepts are problems that need to be corrected before students can develop a greater appreciation for learning science content (Haste, 2004). Therefore, the aims of science must be improved so that students will engage in the development of new technologies. Haste (2004) noted that a limited quantity of America's students have engaged in degrees that pursue science or its interests. Within a technological society, there are many opportunities in science to engage in jobs such as nanotechnology, medical and research (Haste, 2004; Millar & Osborne, 1998; Woolnough, 1998).

Postsecondary Student's Attitudes and Perceptions of Science

Student's perceptions of science at the postsecondary educational level have been both positive and negative (Kennedy, 2000). When students are engaged in rigorous science curriculums in postsecondary education most are motivated and become effective learners and pursue science or science-related degrees (Blanc & Ballenger, 1999; Kennedy, 2000). Science curriculums may not include content for students that are not pursuing degrees in postsecondary science; however, these students must take certain science classes to complete the requirements for graduating (Blanc & Ballenger, 1999). As a result, Blanc and Ballenger suggested that many students become apprehensive toward science and mathematics, doing only enough to barely pass. Kennedy (2000) indicated that students eventually become apprehensive due to their inabilities to comprehend scientific content, which can lead to low test performances.

To measure the effectiveness of their teaching abilities, teachers began to evaluate themselves on the quality of their methods used to influence student comprehension of science objectives (Rhoton & Bowers, 2002). Rhoton and Bowers (2002) study provided evidence to suggest that the incorporation of certain methods and techniques may enhance student comprehension in science education. Neild (2001) used similar techniques but discovered that the science curriculums were weak due to a lack of science objectives being administered to students. Instead, most time is spent teaching previous objectives for the students that have not passed the required science examination.

Seki and Menon (2003) suggested that teachers should not use valuable classroom instructional time to teach outdated objectives. Lee (2003) indicated that the education process should be one that adds to previous knowledge. His study concluded that many students are not completing advanced high school requirements but are entering postsecondary schools by completing assessments in state regulated general education programs. Lee suggested that students are then introduced to competitive academic postsecondary science environments, thus producing or enhancing negative attitudes and perceptions by these students toward science. Lee's study also suggested that student's perceptions toward science education are strengthened and their attitude gives promise toward the achievement of community college students at the postsecondary level.

Although considerable time was spent focusing students that were not successful, Reyna (2002) suggested that it was inappropriate to penalize successful students in science classrooms by directing attention exclusively to those students that had not accomplished the objectives. Results from Reyna's study suggested that students were limited in terms of new science content, thus creating challenges as they entered higher-level science classes. The reason for this decrease in science knowledge by previously successful students was linked to teachers not providing adequate instructions and assignments. Instead, teachers were targeting students with inadequate test scores and performances. Reyna believed that most science classrooms do not have the facilities that are adequately structured for practical science learning. Reyna also observed that student's perceptions were not positive toward science due to poor facilities for science usage and teachers with inadequate science backgrounds.

Farkus (2003) conducted a study to observe the indicators that would support underprivileged students and their ability to become academically successful in the traditional science classroom. Observations conducted by Farkus suggested that students with limited interactions involving class discussions did not perceive science or any other subject matter in a positive manner. Farkus provided indicators that were crucial in assessing problems that may contribute to student failure in science.

Madigan (1997) suggested that the comprehension of science is imperative at all levels of education. Some modifications in science curriculums have been introduced into postsecondary classrooms to enhance the skills of educating postsecondary students in science. Bandiera and Bruno (2006) suggested that test scores of students improved significantly due to their attitudes. When the students began to feel confident in their abilities in science, their approach to science classes were proactive. Bandiera and Bruno argued that the success of students in a cooperative learning science classroom was linked to students being placed in peer groups and collaborating with their teacher. Students were placed in groups of five to seven (depending on the class size) and prearranged by their academic performances. Students were also arranged to be culturally diverse and in various academic levels. The results of this study indicated the students that interacted with their instructor in a cooperative learning environment had encouraging attitudes and perceptions toward science classes.

Though the study with Bandiera and Bruno (2006) had positive results with students working in postsecondary science classes, not all students had the same positive experience. Community college students from secondary schools in distressed areas do not pursue careers in science or mathematics in college due to their apprehension of these subjects. Ascher (1985) suggested that apprehension toward science with many community college students developed while they attended middle and secondary science classes. Deficiencies were not strengthened and these weaknesses were carried on to the community college science classroom (Ascher, 1985).

Psychology contributes to the adult student education process because it addresses the foundation of how adult students incorporate learning and their engagement of science (Tennant, 1997). Student's attitude are primarily devoted to how well they interpret knowledge and are able to reproduce that knowledge when examined by tests. Tennant conducted a study that incorporated the psychological aspect of student attitudes toward learning science and observed that students possessed positive attitudes and were more apt to engage in assignments during and after class. Tennant noticed that students were more inclined to engage in science activities when they performed well and comprehended the materials. Tennant's study also provided evidence to confirm that 33% of the students that possessed a positive attitude toward science continued to pursue degrees and/or certification toward science and science-related careers.

Community college students' beliefs toward science can be characterized by the way that those students comprehend and apply science objectives toward their anticipated careers. Larose, Rotelle, Guay, et al. (2006) completed a longitudinal study to determine contributing factors for acceptance of self-efficacy beliefs in science of adult students in both academic and vocational areas. Many factors emerged that contribute to the participants' self-efficacy beliefs. These can be categorized into academic, career/vocational, and personal/social areas.

Academic factors noted were the academic preparation of students in secondary schools that received prior academic preparation that influenced their career choice. Larose et al. (2006) noted that many students that were not academically prepared for postsecondary courses found out early in their careers that pursuing a career in a science-related field would require intense studying and preparations in science courses. The career/vocation factors Larose et al. (2006) found were that career decidedness, scientific achievement, persistence toward science , and scientific interests are essential components in the attitudes of students' toward careers in science. Students' were found to have had their choices of career based on their academic preparations. Personal and social factors, such as family structure, pedagogy academic preparations, and extracurricular activities were essential components in adult student attitudinal values. Postsecondary students that had a structured family environment with parental motivation were observed to be more apt to pursue a science-related career. Social factors observed Larose et al. (2006) indicated that students having the same ambitions to pursue a career in science took many of the same classes and studied together. This created new social groups with emphasis on studying science assignments. The same groups of students were observed to be highly interested in learning higher-level science courses and technology applications to support and strengthen their science content. Larose et al. (2006) discovered that when students were structured and provided with academic opportunities during their pedagogy careers, their academic beliefs are strengthened and these students are more likely to maintain an interest in science and pursue a career in a science-related field when they enter postsecondary education.

Watt (2004) proposed a study to investigate the origin of low interests toward science. Watt found that most students in elementary school were curious about their environment and were intrigued to learn more. As these students matriculated though middle school, many of these student's attitudes and perceptions toward science education diminished considerably. Gottfried, Fleming and Gottfried (2001) noted that there was also gradual decline in science self-efficacy among students from the time the students leave elementary school until they reach college. Since there was a significant decrease in the way students perceived science through their educational career paths, Gottfried et al. (2001) suggested that during transitioning from one grade level to the other grade level, many of these students become pessimistic and prefer not to pursue science or careers in science**.** Eccles, Roeser, Wigfield, and Freedman-Doan (1999) suggested that decline in students' self-efficacy toward science was based on three items: 1) frequent exposure to feedback failure, 2) significant abilities to integrate success and failure information, and 3) must increase their ability to use assimilated data gained with that of new. Eccles, Midgley, Buchanan, et al. (1993) proposed that high schools' inability to fulfill the adolescent's needs of developmental autonomy, structure and relatedness are barriers that influence the decline in self-efficacy as these students transition through elementary school to college. Eccles et al. (1993) indicated that student's self-efficacy in science may be responsible for the decline in national test scores and apprehension toward pursuing science careers. Some students may develop an interest in science content by their association with their peers. Eccles et al. (1999) concluded that social groups enhanced student learning in science and motivated students to become more inclined to science related materials in their classrooms. These students were also interested in pursuing careers in science-related fields.

Marsh and Craven (1997) implied that many decisions adult students make involving science are predicated on how their peers view science and if they can persuaded by their peers not to pursue a science-related degree or career. Marsh and Craven described this condition as the Small Fish-Big Pond Effect, in which the majority of students pursuing degrees or certifications in other disciplines influence students in science-related disciplines to convert to their discipline.

Community College Students in Science

Student's perceptions of success in postsecondary science are based on themes and are as follows: how the student emulates faculty in a positive measure, creates a working relationship with the institution, any achievement or improvement in the life of the community college student, obtain licensure and certification, graduates and becomes an admirable citizen to society, improves lifestyle and advances the quality of his or her education by advancing in work and toward higher degrees, and becomes a lifelong learner (National Postsecondary Education Cooperative, 2006). In addition, the National Postsecondary Education Cooperative (NPEC; 2006) suggested that students will perceive science and other subject matter in a positive manner when they are introduced to early success in those specific academic subjects, including introductory preparation at the secondary level. As with any student that attends a postsecondary institution, community college students' strongest indicator of success is graduating and becoming employed in a field that they have become competent in (Capaldi, Lombardi, & Yellen, 2006; Van Wagoner, Bowman, & Spraggs, 2005). Graduating from a community college is essential in the lives of these students; however, it is not the only measured outcome for students' success at the postsecondary level (Dale & Drake, 2005; Horn & Ethington, 2002; Horn, Neville & Griffin, 2006; Kozeracki, 2002). McClenney and Greene (2005) implied that students that enter community colleges are faced with many distractions that influence their perceptions of success toward educational attainments. The perseverance of some students in community college science classes and the early departure of other students are constituted by the level of preparation those students received in science at the secondary level, as well as the maturation of these students while enrolled in those science classes (McClenney & Greene, 2005).

Conversely, Gillum and Davies (2003) suggested that the success of community college students is based perception, attitude and reality. Gillum and Davies provided evidence to indicate that students are more apt at being successful when they perceive science as an achievable goal and developing an attitude to contribute to studying and applying themselves in their classroom environments. Reason, Terrenzini and Domingo (2005) argued that student success relates to a student's work ethics, science preparations, and the institutional framework that supports the success of students at the postsecondary level. Failure occurs when these traits are not developed by students. When the attitudes and perceptions of community college students do not align with established policies and protocols, Reason et al. (2005) implied that difficulties in learning develops and failure becomes evident if students do not matriculate with academic structure and alignment. Reason et al. suggested that the results may vary from pedagogical to andragogical demands, due to the methods of instructional delivery. Bedi (2004) indicated that children are generally taught with different methods than the paradigms that are implemented in working with adult students.

Nickels (2003) measured the success of adult students attending community college as situational. This suggests that comprehension of science is controlled by the circumstances and conditions adults are presented with. Nickels suggested that the way students approach the acceptance of learning new material is based on the beliefs that students hold toward a specific project. Pajares (1992) also suggested that situational beliefs formed attitudes that influence community college science student's educational beliefs. Pajares also noted that students' educational perceptions toward science are responsible for the way those students acquire and interpret scientific knowledge. Once those attitudes are shaped, Maslow (1965) concluded that intrinsic and extrinsic motivators heavily influence the thought processes of students and establish origins for learning to be manipulated. Maslow further indicated that formal learning, especially in the Western hemisphere, provides a model for adult success by applying self-actualization through the conscious attitudes hierarchy fulfillment. When adult essential needs are provided, Maslow suggests that the adult mind is clearer to function sustainably.

In order for adult students to become successful academically, they must examine their beliefs and build a paradigm that may influence their transitioning from non-academic to academic environments (Hall, 1974). Hall (1974) confirmed that adult students entering their first semester of college are traumatized by the fact that they are not mentally prepared for the containment of knowledge. Nickels (2003) suggested that students must redefine themselves when wanting to become successful in academics at the postsecondary level. Nickels further examined the academic success of students and observed that when students are away from structured academic environment, those students are faced with a daunting task of taking responsibility for their academic success by immediately learning negotiation skills to apply when working with instructors and professors. Nickels imposed the assumption that adult students in postsecondary learning environments are predisposed to new ways of reiterating knowledge. Nickels suggested that adult learning is highly influenced by personalized beliefs and will dictate decision-making skills to be incorporated in the learning process. Lortie (1975) referred to this personalized belief as the apprenticeship of observation, in which, student beliefs are based on previous experiences in academia and how they perceive their growth in the academic environment. Cole and Knowles (1993) suggested that core beliefs are not likely to be changed in adults and are held on to firmly due to the inability to accept certain changes that are occur in academic institutions. On this premise, adult students find it increasingly hard to adapt to new methods of learning until they are introduced to a routine that is comfortable to their way of learning (Hewson, 1996).

Pedagogy and Andragogy

Student comprehension is determined by the amount of information gained from specifics over a period of time. In order for learning to be achieved, usually paradigms are constructed to provide a framework and method for delivering that information to the audience. Methods for student learning are structured by the direction of teacher-directed and controlled to the facilitating of knowledge by helping others to carry out specific objectives (Carlson, 1989).

Pedagogy is a Greek-derived word that is defined as peda- or *paid* meaning 'child' plus *agogos* meaning 'leading' (Bedi, 2004). Pedagogy, therefore, is defined as the art and science of teaching children by leading them through instruction-based projects (Palmer, 1983). The pedagogical model of instruction was originally developed in the monastic schools of Europe in the Middle Ages (Merriam & Caffarella, 1999). Young boys were methodically placed into the monasteries and taught by monks according to a system of instruction that required these children to be obedient, faithful, and efficient servants of the church (Knowles, 1968). From this origin developed the tradition of pedagogy, which later spread to the secular schools of Europe and America and became the selection for the primary form of instruction. The great teachers of ancient times, such as Confucius and Plato, did not use the pedagogical model in their methods of instruction.

The pedagogical process is an authoritarian technique with views that are inclined to develop active inquiry (Carlson, 1989). Carlson (1989) noted that Confucius and Plato used pedagogy techniques in their method of delivering instruction to their students, which is composed of teacher-centered instruction. In the pedagogical model, Carlson (1989) implied that the teacher has full responsibility for making decisions about what will be learned, how it will be learned, when it will be learned, and if the material has been learned. Pedagogy, or teacher-directed instruction, places the student in a submissive role requiring obedience to the teacher's instructions. Carlson also noted that with pedagogical methods of instruction, the assumption is based on the certainty that learners need to know only what the teacher instructs them to know.

Freire (1993) also described pedagogy as teacher-centered and considered students as receptacles or containers to be filled by the teacher. Freire suggested, however, that pedagogy was like a banking system that demanded students learn directly from the teacher with limited alteration to knowledge given. Freire believed in transformation of knowledge, in which the student would be given information and they would take that knowledge and assimilate it so that it would make them and others productive in their lives. In comparison to pedagogy, Knowles (1968) indicated that the result of effective andragogical teaching and learning is highly dependent on the instructor and the method of delivery that is actively promoted; however, Knowles agreed with Freire that methods of dialogical learning were used to generate classroom interactions and to facilitate comprehension by the learning population. The Frerian approach to teachings transitions away from the teacher lecturing concept and provides the traditional banking system that invites students to participate with the teacher in discussions of certain problems and issues.

House (1993) suggested that the reason for adult maturity is based on the assumption that as adults grow older and mature, they become increasingly independent and responsible for their own actions. Knowles (1984) suggested that adults are often motivated to learn by a sincere desire to solve immediate problems in their lives. Additionally, they have an increasing need to be self-directing. In many ways the pedagogical model does not account for such developmental changes on the part of adults, and thus produces tension, resentment, and resistance in individuals (Carlson, 1989).

Andragogy has been defined as the art and science of helping adults learn (Knowles, 1968). Knowles (1968) indicated that the word was not new, but in fact was used as early as 1833. Andragogy as a concept and set of assumptions about adults was actually not new when Knowles popularized the term. Anderson and Lindeman (1927) first used the word in the United

States in a published piece. Stewart (1986) noted that Lindeman apparently used the term as early as 1926. Brookfield (1984) suggested that Anderson and Lindeman drew upon the work of a German author of the 1920s, Eugene Rosenstock. Davenport and Davenport (1985) asserted that the word was first applied in 1833 by Kapp, a German teacher. The growth and development of andragogy as an alternative model of instruction has defined the word and provided methods to deliver instructions to adults. But this change did not occur overnight.

Andragogy as a system of ideas, concepts and approaches to adult learning was introduced to adult educators in the United States by Malcolm Knowles (Brookfield, 1984). Knowles' made many contributions to the andragogical approaches that have influenced the thinking of countless educators of adults (Knowles, 1975, 1984). Knowles' dialogue, debate and subsequent writings related to andragogy have fostered the growth of the adult education field during the past thirty years. The initial application of the term andragogy took place in 1968, when Knowles, then a professor of adult education at Boston University, introduced the term through a journal article. Knowles (1980) later defined the term as the art and science of helping adults learn. Knowles' thinking suggested that andragogy is simply another model of assumptions for adult learners to use alongside the pedagogical model of assumptions, thereby providing two alternative models for testing out the assumptions as to their fit with particular situations. Furthermore, the models are proposed to be most useful when seen not as dichotomous but rather as two ends of a spectrum with a realistic assumption about learners falling in somewhere between the two ends.

The andragogical model as conceived by Knowles (1968) is predicated on five basic assumptions about learners, all of which have some relationship to our notions about a learner's ability, need and desire to take responsibility for learning:

1. Their self-concept moves from dependency to independency or self-directedness.
2. They accumulate a reservoir of experiences that can be used as a basis on which to build learning.
3. Their readiness to learn becomes increasingly associated with the developmental tasks of social roles.
4. Their time and curricular perspectives change from postponed to immediacy of application and from subject-centeredness to performance-centeredness.
5. Motivation to learn from maturing to learn from internally.

Knowles (1984) associated andragogy associated with a variety of instructional suggestions and detailed roles of facilitation for instructors and ways of helping learners maximize their learning abilities. His early work with andragogy and subsequent interpretation of the learning projects research by Tough (1978) and others led to a 1975 publication on self-directed learning where he provided a variety of inquiry projects and learning resources on the topic.

Knowles (1986) offered some reasons for his evolving scholarship in the area of self-directed learning. One reason was the emerging evidence that people who take initiative in educational activities seem to learn more and learn things better than passive individuals. He noted a second reason that self-directed learning appears to be more in tune with our natural process of psychological development. An essential aspect of the maturation process is the development of an ability to take increasing responsibility for life. A third reason was the observation that the many evolving educational innovations such as nontraditional programs, weekend colleges and online classes throughout the world require that learners assume a heavy responsibility and initiative for their own learning. Welton (1995) brought together four colleagues who shared a more radical philosophy of adult education. Welton introduced andragogy methods to assist adult learners to the panel. The colleagues concluded that the andragogy approach was a clear and precise method for assisting adults in learning. Welton suggested that when applied correctly, the andragogical approach to teaching and learning in the hands of a skilled and dedicated facilitator can make a positive impact on the adult learner.

Welton also proposed that the most important characteristic when teaching adults is the ability of students to comprehend the ideology that Knowles suggested when defining andragogy, which was all adults can learn. Educators in adult education provide paradigms so that assisting adult students learn become the primary focus—not teaching adults (Knowles, 1986). More so, it is also essential to separate teaching from assisting or helping students. Characteristics that are important in helping adults learn are the following: 1) Inform learners as to why something is important to learn, 2) show learners how to direct themselves through information, 3) relationship of the topics to learner's experiences, 4) people will not learn until they are ready and motivated to learn, and 5) requires helping adult learners overcome inhibitions, behaviors and belief about learning.

Knowles (1984 concedes that four of the five key assumptions apply equally to adults and children, the key component to this postulate is that children have fewer experiences and pre-established beliefs than adults, thus children have less to relate to in life (Brookfield, 1984). Adults learn more effectively when previous knowledge is supplemented with new information (Knowles, 1984). Therefore, when learning is facilitated with prior experiences, Knowles (1980) suggests that comprehension of any subject matter may be contained or hindered, depending on the motivation and life experiences.

Adult Learners

The importance of the perception and attitude of adult student learners has become more apparent now than ever before (Ahl, 2006). Since lifelong learners are considered to be the solution to a dwindling economy, Ahl (2006) found that many adult students are entering or returning to community colleges for the opportunity to prepare themselves for new careers. Ahl suggested that the education of adults is based on their attitudes. Ahl suggested that the labor force is demanding that individuals pursuing jobs in this declining economy be well-prepared and up-to-date in their profession. However, not many of the students entering community colleges are motivated to learn science or science-related materials (Franken, 1994). Motivation, as defined by Franken (1994), is *motivus* referring to a moving cause. Franken implied that many students place themselves in positions that does not supplement their interactions in the learning process. Science comprehension at the postsecondary level is based on the motivation of students by their previous and present learning experiences (Braund & Reiss, 2006).

In order for community college students to comprehend postsecondary science, their perception must be positive about topics and their ability to achieve (Chang, Singh & Mo, 2007). Chang et al. (2007) noted that self-concept student’s played a significant role in the way they engaged in science at the community college level. Chang et al. suggested that those student’s beliefs toward science and the organization and delivery of instruction also affects their learning attitudes.

Motivation is believed to be a significant function in the attitudes and perceptions of student learning. McKenzie, Witte, Guarino and Witte (2002) gave notice to the presumption that teacher-centered classrooms were not the most effective way to motivate adult student achievement. McKenzie et al. (2002) implied that the autonomy of adult student learning is due to their ability to comprehend and may be influenced by their motivation and accountability. Ross-Gordon (2003) mentioned that the responsibility of student comprehension relies heavily on the instructor to adapt to new and conventional ways to teach adult students.

Student achievement at the community college setting is mainly tailored by the interest of the individual. In a study to measure the improvement of attitudes of students in a science-related medical class, Goelen, DeClercq, Huygens, and Kerckhofs (2006) concluded that adult students were more susceptible to learning when they are given directions and time to process and complete assignments. Goelen et al. (2006) indicated that a student's learning is based on individual attitudes and experiences in prior educational settings. Adult students can then become capable of structured learning from a theoretical premise, which will continuously add new data to previous knowledge obtained (Fisher & Fisher, 1979).

Pashler, McDaniel, Rohrer and Bjork (2009) conducted a study to examine effective learning styles of adult students in science education. In their examination, Pashler et al. (2009) defined learning styles as the concept in which the students' mode of instruction may be different for each individual and is based on their level of effectiveness toward comprehending new material. Pashler et al. suggested that adults will express their learning styles to comprehending science. Pashler et al. continued by indicating that when adult students are given the opportunity to learn by their own methods, the attitudes of those students becomes positive, especially in science classes.

Learning for adults is based on prior experiences and the rate of success and failure for those individual that have been ascertained during their lifelong learning. Pass (2007) performed a study that revisited the work of Jean Piaget. Piaget's model illustrates the ability to add new information onto what individuals have already learned (schema's) by using accommodations and assimilation. Sachs (2001) acknowledged that students with high academic standings had high beliefs toward their academic competencies. Sachs suggested that adult learners pose challenges that are unique and are based on specific perceptions. Attitudes and perceptions of adult students are more pragmatic because of conditions and responsibilities that are warranted by adults (Sutherland, 1995).

Regardless of the subject matter, the attitudes and perceptions of the adult learner are based primarily on the noteworthy premise of how much an individual has been prepared in previous educational settings and what or how much that individual is willing to add to the knowledge that has already been obtained (Stone & Oliver, 1998). In addition, the responsibilities at home and the amount of time allocated to furthering an education are also essential components to how much an individual places on their desire to learn new material (Schraw & Nietfeld, 1998).

Vygotsky (1978) developed a zone of proximal development, in which observed adult learners gradually moved from knowledge learned to gathering and obtaining new knowledge. Vygotsky pioneered theoretical framework for learning during his time; however, it lack more reliable substance and validity because his studies separated the populations studied by race, class and gender of the targeted population. Sachs (2001) argues that adult learners possess a dichotomy for their learning aspirations, the practical and the mastery. Reiman (1999) further concluded that adult student learning could be enhanced by providing and creating disequilibrium in comprehensive environments which allows students to matriculate from knowledge learned to new and existing knowledge that will be learned later in the academic process. Though differences exist in pedagogical learning, andragogical applications are fluent and is a growing trend accommodates the lifelong learner. Adults learn in different ways and do not typically reflect gender differences; however, some research indicates that age may be of considerable importance when working with mature groups (Sachs, 2001).

Truluck and Courtenay (1999) conducted a study that investigated older adults and how they comprehend and learn under different conditions. The study concluded that adult students appreciate and use hands-on mechanisms to learn such as touching and watching. By using the D.A. Kolb Learning Style Inventory (LSI), Truluck and Courtenay observed that most adults preferred to use the Accommodator, Assimilator and Diverger. These styles allowed adult students to gather instructions and put them into operation. A few adults preferred the Converger style, where adult students prefer to be under the sole authority of the instructor. Truluck and Courtney (1999) indicated that the learning styles of adults are more selective and their effectiveness can be measured by the gradual progression of the adult learner. As the population increases with adults living longer than before and the influx of immigrants worldwide, it becomes evident that more adult students will demonstrate variances in how they learn and how they perceive science and other subjects.

Unemployment in the United States has stagnated due to financial deficits and cutbacks, yet adults are living longer and are in need of occupations to sustain social needs. As a result, older adults are becoming consumers in academic environments and are attending trade and technical schools, community colleges, and four-year institutions (Tennant, 1990). Ventura-Merkel and Doucette (1993) made the distinction between pedagogical and andragogical students and cited that adults must adapt to their learning environment. As adult student educational demands increases, more learning styles will be used to influence the way adult learners (Bonham, 1987; Gregorc, 1982).

Andragogical Needs in Biological Science

The economy today is recovering from a recession that seemed to have started when the collapse of the housing market and wars in Iraq and Pakistan placed a financial strain on the United States (Noppe, Noppe & Bartell, 2006). Noppe, Noppe and Bartell (2006) indicated that many jobs have been lost since that time and the economy is in the early stages of recuperating. Noppe et al. (2006) implied that many of the jobs lost were not recovered; therefore, adults were forced to pursue new careers. There are many occupations that are either have been diminished or have downsized due to the stagnant economy. The medical field, however, is a thriving community that is in constant demand (Matutina, Newman, & Jenkins, 2010). Since there are so many vacancies in the medical community, Matutina, Newman and Jenkins (2010) suggested that many adults are pursuing careers in nursing, medical technology, paramedics and laboratory technicians. To obtain employment in any medical capacity, a substantial amount of science must be mastered to complete requirements and certifications (American Association of Colleges and Nursing, 2010; Matutina et al., 2010). Community colleges serves as the primary source for educating and certifying 87% of adults returning to school for a second career opportunity (Gilbert, 2001). Gilbert (2001) concluded that it is essential for adult students that are seeking careers in the medical field to learn science concepts. Cross (1981) suggested that science is ubiquitous in its methods of delivery and therefore, can be learned by all adult students. The comprehension of science subject-matter, especially science by adult students, stresses the importance of investigating student's motivation because they may express different motivational traits in these areas (Blumenfeld, 1992; Blumenfeld & Meece, 1988; Lee & Anderson, 1993; Lee & Brophy, 1996; Weiner, 1990).

Andragogical needs in science are perceived in many ways. Adult learners are introduced into the classroom settings with high ambitions to succeed and flourish in their endeavors. Hinds (1999) performed a study to evaluate the special needs of adult student learners in science. In this study, Hinds observed that of twenty-five adult students between the ages of 23 through 50, enrolled in his community college introductory biology class, only three of them had taken a biology class while in high school. In addition, many adults were out of school for various lengths of time. During that time deficiencies may have formed in their academic knowledge and the need for reintroducing old information was strong (Uno, 1988). Uno (1988) provided evidence to document and support four distinctive special needs that are essential for adults in biological sciences. The four reasons for difficulties in biology as described by Uno are 1) a lack of early preparation in science, 2) inadequate critical thinking skills, 3) a non-constructive approach toward science, and 4) improper study skills and lack of self discipline.

Many students attending community colleges are entering college for the first time (Katz, 1985). Katz (1985 noted that as students are away from the academic environment over time, they develop many deficiencies. Students that are entering college from high school are not as apprehensive toward science as student that have been out of school for extended periods. Katz concluded that most of these students attending community colleges are apprehensive toward science in the new college setting. The apprehensiveness that occurs within students toward science at the community college level is believed to be due to the lack of previous preparation (Carter, Heppner, Saigo, Twitty, & Walker, 1990). Cole (1990) also observed science classes and noted that many adult students feared science and only took those classes for a requirement of pursuing a degree. Cole observed that these students had negative perceptions toward science, regardless if they had previous experience or not in science. Cole’s study suggested that these student's perceptions toward science did not develop in college but expanded from experiences in high school science classrooms environments. Students, therefore, can develop a fear of science and try to avoid taking classes that are scientifically influenced (Christian & Murphy, 1985; Cole, 1990; Glaser, 1968). When community college students pose these fears toward science, there is trepidation of exploring science classes are at a minimum because students feel as if they will be overwhelmed with difficult assignments and huge volumes of information (Nagalski, 1980).

Students pursuing careers in science or science related fields may also dread taking science classes (Sampson & Oliver, 1990). Sampson and Oliver (1990) performed a study that provided evidence that student success in science courses can determine career paths. Sampson and Oliver observed that students that wanted to be nurses or work in the allied health field took science classes, such as anatomy and physiology, microbiology and chemistry, because those classes were prerequisites for a degree or certification in that field. Career advancement for community college students, therefore, is contingent on the successful completion of the required science classes (Goelen, DeClercq, Huygens & Kerckhofs, 2006). This type of attitude poses heightened stresses to the point that students become frustrated and develop additional fears toward science (Pashler, McDaniel, Rohrer, & Bjork, 2009).

Rennie and Williams (2006) indicated that there is adequate justification for adults to learn science. Student needs for learning investigating science concepts are essential for sustaining an career in a science-related field (Rennie & Williams, 2006). Introducing andragogical approaches to introduce scientific literacy is essential to help adults comprehend science (Goodrum, Hackling & Rennie, 2001). Rennie and Williams (2006) suggested that the free choice method of instruction is the best measure to enhance scientific literacy with adults.

Faulk (2001) described free choice as a nonsequential and a self paced approach to comprehension. Martin (2001) agreed that adult students should learn science objectives at a self- regulated pace. Martin denoted that free-choice options allow students the ability to be positively motivated toward learning science. Museums, laboratories and science centers serve as sites for adult students to visit and acquire the essential components to comprehending scientific objectives. Although adult learning usually takes place when students visit scientific environments, Gilbert (2001) noted that individuals have distinctive ways of learning science. Gilbert argued that adult needs in science are predicated on the ambitions of the student, as well as the science-content familiarity. Gilbert indicated that adult learning is an outcome of interaction within the personal and social connections. Science learning and needs of adults are enhanced when integration of science is provided (Dierking, Ellenbogan, & Falk, 2004; Falk & Dierking, 1992).

Biological **c**omprehension can also be enhanced when mathematics is incorporated into the subject. Hochberg and Gabric (2010) proposed that students that when mathematical concepts are incorporated into the content, students have an enhanced opportunity to comprehend science. Wortman (2008) suggested that the implementation of mathematic concepts into science is an essential component to develop competencies in science because the two disciplines are naturally integrated and the conceptualization requires critical thinking to set a foundation. Postsecondary science instructors should apply mathematic concepts into their methods of teaching by implementing mathematical applications into scientific laboratory procedures. Wortman also implied that mathematic instructor do not normally accept the arrangement of science instructors implementing mathematics in their classrooms due to certain mathematical concepts are often taught differently by many science teachers. This confused students and resulted in the development of poor habits once they students have learned the concepts a certain way. Hochberg and Gabric (2010) implemented of mathematic concepts into science classrooms. They provided evidence to suggest that students are just as apprehensive toward mathematics as they are science; therefore, implementing the two disciplines would only strengthen students' critical thinking skills.

Some college students consider biology as boring; therefore, challenging for comprehending at that academic level (Delpech, 2002; Ebenezer & Zollar, 1993). The motivation to engage in biology and other sciences is usually determined by the students' curriculum, in which a student must take a certain class as a requirement for certification or a degree (Ramsden, 1998). Positive attitudes toward science are believed to be due to how students develop an interest in a specific topic and began to inquire knowledge for that interest. Ramsden (1998) observed that hobbies such as fishing, animal rearing and plant cultivation are high intellectual topics in biology; however, not all students prefer to study those specific topics, whereas other students may engage in one topic of interest but may have limited or no interest in other topics. Ramsden proposed that biology-related activities that were structured to influence adult students' with positive attitudes toward learning science have shown evidence to suggest that those students developed positive attitudes toward science and were not hesitant toward using science applications.

Community college students that were pursuing biology or science-related certification and/or degrees generally had a specific field of study that include specialty areas such as nursing, emergency medical technician (EMT), physical therapy and x-ray technicians and developed confidence in their abilities toward science (Sencar & Eryilmaz, 2004). Even though those specific specialties were based totally on science content, Sencar and Eryilmaz indicated that those students were not necessarily interested in science; they were, however, only interested and motivated in classes that were strictly defined to their intended profession and not the many science classes that were involved in the completion and/or certification.

Prokop, Prokop and Tunnicliffe (2007) suggested that the attitudes of community college student that take biological science classes are not intrigued by taking such classes. Prokop et al. (2007) observed that a number of students taking science classes and pursuing a science-related career do not have a genuine compassion for the field but are willing to work in the field because it provides a high probability for employment when degree/certification are completed. Prokop et al. concluded that only a meager five percent of students evaluated viewed science as an academic subject of interest, whereas the other ninety-five percent scrutinized science and preferred to pursue other academic and technical degrees such as firefighting, law enforcement and social services.

Relationship between Intended Academic Major and Attitude

Tai and Sandler (2001) found that a link existed between the relationship of community college students' academic major and their attitude toward science. Tai and Sadler observed that grades that were earned in postsecondary science classes could be used as a gauge to measure science attitudes of students. Students who are successful in science classes at the postsecondary level usually pursue academic science degrees. Tai and Sadler suggested that many students that were successful in postsecondary science classes either pursued majors in science or related fields and professions (Gainen & Willemsen, 1995). Gainen and Willemsen (1995) suggested that science attainment was measured by student's career aspirations and were based on the way community college students perceived grades obtained from those science classes. Tai and Sadler suggested that postsecondary students' science grades are determined by the course syllabi. Tai and Sadler noted that grades in postsecondary level science classes are composed of tests, quizzes, laboratory reports, homework sets and a comprehensive final examination that takes place over the course of a semester. Tai and Sadler noted that the final grades received were more indicative of student performances than a single attainment, thus creating an opportunity for students to prepare for success in the science classroom. Tai and Sadler concluded that most of the knowledge and comprehension contained by college students in science are based on a series of collective assignments. When a collection of assignments were assessed, community college students' grades were considered as more successful than by assessing with only tests. The use of more than one application to assess community college student's success in science courses enhanced and students were encouraged to pursue careers in science.

The intended major of many postsecondary students are based solely on how successful they were while enrolled in college science classes (Tai, 2001, 2009). Many postsecondary students enter college with an intended major in mind; however, Tai (2001) concluded that thirty-four percent of students that entered college with intentions to pursue science and/or science-related careers modified their pursuit of a degree in science and chose a different academic career. Modifications of student's career choice was primarily because they did not perform well in the science classes and either felt that they could not commit to the challenges of studying and performing well in science and/or re-evaluated their talents and discovered that science was not of a high interest in their academic development.

Relationship between Ethnicity and Student Attitudes

The ethnicity of students and their attitudes toward science disciplines are issues of concern to many educators and administrators at all levels of education, especially at the community college level (O'Neill & Polman, 2004; Polman, 2000). Tai and Sadler (2009) suggested that these differences in attitudes were developed from the student's background. Cronbach and Snow (1977) associated learning science activities to student attainment based on their cultural background as aptitude treatment interactions (ATI). Tai and Sadler (2009) indicated that approximately 50 percent of the students attending most of the major colleges and universities in the United States come from private school settings. Many of these students attending these private institutions were from high socio-economic status (SES) incomes with the majority representing the Caucasian ethnicity (Sadler & Tai, 2001; Tai & Sadler, 2001). Sadler and Tai (2001) proposed that students from certain ethnicities may benefit from science based on their background learning and predisposed conditions. Sadler and Tai described such benefits as being exposure to science content from prior experiences in science classes, guidance and assistance from individuals with science aptitudes, and resources from stable school districts that prepared students with a solid foundation in science. Unfortunately, Sadler and Tai suggested that many ethnic groups reside in districts that do not have the resources to compete with those of private schools.

Sadler and Tai (2009) noted that there were significant differences in science achievement among ethnic groups, such as Hispanic and African American students, which scored significantly lower than Caucasian and Asian students. Eysenck (1996) indicated that African American and Hispanics scored lower on standardized science examinations as compared to Caucasian, Asian and Biracial Americans. Eysenck also observed that there was a dissimilarity of socioeconomic background with Hispanic students being the lowest and Asian and Caucasian students having the highest socioeconomic background. African American students' accounted for 64% of the population that lived in SES environments that are considered to be poor by United States standards when compared to other ethnicities. Eysenck observed that Caucasian students scored significantly higher than all ethnic groups, suggesting an internal locus of control. New methods used for instruction observed by Eysenck highly important when building student's background knowledge and enhancing science performance. Other formats of instruction were used and reportedly raised students' interest by sparking their imagination in science by enhancing their ability to comprehend science content at the postsecondary level.

Relationship between Gender and Student Attitudes

The gender of adult students has been observed to have differences in perception and attitude as related to science (Prokop, Prokop & Tunnicliffe, 2007). Prokop et al. (2007) suggested that females have a higher interest in science and science-related careers than males. Prokop also observed that females were more apt to pursue science-related degrees more often than males and viewed science in a positive way. Sencar and Eryilmaz (2004) indicated that females' high interest and positive attitudes toward science did not start at their community college setting; instead, it may have developed as early as elementary school. Male students were observed to have weak interests toward pursuing science degrees and career paths; however, their interests increased when they were introduced to inquiry-based learning in which students used their hands and drew from the curiosity of their peer's investigations (Gibson & Chase, 2002).

Not all researchers advocate that females have the highest interest toward science and science related careers. Colwill (1982) proposed that male postsecondary students have a wealth of confidence in their science academic abilities and perceive science as a subject of interest more so than females. Male students tend to rate their abilities higher than female students due to the perception that male students portray science and mathematics as masculine academic subjects (Joffe & Foxman, 1988; Marsh, 1989; Marsh & Yeung, 1998; Wilgenbusch & Merrell, 1999).

Lee and Bryk (1986) noted that adult females have a high interest in science and possess the qualifications for employment in science-related fields. Not only does gender play a role in the self perception of students and their attitudes toward science, Seymour and Hewitt (1997) found that the developmental trajectory toward self-efficacy and science beliefs while transitioning from high school to college created a different perception from student to student. Seymour and Hewitt (1997) observed that self-efficacy beliefs were essential components in the transitioning of students. Student transitioning from high school to postsecondary level suggested that gender of students were more likely to determine a career path at the postsecondary level (Fredricks & Eccles, 2002). The successful transitioning from a secondary to postsecondary academic institution is essential in the success of postsecondary students because it allows the student to initiate a career with other peers and have a new start toward establishing their careers in science and technology (Watt, 2004).

Differences in gender and their relationships to student attitudes are due largely to the role of gender when adult students are involved (Kramarae, 2003). Sullivan (2001) analyzed gender differences between community college students in science and indicated that significant differences were observed in the way male and female adult students at the community college level worked and performed domestic chores. Sullivan noted that most female students were parents and were employed in other disciplines other than science-related careers. Sullivan indicated that 85% of females at a community college were not married and 70.6 % had at least one sibling at home. In addition, 90% of the females either worked before or after classes. Sullivan noted that 96% of the male community college students were not married; however, 98% of these community college male students did not have a sibling or responsibilities at home. Sullivan observed that 93% of the male students in this study both lived with their parents or close relatives and had limited responsibilities at home or their dwelling. Students in Sullivan's study were composed of 213 community college female students and 37 males, suggesting that not many males were pursuing degrees or certifications in science or science-related careers such as nursing, physical therapy, radiology, dental hygienist and chiropractic assistant. Sullivan proposed that community college female students are more apt to learning science and are more interested in pursuing science careers than their male counterparts. Additionally, community college female students' attitudes were observed and analyzed as positive, whereas the community college male students were observed and analyzed as not having positive views toward science (Kramarae, 2003; Sullivan, 2001). Sullivan proposed that the roles of the males in science careers are generally found in the field of emergency medical technology, such as paramedics and lab technicians.

Kramarae (2003) found that community college male students possessed higher motivation beliefs and obtained higher academic achievements in science than their female counterparts. Sullivan (1992) implied that males have higher self-concept than females throughout school, including preschool and elementary. Anxiety in both males and female students was believed to be the contributing factor to how gender affected the attitudes and perceptions of students' attitudes toward science (Kramarae, 2003; Yukselturk & Bulut, 2009). Student levels of self-concept may contribute to continued study of mathematics and science (Sullivan, 1992). Therefore, the American Association for the Advancement of Science (1993) noted the importance of educators' attending to student's self-concept as an essential component in comprehending science.

Relationship between Academic Achievement and Student's Attitude

The relationship between academic achievement and student's attitudes is due to three contributing factors. First, students must have an interest in science or related fields with a solid foundation in science (Murnane, 1995). Second, the relationship between academic achievement and student's attitudes toward science can only be influenced and enhanced when students are motivated to learn by their teachers, instructors and professors (Poppleton & Riseborough, 1990). And finally, if students do not have the foundations, whether socially, culturally or academically, and are not motivated by assimilation from andragogical processes, the students will have negative perceptions and attitudes toward science and its domain (Dolton, 1990; Hecker, 1996; Thomas, 1998). Dolton (1990) suggested that academic achievement is viewed by students as positive when those students have obtained experiences in a science subject or career that was successfully motivated by the instructors. Students develop negative attitudes when they are not prepared and enter college classrooms with limited background and foundational knowledge of science. Dolton implied that the relationship between academic achievement and the success of students was not initiated at the postsecondary levels; however, it was developed at the primary and secondary level before a student entered postsecondary education.

The most significant goals of many community colleges and universities in science comprehension are to develop problem solving skills, critical and independent thinking and the ability to explore and investigate new challenges that support academic achievement (Byrne & Johnstone, 1987). For students to perceive academic achievement in science in a proactive manner, Berg, Bergendahl and Lundberg (2003) suggested that two factors, cognitive and affective domains, must be used to significantly enhance community college student achievement in science and science related careers. Berg et al. (2003) denoted that community college students' academic needs can be met with cognitive domains and their attitudes toward science can be met with affective domains.

Chang, Singh and Mo (2007) proposed that many instructors at the postsecondary level have described student perceptions and attitudes toward science as least effective. Students who did not receive sufficient preparation in science during primary and secondary levels may find community college instructors with no patience to carry out specifically scheduled class activities because of student deficiencies. Many science careers are initiated by successful academic achievement performances at the college and university level; however, the implementation of technological skills enhances the opportunity for employment by some businesses (Snow, 1992).

Chang, Singh and Mo implied that the attitudes of adult students and their achievement in science classes are determined by the motivation of instructors and the students desire to pursue degrees in science. Many negative student perceptions and attitudes related to pursuing science-related degrees have caused a shortage in science careers not only in the United States but world-wide (Dinham & Scott 1998; Jones & Sandidge, 1997; Murnane, 1995; Poppleton & Riseborough, 1990). Dinham and Scott (1998) implied that students were dissatisfied with the hours that it takes to achieve science degrees and other science-related careers. Even though many students may be aware that careers in science are promising, especially in a slow economy, many do not pursue these degrees due to their inabilities to devote time and efforts to becoming successful academically. Dinham and Scott noted that there were some students that were not compatible for science-related classes and careers because of their foundational deficiencies in science preparations. These students were not prepared to be successful in a science environment because their preparations were not geared toward comprehending science and related applications. Science majors are usually offered employment in industry and business more often than other students in different fields, and can earn a higher salary by choosing a career other than teaching. These students typically view science in a positive way, with the exception of teaching and instructing. Some students were scientifically inclined; however, they were deterred from pursuing a science teacher position because of low wages, stressful workloads and disruptive student behaviors (Jones & Sandidge, 1997).

CHAPTER 3. METHODS

"Tell it son, what's on your mind? Talk to me soldier." -- Staff Sergeant Kenneth Wilson, Alabama National Guard

"… there is no substitute for hard work, so work hard and do your best! Winning will come from that hard work, so prepare well." --- Fred Holland

Introduction

Chapter 1 introduced the study, presented the problem, the need, the purpose, the research questions, significance of the study, limitations, delimitations, assumptions, and definitions of terms and organization of the study. Chapter 2 provided the review of literature, research questions and the assumptions to this study. To address the community college students' attitudes and perceptions toward postsecondary science, the review of literature provided a historical aspect and presented a paradigm to facilitate the perspectives on issues and factors impacting community college students' success. In general, this chapter highlighted the following topics: science education, postsecondary student's attitudes and perceptions of science, community college students in science, pedagogy and andragogy, adult learners, andragogical needs in biological science, the relationship between intended academic major and student's attitude, the relationship between ethnicity and student's attitude, the relationship between gender and student's attitude, and the relationship between academic achievement and student's attitude. Chapter 3 will discuss the design of the study, sources of data, data collection procedures, data collected, instrumentation, and methods.

The purpose of this study was to identify community college students' attitudes and perceptions toward postsecondary science education and the relationship of their attitudes and perceptions toward their achievement in postsecondary science courses. Wyss et al. (2007) observed that student's perceptions are a major component in learning science objectives in secondary science and are carried on to higher learning at the postsecondary level. By examining the community college student's attitudes and perception toward postsecondary science, continued studies can be conducted to understand why those students have certain views of postsecondary science education. This study also investigated the implications of perceptions toward academic achievement in postsecondary science education. Ansalone (2003) suggested that when students have clear and comprehensible perceptions of postsecondary science objectives, the student's performance in the area of study is enhanced considerably. This study investigated perceptions by measuring the attitudes of students and motivations toward their achievement in postsecondary science education.

Research Questions

The following research questions were used in this study:

1. What is the relationship of community college students' intended academic major and attitude toward science education?

2. What is the relationship of community college students' gender and attitude toward science education?

3. What is the relationship of community college students' ethnicity and attitude toward science education?

4. What is the relationship of community college students' academic achievement and attitude toward science education?

Methods and Procedures

The population in this study consisted of first and second semester students in a two-year community college, located in the Southeastern United States. The community college administrators were contacted and given an overview of the study, as well as a projected time frame needed to collect data and carry out research protocols. Approval for conducting this study was granted by Auburn University Institutional Review Board (IRB) under Expedited Status Protocol # 10-270 (see Appendix 1). Additionally, a copy of the survey instrument, entitled *Attitudes Toward Science/Learning Science*, that was used in this study was provided to administration to review the questions (see Appendix 2). Course instructors were contacted to request permission to allow their students to participate in the study during a scheduled class. A schedule was also submitted to the administration of the community college for dates of data collection. This was done in an attempt to reduce interruption of classroom time and provide course instructors a format for planning class activities around this activity.

The students were randomly selected, based on their age, willingness to participate in this study and recommendation from college instructors, school administrators and deans. Upon arrival, the principal researcher asked the instructor to leave the class to reduce coercion. The recruitment script was then read to the students (see Appendix 3). After the recruitment script was read to the students, those students that were 19 years of age and older and wanted to voluntarily participate in this study were asked to remain in the classroom. Any student that did not qualify or did not want to participate in the study could leave the room. The survey was given to each participant meeting the requirements for this study. The survey consisted of 46 closed-ended questions and 1 opened-ended question, totaling 47 questions. The instrument measured community college student's perception and attitude toward science education. The survey took approximately 30 minutes for participating students to complete. After the students completed the survey, they were instructed to place the instrument in an envelope and seal it. The students then placed the envelope (with survey enclosed) in a box placed in the front of the room by the door as they left the room. After completion of the instrument, data was collected by the researcher and placed under lock and key at Auburn University. The data were analyzed with a 6 (major of students) x 5 (ethnicity groups) x 2 (gender) factorial design (with no repeated measures) with a $p < .05$ level of statistical significant difference. Data were analyzed using SPSS 17, a statistical software package that is used in social sciences research projects and that reports quantitative results.

Sample

The participants in this study were selected from a community college located in the southeastern United States and serving approximately 3700 students. The population for this study consisted of 200 students who were 19 years of age and older and enrolled in science classes during the fall semester of 2010 at this community college. All entering freshman students enrolled in science classes were allowed to participate in this study only if their age met the mandatory protocol.

Instrumentation

The instrumentation used in this study was a modified version of *Student Attitudes Surveys Instrument 14: Conceptions/ Nature of Science* originally developed by the National Science Foundation (NSF), Division of Undergraduate Education and used for the first time at the University of Wisconsin-Stevens Point. The original instrument was composed of 105 questions that investigated student’s attitudes and beliefs (science content and nature of science), background characteristics and activities (academic performances and postsecondary plans), demographics (gender, academic success, age and ethnicity, as well as major and professional goals) and impact on outcomes (instructional methods, assessment and technology). For this study the modified survey, *Attitudes Toward Science/Learning Science*, was used for the purpose that the researcher was not interested in measuring students' conceptions/nature of science and impact of various course-related activities. Instead, the researcher used the modified version that consisted of 47 questions: 46 closed-ended questions and 1 opened-ended question. The modified survey investigated student's attitudes toward science and their abilities to learn science, as well as general demographics such as gender, age, ethnicity, college major, years of professional experience, grade point average, intended major and academic classification. A copy of the survey instrument is included in Appendix 2.

To ensure systematic analysis of the survey, a rating scale was developed by a member of the researcher's dissertation committee. The rating scale was designed to assess the content validity of the 46 questions used in this research study. The scale involved a rating on the survey as following: 1 = Strongly Disagree, 2 = Disagree, 3 = Neutral, 4 = Agree and 5 = Strongly Agree.

To determine the validity of each question, the researcher averaged the scores contained from the members of the dissertation committee on each question. Any question not receiving the cut score of 2.0 was eliminated from the survey. Based on the computation of the scores, a panel of three experts in the area of Educational Foundations, Leadership and Technology reviewed and agreed that the questions in the *Attitudes Toward Science/Learning Science* survey were valid. The coefficients of reliability were analyzed using a Cronbach's alpha to determine the internal consistency of the instrument (Cronbach & Snow, 1977; Shannon & Davenport, 2001). The survey demonstrated consistency with all Likert-scaled items and purports to measure the proper content. The internal consistency for the survey when measured against all groups was reliable with a Cronbach's alpha of .91. Alpha coefficients were moderately high, signifying acceptable reliability and homogeneity of the items (Cronbach & Snow, 1977); therefore, the score is indicative of being reliable and homogeneous. Cronbach's alpha ranges from 0–1. Shannon and Davenport (2001) indicated that an internal consistency of .90 and higher on Cronbach's alpha indicates an excellent reliability. Some researchers have the tendency to avoid the necessity to establish and report validity and reliability of their personal data if the instrument has been previously validated (Cronbach & Snow, 1977).

Data Collection

The research was conducted by administering a modified survey *Attitudes Toward Science/Learning Science,* originally developed by the National Science Foundation (NSF), Division of Undergraduate Education. Participants were students 19 years of age and older and were registered in at least one science class at a two-year community college, located in Southeastern Alabama. The survey was designed to measure the perceptions, attitudes and beliefs, background characteristics, demographics and impact on outcomes. The researcher analyzed the data and presented descriptive data in addition to analyses of the variables using ANOVA statistical technique. The dependent variables were community college students' intended academic major, academic achievement, ethnicity and gender. Community college student's attitudes were measured by the *Attitudes Toward Science/ Learning Science* survey. The independent variable was the student's attitudes toward science, which measured their perceptions.

The scoring was based on the responses to 46 questions. Thirty-eight questions were Likert-type that investigated student's scientific attitudes and perceptions toward science. The scoring for these questions was as following: 1 = Strongly Disagree, 2 = Disagree, 3 = Neutral, 4 = Agree and 5 = Strongly Agree. The remaining 8 questions collected demographic information.

Privacy and Confidentiality of Student Data Collected

The proper courses of action were taken to insure the privacy and confidentiality of the data collected at the research site. The researcher obtained permission from the Institutional Research Board (IRB) of Auburn University to conduct this study. As required by the IRB, the researcher also obtained permission from a community college, located in the southeastern United States, to conduct this study with the understanding that only the researcher and committee chairperson had permission to view students' responses to data obtained. A copy of the Auburn University IRB approval letter is included in Appendix 1. During the study, all data obtained using the recording forms were kept in secure files at the researcher's residence. Copies of the data were provided to Committee Chair and kept under lock and key at Auburn University. A numbering system was used to keep student information anonymous.

Data from this study were collected from 200 community college students that were 19 years of age and older and currently enrolled in biological and/or physical science classes. The researcher obtained written permission from the dean of students and chairpersons at the community college.

Data Analysis

Data analysis consisted of the use of SPSS 19, statistical software that is used in the social sciences research projects which will report quantitative results. The 6 x 5 x 2 factorial design ANOVA and Pearson Product Moment Correlation were the statistical approaches that were used for the results.

Breach of Confidentiality

Risk of breach of confidentiality was reduced through the survey collection methods by allowing no identifying information to be collected on the survey. There were no vulnerable participants included in this study. Instructor's permission to enter class and collect data was obtained prior to data collection. A specific date and time most appropriate to visit the class was identified so that the researcher did not take up regularly scheduled time for the course. The instructor was asked leave the room prior to data collection to reduce coercion. The study's documents were kept in confidence, locked in a file cabinet at investigator's home. The Dissertation Committee Chair was provided a hard copy of each completed questionnaire as a means of secure back up, stored in 4010 Haley Center.

Summary

The purpose of this study was to identify community college students' attitudes and perceptions toward postsecondary science education and the relationship of their attitudes and perceptions toward their achievement in postsecondary science courses. This study investigated those perceptions by measuring the attitudes of students and motivations toward their achievement in postsecondary science education.

Chapter 3 discussed the methods used in this study to collect data. Information was discussed about the design of the study. This chapter was composed of an introduction, detailing the literature of community college student's attitudes toward science education. The research questions, methods and procedures, sample of population, instrumentation, sources of data and the data collection procedures were also discussed in this chapter. The validity and reliability of instrument, *Attitudes Toward Learning Science,* was discussed. The Cronbach's alpha was established at .91, which indicated that the instrument was reliable for this study. Data were solicited from 200 community college students from a community college located in the Southeastern United States. The students were first and second year students that were at least 19 years of age and older. The participants were enrolled in at least one biology course during this study. The privacy and confidentiality of student data collected were also discussed in this study. The data analysis and results to this study are presented in Chapter 4.

CHAPTER 4. FINDINGS

> "I've seen the light and watched it shine down on me. I'm gonna spread my wings, yeah and I'm gonna tell all I see that these happy feelings (feel that happy feeling), I'll spread them all over the world, from deep in my soul…I wish you happy feelings, and you know what I mean." -- Maze featuring Frankie Beverly

Introduction

Chapter 1 provided background information and a theoretical framework for this study, statement of the research problem, purpose of the study, research questions, and definition of terms, limitations, delimitations and the significance of the study. Chapter 2 presented a review of literature related to the science attitudes and perceptions of postsecondary students. Chapter 3 presented the methods and procedures used to identify and select subjects to be studied, general procedures for the data collection and recording, design of the study, and statistical treatment of the data. Chapter 4 addressed the results of the data analysis. Research findings addressing the four research questions are discussed in this chapter with statistical evidence.

The purpose of this study was to identify community college students' attitudes and perceptions toward postsecondary science education and the relationship of their attitudes and perceptions toward their achievement in postsecondary science courses.

Research Questions

The following research questions were used in this study:

1. What is the relationship of community college students' intended academic major and attitude toward science education?

2. What is the relationship of community college students' ethnicity and attitude toward science education?

3. What is the relationship of community college students' gender and attitude toward science education?

4. What is the relationship of community college students' academic achievement and attitude toward science education?

Demographic Results

Demographic characteristics for all participants enrolled in postsecondary science classes used in this study were summarized in terms of students' attitudes toward intended college major, ethnicity, gender and academic achievement. A total of 200 participants were asked to respond to demographic questions including intended major, ethnicity, gender and academic achievement. All 200 eligible participants responded by completing the survey under established guidelines and protocols.

Students Registered in Science Classes

There were 200 students that participated in this study. Of those students, there were 26 (13%) that registered for a science class to satisfy a critical science degree requirement at the community college. There were 140 participants (70%) that registered for a science class to satisfy a course requirement for a major or minor. There were 23 participants (11.5%) that registered for a science class because it was an elective that sounded interesting. The remaining

11 participants (5.5%) registered for science classes for reasons unknown at this time. Distribution of participants in this study by Registered for Science Class is provided in Table 1.

Table 1

Distribution of Participants by Registered for Science Class

Science Course Enrollment	Frequency	Percent
Science degree requirement	26	13
Course for minor or major	140	70
Elective	23	11.5
Other	11	5.5
Total	200	100

Course Selection

Of the total 200 participants, there were 109 participants (54.5%) in this study that selected a science course as their first choice while registering. Fifty-three participants (26.5%) indicated that they chose the selected science class as an alternate choice due to their first choice course being closed or if it conflicted with another course. There were 38 participants (19%) that indicated that they never wanted to take a science class; however, they had to in order to satisfy the community college requirement. Distribution of participants in this study by course selection is provided in Table 2.

Table 2

Distribution of Participants by Course Selection

Course Selection	Frequency	Percent
First Choice	109	54.5
Alternate Choice	53	26.5
Never Wanted to Take this Class	38	19
Total	200	100

Grade Level

Most community colleges have generally two grade levels that are composed of freshmen and sophomores. Many of the other students are attending the community college for certification or qualifying for a specific career. Of the student population of 200, there were 88 freshmen and 85 sophomores with percentages of 44% and 42.5%, respectively. The remaining 27 participants (13.5%) of students were transient and taking science classes to meet requirements at four-year institutions. Distribution of participants in this study by grade level is provided in Table 3.

Table 3

Distribution of Participants by Grade Level

Student Classification	Frequency	Percent
Freshman	88	44
Sophomore	85	42.5
Other	27	13.5
Total	200	100

Gender of Participants

This study was composed of 200 community college students. Of those students, the largest group was the female participants with 111 (56%). Second were the males with 89 (44%). Distribution of participants in this study by the gender is provided in Table 4.

Table 4

Distribution of Participants by Gender

Gender	Frequency	Percent
Female	111	55.5
Male	89	44.5
Total	200	100

Ethnicity of Participants

There were 200 participants in this study and they were categorized as following: Caucasian = 138 (69%), African- Americans = 37 (18.5%), Asian = 10 (5%), Native American = 8 (4%) and Latin = 7 (3.5). Of the remaining three ethnicities, they were not significantly represented within the sample as a single group; therefore, the three ethnicities were added together to form a more presentable and significant group. Distribution of participants in this study by ethnicity is provided in Table 5.

Table 5

Distribution of Participants by Ethnicity

Ethnicity of Participants	Frequency	Percent
Caucasian	138	69
African American	37	18.5
Asian	10	5
Native American	8	4
Other	7	3.5
Total	200	100

Grade Point Average of Participants

The participants reported grade point averages (GPA) that ranged from 1.30 to 4.00. The mean GPA was 2.813 with the largest percentage of the sample (83%) consisting of students whose GPA was between 2.30 and 3.60. The standard deviation for the GPA of students was 0.577. Distribution of participants in this study by GPA is provided in Table 6.

Table 6

Distribution of Participants by GPA

GPA of Participants	Frequency	Percent
1.30	1	.5
1.60	4	2
1.90	6	3
2.00	7	3.5

(table continues)

Table 6 (continued)

GPA of Participants	Frequency	Percent
2.10	3	1.5
2.20	4	2.5
2.30	37	18.5
2.40	4	2.0
2.50	9	4.5
2.60	9	4.5
2.70	5	2.5
2.80	29	14.5
2.90	2	1
3.00	5	2.5
3.10	6	3
3.20	5	2.5
3.30	26	13
3.40	4	2.0
3.50	3	1.5
3.60	22	11
3.70	1	1.5
3.80	4	2.0
3.90	3	1.5
4.00	1	.5
Total	200	100

Student Declared Major of Study

Major consisted of the degree of study or certification that each participant was enrolled in while attending this community college. There were 56 participants (28%) who majored in Science (biology, chemistry, computer information systems, geography, mathematics, natural science, and physics). There were 46 (23%) undecided at the time of this study and had not declared a major. Forty-five participants (22.5%) majored in a Social Science discipline, such business administration, economics, geography, managerial accounting and sociology. There were 42 participants (21%) that majored in Professional Studies such as communicative disorders, education, athletic training, health promotion, dietetics, interior architecture and clinical laboratory science. The last two categories, Fine Arts and Communication (art, music, communication, theater) and Humanities (English, history, philosophy, Spanish) were the least sought-after degrees and were composed of eight and three participants with a percentage of 1.5 and 4, respectively. Distribution of participants in this study by student declared major of study is provided in Table 7.

Table 7

Distribution of Participants by Student Declared Major of Study

Declared Major	Frequency	Percent
Science	56	28.0
Social Science	45	22.5
Humanities	3	1.5
Fine Arts	8	4.0
Professional Studies	42	21.0
Undecided Major	46	23.0
Total	200	100.0

Career Choice in Science

There were 127 participants (63.5%) in this study that indicated that they were not seeking a career in science or science-related field. Fifty-four of the participants ((27%) indicated that were seeking a career in science or science-related field. The remaining 18 participants (9%) were not sure at the time of the study if they would pursue a career in science or related field. Since this study was focused mainly on community college students' attitudes toward postsecondary science education, the mean, range, and standard deviation for those students that were pursuing a science career/degree were observed. The item means ranged from 76 (minimum) to 128 (maximum). The standard deviations ranged from 2.82 to 24.85. Distribution of participants in this study by career choice in science is provided in Table 8.

Table 8

Distribution of Participants by Career Choice in Science

Career Choice	Frequency	Percent
Non-science-related career	127	63.5
Science-related career	54	27.0
Not sure of career choice	18	9.0
Did not answer item	1	0.5
Total	200	100.0

Data Analysis

Descriptive data such as frequencies and percentages were summarized for community college students' intended major, ethnicity and gender. This information was used to answer Research Questions 1, 2, and 3, in which, a 6 x 5 x 2 factorial design was used. Research

Question 4 was answered by using Pearson's R coefficient, which measured the relationship between community college students' academic achievement (GPA) and their attitude toward science education.

As mentioned above, Research Questions 1, 2, and 3, used an independent factorial ANOVA. To begin, the first assumption of this statistical approach is that the dependant variable, attitude, must be distributed normally for all populations. By normal distribution, the factorial design presented no skewness and was found to be normally distributed.

The next statistical procedure was to test for equal variance of the dependant variable (attitude) to see if equal variance existed across all groups. A test was performed on all groups (major, gender and ethnicity). Levene's Test of Equality indicated that the error variance of all groups were significantly different across all groups, F (3, 158) = 1.515, $p < .037$, indicating the assumption of homogeneity of equal variance was violated. The ANOVA procedure was robust and, therefore, violated the equal variance assumption (see Table 9).

Table 9

Levene's Test of Equality of Error Variances

F	df1	df2	Sig.
1.515	41	159	.037

Research Question 1: What is the relationship of community college students' intended academic major and attitude toward science education?

Intended Major

Community college students that participated in this study were asked to describe a major that they were pursuing. The students were given six choices to describe their intended major at that time. The choices were as following; 1) = Science, 2) = Social Studies, 3) = Humanities, 4) = Fine Arts, 5) = Professional Studies and 6) = Undecided. The disciplines had the following number of students and are as follows: Science (56), Social Science (45), Humanities (3), Fine Arts (8), Professional Studies (42) and Undecided (46) (see Table 10).

Table 10

Attitudes toward Intended Major

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Major	1253.89	5	250.78	.646	.665
Error	61317.025	158	388.082		

A 6x5x2 Factorial ANOVA test was conducted to evaluate the relationship between the attitudes of community college student and their intended major. The 6x5x2 Factorial ANOVA was tested at the .05 level of significance. The 6x5x2 Factorial design revealed no significant relationship between community college students' attitudes and their intended major, F (5, 158) = .646, p = .665. Means and standard deviations for intended major are reported in Table 11.

Table 11

Distribution of Attitudes by Intended Majors

Major	Mean	S.D.	N
Science	115.88	20.22	56
Social Science	122.33	20.21	45
Humanities	120.00	19.09	3
Fine Arts	114.88	16.45	8
Professional Studies	116.93	21.20	42
Undecided Majors	117.83	19.68	46
Total	118.02	20.07	200

Research Question Two: What is the relationship of community college students' ethnicity and attitude toward science education?

Ethnicity

A 6x5x2 Factorial ANOVA test was conducted to evaluate the relationship between the attitudes of community college student and their ethnicity. The 6x5x2 Factorial ANOVA was used to test at the .05 level of significance. The 6x5x2 Factorial design revealed no significant effect for community college students' attitudes and ethnicity, F (4, 158) = 1.835, p = .125 (see Table 12). Means and standard deviations for ethnicity are reported in Table 13.

Table 12

Attitudes toward Ethnicity

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Ethnicity	2848.48	4	712.12	1.835	.125
Error	61317.025	158	388.082		

Table 13

Distribution of Attitude by Ethnicity

Ethnicity	Mean	S. D.	N
Caucasian	119.65	20.53	138
African American	118.39	15.27	37
Asian	115.50	18.67	10
Native American	100.25	22.41	8
Other	107.86	24.84	7
Total	112.33	20.34	200

Research Question Three: What is the relationship of community college students' gender and attitude toward science education?

Gender

A 6x5x2 Factorial ANOVA test was conducted to evaluate the relationship between the attitudes of community college student and their gender. The 6x5x2 Factorial ANOVA was used to test at the .05 level of significance. The 6x5x2 Factorial design revealed no significant effect for community college students' attitudes and gender, F (1, 158) = .203, p = .653 (see Table 14). Means and standard deviations for gender are reported in Table 15.

Table 14

Attitudes toward Gender

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Gender	78.60	1	78.60	.203	.653
Error	61317.025	158	388.082		

Table 15

Distribution of Attitude by Gender

Gender	Mean	S. D.	N
Female	116.08	19.46	111
Male	120.44	20.67	89
Total	118.26	20.07	200

Research Question Four: What is the relationship of community college students' academic achievement and attitude toward science education?

Academic Achievement

A factorial ANOVA design was used to see if a relationship existed in the academic achievement (GPA) and community college students' attitudes toward science education. The factorial ANOVA was used to test at the .05 level of significance. The factorial design revealed that no significant correlation existed between the attitudes of community college students and their academic achievement, r = -.065, p = .362. Correlations of attitude and academic achievement are provided in Table 16.

Table 16

Correlations of Attitude and Academic Achievement

Correlation		Attitude	GPA
Attitude	Pearson Correlation	1	-.065
	Sig. (2-tailed)		.362
	N	200	200

Ethnicity and Gender

A 6x5x2 Factorial ANOVA test was conducted to evaluate the relationship between the attitudes of community college student and their ethnicity and gender. The 6x5x2 Factorial ANOVA was used to test at the .05 level of significance. The 6x5x2 Factorial design revealed no significant interaction between the attitudes of community college students' ethnicity and gender, F (4, 158) = 1.574, p = .184 (see Table 17).

Table 17

Attitudes between Ethnicities and Gender

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Gender * Ethnicity	2443.49	4	610.87	1.574	.184
Error	61317.025	158	388.082		

There were five ethnicities that participated in this study and are as follows: Caucasians, African American, Asian, Native American, and other. This study consisted of 138 Caucasians, 37 African Americans, 10 Asians, 8 Native Americans, and 7 of other ethnicities not described. Of the five ethnicities, the genders are as follows: Caucasians = 78 females and 60 males, African American = 24 females and 13 males, Asian = 4 females and 6 males, Native American = 3 females and 5 males, and other = 2 females and 5 males.

Intended Major and Gende*r*

A 6x5x2 Factorial ANOVA test was conducted to evaluate the relationship between the attitudes of community college student and their intended major and gender. The 6x5x2 Factorial ANOVA was used to test at the .05 level of significance. The 6x5x2 Factorial design revealed no significant interaction between the attitudes of community college students' intended major and gender, F (5, 158) = .870, p = .503 (see Table 18).

Table 18

Attitudes between Intended Major and Gender

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Major * Gender	1688.51	5	337.70	.870	.503
Error	61317.025	158	388.082		

Intended Major and Ethnicity

A 6x5x2 Factorial ANOVA test was conducted to evaluate the relationship between the attitudes of community college student and their intended major and ethnicity. The 6x5x2 Factorial ANOVA was used to test at the .05 level of significance. The 6x5x2 Factorial design revealed no significant interaction between the attitudes of community college students' intended major and their ethnicity, F (14, 158) = .947, p = .510 (see Table 19).

Table 19

Attitudes between Intended Major and Ethnicity

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Major * Ethnicity	5147.58	14	367.68	.947	.510
Error	61317.025	158	388.082		

Major, Gender, and Ethnicity

A 6x5x2 Factorial ANOVA test was conducted to evaluate the relationship between the attitudes of community college student and their major, gender, and ethnicity. The 6x5x2 Factorial ANOVA was used to test at the .05 level of significance. The 6x5x2 Factorial design revealed no significant interaction between the attitudes of community college students' intended major, gender, and ethnicity, F (8, 158) = .172, p = .994 (see Table 20).

Table 20

Major, Gender, and Ethnicity

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Major * Gender * Ethnicity	534.26	8	66.78	.172	.994
Error	61317.025	158	388.082		

Summary

A 6x5x2 Factorial ANOVA test was conducted to evaluate the relationships between the attitudes of community college students and their major, gender and ethnicity. The Pearson's R coefficient was used to measure the correlation between community college students' attitudes and their academic achievement (GPA). A reliability analyses was also conducted to access the reliability of the instrument used in the study. Cronbach's alpha coefficient was .91, indicating that the instrument was reliable. The Levene's Test of Equality indicated that the error variance of all groups were significantly different across all groups. This indicated that the assumption of homogeneity of variance violated the equal variance assumption.

Three 6x5x2 Factorial ANOVA tests were conducted to assess the relationships between the attitudes of community college students and their major, gender and ethnicity. The results indicated that there were no statistically significant differences between the attitudes of community college students' and their major, gender and ethnicity. When the Pearson's R coefficient was used to measure the relationship of community college students' attitude and their academic achievement (GPA), the results also indicated that were no significant relationship between the two. Chapter 5 will present the summary, conclusion, implications and recommendations to the study.

CHAPTER 5. SUMMARY, CONCLUSIONS, IMPLICATIONS, AND RECOMMENDATIONS

"… and as I look back over my life, I realize that the Lord has brought me from a mighty long way." -- Rev. Dr. L. C. McMillian

"… me and my family, we come from poor folks and didn't have much, but the Lord sure has been good to us." -- Rev. Michael Foster

Chapter 1 provided background information and a theoretical framework for this study, statement of the research problem, purpose of the study, research questions, and definition of terms, limitations, delimitations and the significance of the study. Chapter 2 presented a review of literature related to the science attitudes and perceptions of postsecondary students. Chapter 3 presented the methods and procedures used to identify and select subjects to be studied, general procedures for the data collection and recording, design of the study, and statistical treatment of the data. Chapter 4 addressed the results of the data analysis. Research findings addressing the four research questions are discussed in this chapter with statistical evidence.

The purpose of this study was to identify community college students' attitudes and perceptions toward postsecondary science education and the relationship of their attitudes and perceptions toward their achievement in postsecondary science courses. The study sought to answer the following research questions:

1. What is the relationship of community college students' intended academic major and attitude toward science education?

2. What is the relationship of community college students' ethnicity and attitude toward science education?

3. What is the relationship of community college students' gender and attitude toward science education?

4. What is the relationship of community college students' academic achievement and attitude toward science education?

The participants in this study were selected from a community college, located in the southeastern United States and serving approximately 3700 students. The population for this study consisted of 200 students who were 19 years of age and older and enrolled in science classes during the fall semester of 2010 at this community college. All entering freshman students enrolled in science classes were allowed to participate in this study only if their age met the mandatory protocol. In order to assess the community college students' attitudes and perceptions toward science, a modified survey — *Attitudes toward Science/Learning Science* — was created that contained two parts. The first part consisted of thirty-eight items. The second part consisted of nine demographic items. Community college students were surveyed during fall semester 2010. Community college students completed surveys reflecting their major, gender and ethnicity.

Items 1 through 38 consisted of attitudes toward science education. It contained items that related to community college students' abilities to learn science and their attitudes concerning science. The second part consisted of demographics that included community college students' class, course, grade level, gender, and ethnicity, GPA, major and career.

The quantitative data revealed the following from the three research questions by using a 6x5x2 Factorial ANOVA. Research Question 1 addressed the relationship of community college students' intended major and their attitudes toward science education. The results revealed that no statistically significant differences existed in the intended major of community college students' and their attitudes toward science education, $F(5, 158) = .646$, $p = .665$.

Research Question 2 investigated the relationship of community college students' ethnicity and attitude toward science education. The results revealed that there were no statistically significant differences between the community college students' ethnicity and attitude toward science, $F (4, 158) = 1.835$, $p = .125$.

Research Question 3 investigated the relationship of community college students' gender and attitude toward science education. The results revealed that no statistically significant differences existed between the community college students' gender and attitude toward science, $F (1, 158) = .203$, $p = .663$.

Research Question 4 investigated the relationship of community college students' academic achievement and attitude toward science education. The results indicated that there were no statistically significant relationships between community college students' academic achievement (GPA) and their attitudes toward science education, $r = -.065$, $p = .362$.

The attitudes of community college students were measured between all interactions in this study. The interactions revealed no statistical significant difference between all variables in this study as are as follows:

1. Community college students' attitudes toward postsecondary science education when measured between ethnicity and gender, $F (4, 158) = 1.574$, $p = .184$.

2. Community college students' attitudes toward postsecondary science education when measured between major and gender, *F* (5, 158) = .870, *p* = .503.
3. Community college students' attitudes toward postsecondary science education when measured between major and ethnicity, F (14, 158) = .947, p = .510.
4. Community college students' attitudes toward postsecondary science education when measured between major, gender, and ethnicity, F (8, 158) = .172, p = .994.

Conclusions

To the extent that the data collected for this study were valid and reliable and the assumptions of the study were appropriate and correct, the following conclusions may be made. Based on the results of this study, it may be concluded that there were no statistically significant differences for community college students' based on attitudes, major, gender, and/or ethnicity. Additionally, it may be concluded that there were no statistically significant differences for the relationship of academic achievement (GPA) and their attitudes toward science.

Implications

Many adults are entering America's community colleges now more than ever before. Many of these community college students are seeking careers in many fields; however, a limited number of these students are pursuing science and/or science related fields (Braund & Reiss, 2006; Gibson & Chase, 2002; Graber & Bolte, 1997). Science education plays a major role in the way that students interpret scientific skills and relay those learned technologies into diversified learning (Ramsden, 1998; Thorndike, 1997). The results from this study indicated that there were no statistically significant differences in community college students' attitudes toward postsecondary science education based on their intended major, gender, and ethnicity.

Implications may be drawn from this study's findings, which may be beneficial to community college students for future planning and implementing strategies for students to have positive attitudes toward postsecondary science education. The literature suggests that many American students are not pursuing science/science-related degrees (Sachs, 2001). Many of these students avoid taking science classes early in their academic careers. Graber and Bolte (1997) suggested that many students avoid taking science-related classes early in their academic careers due to alternatives classes offered at that level that are more student-friendly. It is just as equally important, however, to gain an academic foundation in science or science-related classes so that when these students reach the postsecondary level science classroom, there is less apprehension toward pursuing science careers.

Transitioning from one academic setting to the next is an essential component when comprehending science content. Better educational foundations at the secondary level will allow community college students to adapt to new academic environments. The implications of this study reinforce the need for assisting community college students that may lack the educational background needed to learn science content.

Results of the study and review of literature stressed the need for preparation of learning science early in the community college science students' academic careers so that they may be prepared when they reach the postsecondary science classroom. As students mature from the pedagogy way of learning (teacher-centered) to andragogy (serving as a facilitator to the adult), delivery of instructions are essential in the way students learn or adapt to new science content. Malcolm Knowles, the father of adult education, suggested that adults learn more content when assisted by a facilitator (Knowles, 1968, 1975, 1980, 1990). Because adults have different needs, more so than those of teenagers, the methods of delivery of instruction should be different.

Many community college students are over the age of 19 and are considered to be legal adults. They hold responsibilities such as paying bills and child care and are attending postsecondary classes at community colleges. Another major responsibility is that many of these students are married. When the needs of students are met, they are often successful in their academic environments (Hall, 1974).

Interestingly, many adults at the community college level not only lack the academic background in science, but also do not possess the time to delegate to studying challenging academic subjects such as the sciences and mathematics (Kennedy, 2002). To meet those needs, community college students' must interact in structured initiatives that support their academic level of science. This will allow the community college students to use paradigms that allow them to pursue science courses successfully. This may also encourage students to investigate opportunities to pursue degrees in science/science-related fields.

Implications for the Community College Science Instructors

Meeting the needs of community college students' that are enrolled in postsecondary science classes warrants an understanding of student's backgrounds. Many of the students entering community college are from academic settings that do not support a strong academic background (Gibson & Chase, 2002). Furthermore, students may have never been exposed to the science concepts in their previous learning environment. Some students reside in the same community as the community college and only have that alternative for advancing their learning. These same students may not be accepted at larger institutions of higher learning for the reason that they have academic deficiencies (Graber & Bolte, 1997).

Many community college science instructors may not realize that large segments of their students may have major deficiencies in science, indicating why many are apprehensive toward taking even the basic science class to meet a requirement, let alone pursuing a degree or career in a science/science-related field. By observing the community college students' responsibilities, it is obvious that more science classes are in need of being constructed so that they supply a demand to the deficiencies that exist by these students. Community college science faculty may learn of their students' deficiencies early during the semester (Ramsden, 1998). Though the community college science instructor may observe the deficiencies, it can become impossible to redo a syllabus in the middle of a semester to fit a group of students with deficiencies in science. Those students usually fail and the more academically-inclined students are grasping the knowledge and prospering successfully.

Academically-inclined students should not be hindered in learning new science content. Those students with deficiencies in science must work on those issues to strengthen their backgrounds. The community college serves many purposes. One particular purpose is to provide a foundation so that students may further their education at a four-year institution. If the community college instructor weakens the academic rigor in a science classroom, then events may happen to deter a whole community and eventually the science department. For example, if community college students with science deficiencies are promoted through a weakened science program and matriculate through a nursing field, they will be graduates with a degree but who cannot perform on the job. That community college will have provided a disservice to its community. To add, there may be many lives that come into jeopardy due to this academic injustice.

When community college instructors and faculty members restructure their curriculum to facilitate learning by all community college students this will provide positive reinforcements for community college students. By providing these postsecondary science classes for students, the chance for success will be enhanced significantly. More students may take the developmental postsecondary science classes to strengthen their deficiencies. Once their deficiencies are met, the community college students may develop an attitude that supports investigating a career in science-related fields.

Implications for Community College Administrators

The main purpose of the community college is to serve the community by preparing the community's constituents with the skills and resources that will maintain a stable community. Results of the literature and this study may serve as a basis for administrators to observe the attitudes of students and their views toward postsecondary science education. The researcher developed four postulates from this study that provides ideas for administrators consider when evaluating community college science departments and are as follows:

1. Many community college students attend community college to learn basic and new skills but are not as apt to learn as fast as students that have transitioned from one academic environment to another.
2. Many of the community college students are much older than others. They are returning to the community college because they are preparing for a second career. Many have been laid-off from their jobs due to a stagnated economy.
3. Most students want to learn; however, their goals and deficiencies do not match. Students with poor science fundamentals do not need to pursue careers in science or medicine until those weaknesses are met and satisfied.
4. Funds must be provided to the department to hire more science instructors to teach developmental classes in postsecondary science so that the student will have an opportunity to succeed.

Just as important as the four postulates are the administrative recognitions of the community college students' responsibilities outside of the academic environment. As mentioned earlier, many community college students are overwhelmed with their responsibilities and may have to miss classes or be tardy. Attendance is essential in the postsecondary science classroom; however, students may need to take classes at one time and labs at another time so that they may be accommodated to fit their intended purposes. Allowing and encouraging additional privileges at non-traditional hours will significantly increase community college science students' attitudes toward postsecondary science education. Additionally, by creating more postsecondary science laboratories with optional times to take those classes will greatly enhance student attendances and benefit the working community college student.

Recommendations

This study was conducted to measure the attitudes of community college students toward science. It is recommended that this study be replicated by adding more demographic variables. The following community college science students' variables were not measured in this study: age, enrollment status (part-time or full-time), socio-economic status (SES), employment status (work part-time or full-time), living arrangements (live with parents, rent, or commute over 15 miles), methods of paying tuition and marital status with number of children included. Adding these variables may expose more stresses of students and provide more reasons to why community college students develop apprehension toward postsecondary science courses.

It would also be valuable to survey more students from diverse backgrounds. The population in this study only measured community college students that were enrolled in postsecondary science classrooms. The population consisted of 200 participants; however, there was a lack of diverse ethnic backgrounds. There were 138 Caucasians and 37 African

Americans in this study. The three remaining ethnic groups were combined to make up the remaining 25 students in this study. By duplicating this study with a more heterogeneous population (among ethnicity) the results may be enhanced.

The location of the community college in this study needs to be given consideration as well. The community college is located in the southeastern United States with two satellite campuses. Adding the populations of those two community college satellite campuses to the original 200 participants may yield different results to this study. Also, by replicating this study at four-year institutions, different results may be yielded.

The questions in this study were developed to seek data on the attitudes and perceptions of community college students' toward postsecondary science education. While the results of this study were not significant, there were many inferences that derived from the conclusions. For example, the major of students does not play a significant role in the attitudes of community college students.

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Appendix 1

Survey Instrument

*ATTITUDE TOWARD SCIENCE SURVEY**

These statements address your attitudes toward science in general and learning science. There are no right or wrong answers in this survey. Please check the appropriate box for each statement.

	Strongly Disagree		Neutral		Strongly Agree
1. Scientific thinking is not applicable to my life.	☐	☐	☐	☐	☐
2. Most people can understand science.	☐	☐	☐	☐	☐
3. Science classes are boring.	☐	☐	☐	☐	☐
4. Science is relevant to our society.	☐	☐	☐	☐	☐
5. I don't like science because I'm not good at it.	☐	☐	☐	☐	☐
6. Earth science (physical geography/geology) is worthless.	☐	☐	☐	☐	☐
7. I can learn science.	☐	☐	☐	☐	☐
8. I use science in my everyday life.	☐	☐	☐	☐	☐
9. People with poor social skills tend to become scientists.	☐	☐	☐	☐	☐
10. Scientists have to study too much.	☐	☐	☐	☐	☐
11. People should understand science because it affects their lives.	☐	☐	☐	☐	☐
12. Nothing interesting can be learned from studying the earth.	☐	☐	☐	☐	☐
13. I enjoy studying science.	☐	☐	☐	☐	☐
14. Scientific work is useful only to scientists.	☐	☐	☐	☐	☐
15. I may not make great discoveries, but working in science would be fun.	☐	☐	☐	☐	☐
16. Earth science (physical geography/geology) discoveries made today are important for the future.	☐	☐	☐	☐	☐
17. Only highly trained scientists can understand science.	☐	☐	☐	☐	☐
18. Science is boring.	☐	☐	☐	☐	☐
19. I am interested in earth science (physical geography/geology).	☐	☐	☐	☐	☐

	Strongly Disagree		Neutral		Strongly Agree
20. Science should be a required part of everyone's education.	☐	☐	☐	☐	☐
21. Science has done more harm than good.	☐	☐	☐	☐	☐
22. Earth science (physical geography/geology) is irrelevant to my life.	☐	☐	☐	☐	☐
23. I don't like taking science courses.	☐	☐	☐	☐	☐
24. Science is not essential for the continued vitality of society.	☐	☐	☐	☐	☐
25. I like to learn about new scientific discoveries.	☐	☐	☐	☐	☐
26. Science does not improve our understanding of our world.	☐	☐	☐	☐	☐
27. I like earth science (physical geography/geology).	☐	☐	☐	☐	☐
28. Physical geographers and geologists are not as scientific as other scientists.	☐	☐	☐	☐	☐
29. I would like to work with other scientists to solve scientific problems.	☐	☐	☐	☐	☐
30. I like learning about the earth.	☐	☐	☐	☐	☐
31. Scientists do not have enough time for their families or for fun.	☐	☐	☐	☐	☐
32. Science is interesting.	☐	☐	☐	☐	☐
33. I do not want to be a scientist.	☐	☐	☐	☐	☐
34. Science is not useful to the average person.	☐	☐	☐	☐	☐
35. Most people can understand earth science (physical geography/geology).	☐	☐	☐	☐	☐
36. The thought of taking a science course scares me.	☐	☐	☐	☐	☐
37. I find it difficult to understand scientific concepts.	☐	☐	☐	☐	☐
38. I can learn earth science (physical geography/geology).	☐	☐	☐	☐	☐

*Survey modified with permission from the Online Evaluation Resource Library (OERL) – National Science Foundation Student Attitude Survey

Instrument 14: Conceptions/Nature of Science

General Information

39.	**Why are you enrolled in this class?**
☐	To satisfy SUSCC's critical science degree requirement
☐	To satisfy course requirements for my major or minor.
☐	Elective course that sounded interesting.
☐	Other:
40.	**When you registered, was this a course you wanted to take?**
☐	It was one of my first choices for a course.
☐	It was one of my alternate choices; my first choice course was closed or conflicted with another course.
☐	I never wanted to take this course.
41.	**What is your current class standing?**
☐	Freshman
☐	Sophomore
☐	Other:
42.	**What is your gender:**
☐	Female
☐	Male
43.	**What is your ethnicity?**
☐	Caucasian
☐	African American
☐	Asian
☐	Native American

☐	Other:
44.	**What is your GPA?______________________**
45.	**What major are you pursuing or are planning to pursue?**
☐	Science (biology, chemistry, computer information systems, geography, mathematics, natural science, physics)
☐	Social Science (business administration, economics, geography, managerial accounting, sociology)
☐	Humanities (English, history, philosophy, Spanish)
☐	Fine Arts and Communication (art, music, communication, theater)
☐	Professional Studies (communicative disorders, education, athletic training, health promotion, dietetics, interior architecture, clinical laboratory science)
☐	Undecided
46.	**Are you seeking a career in a science or science-related field?**
☐	No
☐	Yes
☐	Not sure at this time
47.	**Why do you like or dislike science? What experiences have you had led you to this attitude?**
(please use the back of this page if needed)	

Thank you for your participation!

Appendix 2

Recruitment Script

My name is Clint Foster, a doctoral candidate at Auburn University, located in Auburn, Alabama. I am in the College of Education and the Department of Educational Foundations, Leadership and Technology. I am seeking the Doctor of Philosophy Degree in Adult Education. I would like to invite you to participate in my research study entitled “Community College Students’ Perceptions of Postsecondary Science Education.”

Any student whether male or female that is presently attending Southern Union State Community College, located in Opelika Alabama and is of age 19 and over is eligible to participate in this study.

As a participant, you will be requested to complete a thirty minute survey that asks you to respond to questions that pertain to your attitudes and perceptions toward science education. Although the results of this study may not provide personal benefits to you, it may be used to inform present and future instructors, counselors, administrators and other agencies as they work to meet your academic achievements in science classrooms.

Your participation is absolutely voluntary and all responses are strictly anonymous. You will not be identified when data are analyzed.

If you would like to participate in this study, you must first agree to do so. Shortly, I will distribute, read and thoroughly explain the Information Letter. You will also receive a survey document that will take thirty minutes to complete.

THIS SURVEY IS COMPLETELY VOLUNTARY. I WOULD GREATLY APPRECIATE YOUR PARTICIPATION.

Appendix 3

Auburn University IRB Approval Letter

AUBURN
UNIVERSITY

Office of Research Compliance
115 Ramsay Hall, basement
Auburn University, AL 36849

Telephone: 334-844-5966
Fax: 334-844-4391
hsubjec@auburn.edu

July 11, 2011

MEMORANDUM TO:	Clint T. Foster Department of Educational Foundation, Leadership and Technology
PROTOCOL TITLE:	"Community College Students' Perceptions of Postsecondary Science Education"
IRB AUTHORIZATION NO:	10-270 EP 1010
APPROVAL DATE:	October 2, 2010
EXPIRATION DATE:	October 1, 2011

The referenced protocol was approved as "Expedited" by the IRB under 45 CFR 46.110 (7):

> "(7) Research on individual or group characteristics or behavior (including, but not limited to, research on perception, cognition, motivation, identity, language, communication, cultural beliefs or practices, and social behavior) or research employing survey, interview, oral history, focus group, program evaluation, human factors evaluation, or quality assurance methodologies."

You must report to the IRB any proposed changes in the protocol or procedures and any unanticipated problems involving risk to subjects or others. Please reference the above authorization number in any future correspondence regarding this project.

If you will be unable to file a Final Report on your project before October 1, 2011, you must submit a request for an extension of approval to the IRB in mid September 2011. If your IRB authorization expires and/or you have not received written notice that a request for an extension has been approved prior to October 1, 2011 you must suspend the project immediately and contact the Office of Research Compliance.

<u>A Final Report will be required to close your IRB project file</u>. You are reminded that you must use only copies of the stamped, approved information letter when you consent your participants.

If you have any questions concerning this Board action, please contact the Office of Research Compliance.

Sincerely,

Kathy Jo Ellison, RN, DSN, CIP
Chair of the Institutional Review Board
for the Use of Human Subjects in Research

cc: Dr. James Witte

Appendix 4

Recruitment Email

Mail Message

Reply Resend Read Later Delete

Mail	Properties	
From:	Clint Foster	Monday - July 12, 2010 4:05 PM
To:	sowen@suscc.edu	
Subject:	Research at SUSCC	

Mr. Owens:

Thank you for meeting with me last week for I really enjoyed your time and interests in my research. I am very interested in the possibility of collecting data from SUSCC science students. As of now, I am preparing to submit data to the Institutional Review Board (IRB) at Auburn University. At this time, I am awaiting permission from you and Dean White for permission to collect data from students that are age 19 or older and volunteer to participate in the study. Please inform me of any other information that you may need and I will get it to you all ASAP. Thank you so much and looking forward to working with you all this Fall Semester.

Regards,

Clint Toneyo Foster
Ph.D. Candidate, 2008 Alabama SREB Scholar
Department of Educational Foundations, Leadership and Technology
Auburn University
Auburn, AL 36830
334.372.2739 (Work Cell)
334.344.8319 (Cell)
2 Timothy 2:3

Appendix 5

Request to Use Instrument

Mail Message

Reply Resend Read Later Delete

Mail	Properties	
From:	Clint Foster	Monday - June 21, 2010 9:57 AM
To:	Geneva.haertel@sri.com	
Subject:	Research Instrument #14	

> Geneva Haertel:
>
My name is Clint Foster, a PhD Candidate at Auburn University, located in Auburn Alabama. We spoke last week via telephone concerning research instrument “Student Attitude Survey Instrument 14: Conception/Nature of Science”. I am writing to request permission to use this instrument for my dissertation. If possible, would you forward me information that gives me permission to use the instrument for research purposes, as we discussed last week.
>
> Thank you so much for your availability and assistance in this process for your time has been essentially important. Please feel free to email or call me at the numbers below.
>
> Warmest Regards,

Clint Toneyo Foster
Ph.D. Candidate, 2008 Alabama SREB Scholar
Department of Educational Foundations, Leadership and Technology
Auburn University, Auburn Al. 36830
334.372.2739 Work Cell
334.344.8319 Cell
2 Timothy 2:3

Appendix 6

Permission to Use Instrument

Mail Message

Reply Read Later

Mail Properties

From:	Geneva Haertel <geneva.haertel@sri.com>	Thursday - June 24, 2010 10:19 AM
To:	Clint Foster <fostect@auburn.edu>	
Subject:	Re: Research Instrument #14--permission to use Instrument #14	
Attachments:	Mime.822 (3893 bytes)	[Save As]

Hi Clint,

This email confirms that the instruments posted on the publicly available OERL site (http://oerl.sri.com) can be used "as is" or adapted for research purposes, unless they are designated as copyrighted. Instrument #14 is available for users to adapt or use "as is". In your dissertation, please acknowledge the project and/or instrument developer as specified in the contributor's list on the Web site and please cite the OERL Web site itself as the location where you found the instrument.

The American Psychological Association Style Manual provides information on how to cite a Web site.

Good luck on your dissertation! Feel free to get back in contact if you need more information.

Geneva Haertel
Director of Assessment Research and Design
Center for Technology in Learning
SRI International

Appendix 7

Letter of Consent

INFORMATION LETTER

for a Research Study Entitled

"Community College Students' Perceptions of Postsecondary Science Education"

You are invited to participate in a research study that examines the perceptions of community college students' attitudes toward postsecondary science education. This study is being conducted by Clint T. Foster, a Doctoral Candidate at Auburn University. You were selected to take part in this study because you are an undergraduate science student at least19 years of age or older and are enrolled in at least one science class at Southern Union State Community College.

What will be involved if you participate? Participation is totally voluntary. If you agree to participate, you will be asked to complete a survey. Answer each question based on your own opinion and experiences. After completing all items on the survey, you are to place it inside the envelope that has been provided for you. Please be sure to seal the envelope completely. If you decide not to participate in this study, you may turn in the questionnaire unanswered. The survey will take thirty minutes to complete.

Are there any risks or discomforts? There are no identifiable risks or discomforts associated with this study. All data collected will be anonymous. Your name will never appear on any document.

Are there any benefits to yourself and others? There will be no benefits to you directly if you decide to participate. If you decide to participate, you will help instructors and professors, as well as, other administrators in education to get in-depth analyses of the perception of community college students and their views toward science education.

Will you receive compensation for participating or any other rewards or gifts? There is no compensation for participating in this study.

Are there any costs? There are no costs associated with participating in this study.

What if you change your mind about participating? Your decision whether or not to participate in this study will not jeopardize your relations with Southern Union State Community College, Auburn University or its Department of Educational Foundations, Leadership and Technology. Further, you may discontinue participation at any time without penalty during the data collection process. Once you have submitted your survey, the data may not be withdrawn due to it not being identifiable.

Any data obtained in connection with this study will remain anonymous. The investigator and the Dissertation Committee Chair will protect your privacy and the data you provide by excluding your identity and restricting access to only those individuals who are conducting this study. Information collected through your participation may be used to fulfill an educational requirement, published in a professional refereed journal, and/or presented at a professional conference or meeting.

If you have any questions or concerns about this study, please contact Clint T. Foster at (334) 372-2739 (fostect@auburn.edu) or Dr. James E. Witte at (334) 844-4460 (witteje@auburn.edu).

For more information regarding your rights as a subject, you may contact the Office of Human Subjects Research or the Institutional Review Board by phone at (334) 844-5966 or email at hsubjec@auburn.edu or IRBChair@auburn.edu.

HAVING READ THE INFORMATION PROVIDED, YOU MUST DECIDE IF YOU WANT TO PARTICIPATE IN THIS RESEARCH PROJECT. IF YOU DECIDE TO PARTICIPATE, THE DATA YOU PROVIDE WILL SERVE AS YOUR AGREEMENT TO DO SO. THIS LETTER IS YOURS TO KEEP.

Investigator's Signature Date

Printed Name