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Student Perceptions of Biology Teachers' Interpersonal Teaching Behaviors and Student Achievement

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COLLEGE OF EDUCATION

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2015

Abstract

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MS, Alabama A&M University, 1986

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Doctoral Study Submitted in Partial Fulfillment

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Abstract

Inadequate student-teacher interactions in undergraduate courses have been linked to poor student performance. Researchers have noted that students' perceptions of student-teacher relationships may be an important factor related to student performance. The administration of a Mid-Atlantic community college prioritized increasing undergraduate biology student performance. The purpose of this quantitative study was to examine the relationship between students' biology achievement and their perceptions of interpersonal teaching behaviors and student-teacher interactions in introductory biology courses. Leary's theory on interpersonal communication and the systems communication theory of Watzlawick, Beavin, and Jackson served as the theoretical foundation. The Wubbel's Likert-scale questionnaire on student-teacher interactions was administered to 318 undergraduate biology students. Non-parametric Spearman's rank correlations revealed a significant direct correlation between students' grades and their perceptions of teachers' interpersonal teaching behaviors. The relationship between student achievement and students' perceptions of student-teacher interactions prompted the recommendation for additional study on the importance of student-teacher interactions in undergraduate programs. A recommendation for local practice included faculty development on strategies for improving student-teacher interactions. The study's implications for positive social change include increased understanding for administrators and instructors on the importance of teacher-student interactions at the community college level.

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Dedication

To my wife, Sharon: Several years ago, we promised to stand together for better or worse, for richer or poorer, in sickness and in health; we have been through good times and bad, yet we remain committed to each other. You are the greatest gift of my life and I thank God every day that we are together.

To my daughter, Gabrielle: I am very proud of you and love you very much. Set high goals and work diligently to achieve them.

Finally, to my dad, who passed away before this study was completed, and my mom, both lifelong educators: Your belief in education as an effective instrument for bringing about desirable changes in people is what inspired me to pursue a career in science education I love you Mom and Dad. Dad I miss you.

Acknowledgments

As with any project of this magnitude, numerous people provided invaluable support to its successful completion. Several faculty members contributed something to my work during each of my semesters at Walden, but I am especially grateful to Dr. Wallace Southerland III for stepping in to help me through the doctoral stages of this program. Without his support, guidance, and feedback, I would not have completed this project. Thank you also to Dr. Maryann Wangemann for serving as my methods adviser and for reviewing my work and offering feedback and support that helped to shape this project. I am grateful to Dr. Geralyn Stephens, my URR reviewer for reviewing my work and offering feedback that helped shape this study. I am also grateful to the community college where the study was conducted, the science faculty for making their students available, and the students for participating in the data collection process. It is my hope that the results from the study will have a positive impact on instruction.

Several of my teaching colleagues offered support and expressed interest in my study, and I am grateful for your encouragement and support.

A special thank you to Dr. Theo Wubbels for allowing me to use the survey he created to measure students' perception of teacher interaction. The assessment tool is an excellent way for evaluating teacher-student relationships in science classrooms.

Finally, I would like to thank both my immediate and extended family, especially my wife and daughter, for their patience and understanding during this challenging process. I have been blessed with a great deal of love and support.

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Section 1: Introduction to the Study

The National Science Board (2010) warned of a "troubling decline" (p. 1) in the number of U.S. citizens studying to become scientists and engineers, even as the number of jobs requiring science and engineering training was growing. Their report concluded that U.S. global leadership in science and technology was declining as foreign nations—especially China and other Asian countries—were rapidly developing their national innovation systems. In 2009, the respected Program for International Student Assessment reported that in the United States 15-year-old students ranked 17th on science tests and 24th on math tests, compared with their peers from 29 other wealthy nations. Lemonick (2006) provided additional support for this trend by noting that the number of American students entering technical fields in undergraduate universities and graduate schools had been plummeting.

For many decades, eager immigrants came to United States to earn advanced degrees in science and engineering. Most of these graduates continued working in this country even long after their graduation. The trend now is for these students to receive their science education in the United States and return to their homelands with the new knowledge. Lemonick (2006) called this trend a crisis and stated, "Unless things change, they will overtake us, and the breathtaking burst of discovery that has been driving our economy for the past half-century will be over" (p. 24). In 2007, 17% of all bachelor's degrees awarded in the United States were in the sciences and engineering, while in China, 52% of 4-year degrees focused on these areas (Zimmer, 2007). In Japan, South Korea, Sweden, and Switzerland more than 40% of the graduate degrees were awarded in

science (Zimmer, 2007). These numbers, according to Zimmer (2007), indicate that the American scientist population is not healthy, especially not in comparison to scientists in other countries. Zimmer wrote that the inability of the United States to attract young people to enroll in these fields will affect America's ability to retain its top place in the global scientific and technological arena. The National Academies (2005), one of the United States' leading organizations in science, medicine, and engineering, noted that the erosion of the nation's scientific and technical strength threatened America's strategic and economic security. The United States has to reverse these trends to retain a technological advantage in this highly globalized economy.

In a speech to members of the National Academy of Sciences in 2009, President Obama (Proceedings of the National Academy of Science, 2009*)* addressed the need to improve science education in the United States. He outlined a number of budget and policy priorities. Key among them: boosting interest among youngsters in science and math-with an eye towards encouraging them to consider careers in allied fields (Science Insider, 2009). Winters (2006) stated, "Perhaps, even more important than the struggle of United States students to keep pace with their international peers is their failure to keep up enthusiasm for the subject" (p.26). Research studies on the effect of motivation on learning have shown that children are attracted to ideas that address both their cognitive and affective needs (Butler & Nesbit, 2008). Young children, according to Butler and Nesbit (2008), are excited about science when they are given the chance to explore science. Children love to explore the natural world to make sense of it (Geary, 2008; Tella, 2007, 2009). Some researchers have argued that children's enthusiasm and

curiosity are squashed by fourth grade because of the manner in which American educators teach science (Lesner, 2009; Winters, 2006). According to Winters (2006), if a child loses enthusiasm and curiosity about science, it is awfully hard for the child to get back into science in high school and college. Community college science faculty have a difficult and extremely challenging task of keeping students' enthusiasm and motivation high while increasing their science achievement (Eddy, 2007; Huber, 1998; Murray, 2002). In the context of these findings, the United States must invest resources to improve science education if it is to maintain its preeminence in science and engineering innovation.

This study determined the relationship between students' academic achievement in a community college's introductory biology courses and their perceptions of the teachers' interpersonal teaching behavior. In prescribed educational settings, students and teachers spend a significant amount of time in classrooms interacting with each other. Educators believe that good quality relationships between teachers and students are crucial in the learning process (Klem & Connell, 2004; Muntner, 2008). Many variables determine, to differing degrees, the success of any particular learning environment, and one of the key variables is the nature and quality of the student-teacher interaction. Studies have shown that students with caring and supporting interpersonal relationship with their teachers reported more positive academic attitudes and satisfaction with school (den Brok, Taconis, & Telli, 2010; Klemm & Connell, 2004; Koul & Fisher, 2004). Arends (2001) wrote that establishing bona fide relationships with students is a precondition to everything else in teaching. Research over the past two decades indicated

that effective teaching demands the use of a wide array of skills that must be adapted to specific contexts. According to Koul and Fisher (2005), a teacher's behavior, when interacting with students, can have a lasting positive or negative impact on how the students perceived the learning environment that teacher created. According to Good and Brophy (2000), the ideal classroom starts with creating a supportive climate in which students feel at ease asking questions and contributing to lessons without the fear of embarrassment or ridicule. Good and Brophy concluded that teachers who emphasize this type of environment tend to be more effective than those who emphasize their roles as disciplinarians.

Attempts by researchers to quantify the impact of teacher effectiveness on students' learning outcomes in science can be traced to the early 1950s. Many research studies on teacher effectiveness consistently showed that effective teaching resulted in increased science achievement for all students (Johnson, Kahle, & Fargo, 2007; Lynch, Kuipers, Pyke, & Szesze, 2005; Wojnowski, Bellamy, & Cooke; 2003). Johnson et al. (2007), in a study designed to assesses the impact of teaching effectiveness on student learning outcomes in science and the long-term consequences associated with their science learning experience, found that effective teachers positively impact student learning. Johnson et al. used a general linear mixed model approach to assess change in student scores on the Discovery Inquiry Test as a function of time, race, teacher effectiveness, gender, and impact of teacher effectiveness over a 3-year period. Effective teaching in the study was identified through multiple classroom observations using the local systemic change classroom observation protocol (Horizon Research, 1999). The

outcome of the study was important because it found that effective teaching not only increased student achievement, but it also closed achievement gaps for all students. Findings from this study strongly supported evidence from other studies that effective teaching may hold the key to increasing student achievement and narrowing achievement gaps in science.

The 2009 Community College Survey of Student Engagement (CCSSE) reported that community colleges serve a diverse mix of students with dramatically varying goals and levels of academic preparation. A good number of these students are returning from the workforce to learn new skills. Many are first-generation college students who have never been to a college campus. According to the CCSSE report "Most have significant demands on their time as they juggle personal, academic, and financial challenges" (p. 5). Many researchers studying 21st century students have described them as diverse individuals with varying learning needs. For them to be successful in the classroom, instruction must focus on the learning styles and preferences of the target population (Brown, 2003; Byrd & Macdonald, 2005; Mellow & Heelan, 2008; Phillipe & Sullivan, 2005).

Data from the National Science Foundation's 2001 National Survey of Recent College Graduates showed that more than 40% of recent science and engineering graduates attended community colleges at some point in their educational paths. A majority of students going into the allied health field such as nursing began their education in community colleges (Chen, 2008). In the last two decades, community colleges have undergone considerable demographic change. According to the National

Center for Educational Statistics (2008), the median age of community college students in 2008 was 24 years old. Thirty-five percent of community college students were 30 years old or older, 18% were between 24 and 29 years old, and 38% were between 19 and 23 years old (National Center for Educational Statistics, 2008). The majority of these students are returning students seeking retraining or new career skills, and the number of women and minorities has been increasing (Phillipe & Sullivan, 2005). Community college faculties, like many of their colleagues in higher education institutions, bring very little experience and training to the teaching dimension of their roles (Grubb, 1999; Wagoner, 2008). Wagoner (2008) said that even though teaching is the core process of community colleges, many faculty members are hired for their expertise in a specific content area such as biology with little to no background in pedagogy and curriculum design. These faculty are also expected to be proficient in the use of the latest teaching methodologies and instructional technologies, including presentation software such as PowerPoint, and to teach in classrooms equipped with the latest technology to engage students and lead them to academic success (Barrington, 2004; Galbraith, 2004; Sperling, 2003).

Many community college faculty members are not trained in graduate school to face the pedagogical challenges of a diverse student population that requires using different approaches to teaching and learning (Eddy, 2007; Murray, 2002). Faculty members in community colleges spend the greatest portion of their professional time devoted to teaching. The interactions that occur within the classroom environment are where faculty and students have the greatest opportunities to connect. Faculty also

interacts with community college students in a variety of other ways outside the classroom, from campus activities to formal and informal advising. Studies, however, showed that it was the central role of instruction for which community college faculty had the least preparation (Grubb, 1999; Wagoner, 2008). Even though educational researchers have identified many pedagogical approaches and learning theories, there is still a debate among educators about what approach works best for effective teaching and learning (Chickering, 2006; Ediger, 2005; Erickson, Peters, & Strommer, 2006; Fernandez, 2005; Grossman, 2005). According to Campbell (2009), "The apparent disconnect between teaching preparedness of the varied methodologies and the diverse learning needs of students come at a critical time when society is requiring increasingly complex scientific skills of its members for them to be successful". Professional development for faculty could fulfill this need by providing appropriate learning opportunities for them. Community colleges must be required as part of their core mission to implement faculty development activities to assist faculty in developing the skills and strategies necessary to provide effective instruction designed to improve teaching and learning.

This study addressed the problem of inadequate teacher-student interactions in community college introductory biology classrooms and their impact on student cognitive outcomes. The study determined if there were relationships between students' cognitive outcomes and the quality of teacher-student interactions among students taking an introductory biology course in a community college. Teachers are pivotal to student perceptions of learning (West, 1994), inhibiting or facilitating student learning. Several

studies on teacher-student interaction and student achievement have shown that some of the qualities that lead to effective relationships are positive affection, warm attitude, tact of teaching, teacher immediacy and teacher power, teacher assertiveness and responsiveness, and low differential treatment (Pekel, Demir & Yildiz, 2006; Santiboon &Fisher, 2005; Scott & Fisher, 2001). A lack of any of the aforementioned traits may negatively influence teacher student interactions (Pekel et al., 2006). This study is important because it provides information that instructors can use to modify instructor-student interactions and teaching strategies in a community college introductory biology classroom to increase student achievement. The outcomes of the study can help in building more positive teacher–student relationships through reflection. Potentially, collecting information on students' perceptions of teacher interpersonal behavior will help in initiating and supporting activities in professional development programs in community colleges.

Problem Statement

The problem of inadequate-teacher interactions in undergraduate introductory biology classrooms has been linked to poor student performance, resulting in fewer students pursuing advanced degree and careers in life science (National Science Board, 2008; Wood, 2009). Using data from its study of undergraduate institutions, the Center for Institutional Data Exchange and Analysis (IDEA; 2001) found that approximately 50% of students with an initial major in science switched to a nonscience major within the first 2 years of enrollment. A majority of undergraduate students, regardless of their majors, take at least an introductory biology course during their undergraduate career,

providing them with the best opportunity to learn about the basic facts of modern biology. In a report on vision and change in undergraduate biology education, the American Association for the Advancement of Science (AAAS; 2009) wrote:

> Introductory biology courses provide students an opportunity to develop an understanding of the nature of science and the scientific process so that when they confront issues that involve science and technology, they can solve every-day problems and use evidence and logic to reach sound conclusions (p. 5).

The authors of the report concluded that, no matter what their ultimate career paths, all students will need these very basic skills to participate as citizens and prosper in the modern world. For many undergraduate students, the course might be the only exposure they have to the life sciences, or to any of the sciences. The course therefore is important because it often serves as the best opportunity to interest students in a biomedical research or other life science career.

Stokstad (2001), in a study measuring how well students learned the basics in science, concluded that there was substantial evidence that scientific teaching in the sciences—that is, teaching that employs instructional strategies that encourage undergraduates to become actively engaged in their own learning—can produce significant levels of understanding and retention in introductory biology courses. According to Stokstad, "Each year, hundreds of thousands of U.S. students get their only exposure to science in an intro class--and most leave without understanding how science works or with any desire to take further courses" (p. 1). Changing the way educators

teach introductory biology courses requires moving from a passive experience to an active and engaged classroom, which will increase students' interest in the subject.

Several variables in community college introductory biology classrooms were examined in this study, two of which were ineffective teaching strategies and inadequate teacher-student interactions and their impact on student learning outcomes. Arends (2011) said that effective teaching requires thorough and insightful thought about what a teacher does and the effect it has on students' social and cognitive learning. Efforts to address ineffective teaching would require increasing the frequency and quality of interactions within university science courses including enhancing student-to-instructor communications (Lee, & Rha, 2009; Mahle, 2011; Preszler, Dawe, & Shuster, 2007). This study contributes to the body of knowledge needed to address this problem by examining if there was an association between community college introductory biology students' perceptions of interpersonal teaching behaviors and their achievement in introductory biology courses in a community college.

Hypotheses and Research Questions

This study investigated the relationship between teacher-student interactions and students' achievement in introductory biology in a suburban community college in a Mid-Atlantic state. The following three research questions were formulated to guide the exploration. Following the research questions are the corresponding hypothesis and null hypothesis.

Research Question 1: How do students perceive the interpersonal behaviors of the instructors of their introductory biology courses?

For Research Question 1, the hypothesis is exploratory in nature, and no specific hypothesis is stated.

Research Question 2: What is the relationship between students' perceptions of teacher interpersonal teaching behavior and student achievement in introductory biology courses?

Null Hypothesis 2 ($H_0$2): Student perceptions of teacher interpersonal teaching behavior will not be related to student achievement.

Alternate Hypothesis ($H_1$2): Students' achievement will be positively related to students' perceptions of teacher interpersonal behaviors in introductory biology courses. In other words, the higher students' grades are in the course, the more positively they will rate their teachers' interpersonal behaviors.

Research Question 3: Do student perceptions of teacher interpersonal behavior differ based upon student achievement levels in introductory biology courses?

Null Hypothesis ($H_0$3): Students' perceptions of teacher interpersonal behavior will not differ based on students' achievement levels in introductory biology courses.

Alternate Hypothesis ($H_0$3): High achieving students (attaining grades of As and Bs) will rate their teachers' interpersonal behavior significantly more positively than low achieving students (students receiving grades of Cs, Ds, and Fs).

I discuss more details on the nature of this study and the research design in more detail in Section 3.

Purpose of the Study

The purpose of this quantitative study was to examine whether relationships exist between students' cognitive outcomes and the quality of teacher-student interactions among students taking introductory biology courses in a suburban community college in a Mid-Atlantic state. Research conducted over the past 30 years has shown that the quality of the classroom environment is a significant determinant of student learning (Chua, 2009; Dorman, Aldridge, & Fraser, 2006, Fraser, 1998, Khine, 2002, 2005). That is, students perform better and have more positive attitudes toward the subject taught when they perceive the classroom environment positively.

Theoretical Frameworks

The theoretical frameworks that anchored this investigation were Leary's (1957) theory on interpersonal communication and the systems communication theory of Watzlawick, Beavin, and Jackson (1967). The interpersonal communication and systems communication theory models were widely used in clinical and psychological settings but were adapted by a team of Dutch researchers for use in the educational setting since the early 1980s (den Brok, Brekelmans, & Levy; 2002).

Leary's Interpersonal Communication Theory

Rogers (1995) defined communication as a process in which participants create and share information with one another in order to reach mutual understanding. According to Rogers, communication is a social process in which individuals employ symbols to establish and interpret meaning in their environment. The term *interpersonal communication* refers to face-to-face communications that have high affectivity. It

involves investigating how relationships begin, the maintenance of relationships, and the dissolution of relationships (West & Turner, 2007).

Leary (1957) developed interpersonal communication theory to describe and measure specific interpersonal behaviors, primarily in a therapeutic setting. The Leary model, with its two dimensions of influence and proximity, has been widely investigated in clinical psychology and psycho-therapeutic settings and has proven to be a rather complete model to explain interpersonal behaviors (Foa, 1961). The model of interpersonal teacher behavior was an adaptation of the Leary model of interpersonal behavior for use in education. Wubbels, Créton, and Hooymayers (1985) focused on the teacher variable for improving the learning environment and developed a model to map teacher interpersonal behavior. They mapped the behaviors of teachers along two-dimensional axes: an Influence dimension (dominance and submission) and a Proximity dimension (cooperation and opposition). The Influence dimension portrays who is controlling or directing the communication process and how often; the Proximity dimension indicates the degree of cooperation or closeness among those who are involved in the process of communication (den Brok, Wei, & Zhou; 2009). Both dimensions of Influence and Proximity are independent and reminiscent of effective teacher behaviors that could influence classroom processes. For instance, directivity and warmth were two descriptions of effective teacher behavior (Dunkin & Biddle, 1974) that bore strong resemblance to Influence and Proximity.

Systems Communication Theory

The systems communication theory (Watzlawick et al., 1967) postulates that, among other important features, the occurrence of circular processes, stability, and resistance to change are crucial for understanding human communication. Dutch researchers (Creton, Hermans, & Wubbels, 1990) believed that these very features are also present in classroom communication. Creton et al. (1990) described classes as characterized by circular processes, stability, and resistance to change and interaction between a teacher and the students is of pivotal importance in classroom communication. In the context of the classroom, the behavior of the teacher not only influences student behavior, but the behavior of the teacher is also influenced by the behavior of students. Goh (1994) described how teacher communication behavior can convey different underlying messages to students. For instance, when a teacher points out a student's mistakes in class, one likely command message is “I want to help you to learn” while another very different version could be “You are too stupid to learn.” It is, therefore important, for teachers to be more conscious of the report and command aspects of their messages as these may have a tremendous influence on teacher-student classroom communication. Many research studies of biology classroom environment consistently showed that interpersonal communication between teacher and students increased student achievement in the subject by motivating students (Aydogan, 2008; Corrigan & Chapman 2008; Elias, 2006). Building a positive relationship between the teacher and students is very important because it helps students become more successful in the classroom.

Operational Definitions

The following are definitions of technical terms used throughout the study. For the purpose of this study, the following terms are defined and derived from the literature related to the phenomenon.

Classroom environment or climate: Classroom climate is a term used by educators to describe the learning environment on a number of dimensions including student perceptions of personal support and encouragement for learning (Johnson & Johnson, 1983). Instructors influence classroom climate by establishing and maintaining the nature of the learning environment in terms of competition, collaboration, and caring (Hirschy & Wilson, 2002). Maslowski (2003) described class climate as the collective perceptions of students with respect to the mutual relationships within the classroom, the organization of the lessons and the learning tasks of the students.

Community college: A 2-year traditional school, offering programs leading to the associate's degree and, typically, many noncredit courses in arts, crafts, and vocational fields for community members not seeking a degree. They typically have relatively low admissions requirements, low tuition, and reside in populated areas, making college education accessible to many.

Interpersonal teachers' behaviors: This term refers to interactional aspects of teacher behavior and is synonymous with the term *interpersonal teacher behavior*. Wubbels et al. (1985) defined it as " behavior that refer to the relationship between the teacher and his students and which is expressed in the interaction between the personal communication in the classroom" (p. 3).

Introductory biology course: According to the 2008 learning outcomes assessment at the community college that served as the research site, it is a course that focuses on the basic biological principles common to all living things, including cell structure and function, molecular, cellular reproduction, genetics, energy transformation, and biotechnology. The introductory biology course is the first biology course taken by science majors and the most common biology course taken by nonscience majors. A course such as this exposes students to a broad body of knowledge about biology.

Student achievement: Academic achievement is all about what students can actually do when they have finished a course of study. Students' achievement in this study was determined by student performance on an introductory biology comprehensive final examination given to all students in the course as part of the ongoing learning outcome assessment. Successful achievement was 70 points out of 100 points.

Teacher interaction: Teacher-student interaction, by its very nature, can be characterized as a systematic and intensive social contact, necessitating a mechanism that maintains order and control (Jackson, 1968). That is the academic relationship between teachers and their students. The variables linked to the process of classroom interaction are determined by school roles and the structure of the lesson itself.

Questionnaire on Teacher Interaction (QTI): An instrument developed specially for evaluating teacher-student relationships in secondary classrooms (Wubbels, Brekelmans, & Hoomayers, 1991). The instrument has been modified and used in postsecondary classrooms. The QTI was developed in the Netherlands between 1978 and 1984 to gather student and teacher perception data (Wubbels et al., 1985) based on the

model for interpersonal teacher behavior (MITB). Research with the QTI has resulted in a vast and evolving knowledge base on teacher–student interpersonal behavior (Fraser 1998; Levy et al. 2003; Wubbels & Brekelmans, 1998; Wubbels, Brekelmans, den Brok, & van Tartwijk, 2006).

Assumptions, Limitations, Scope and Delimitations

Assumptions

An assumption is defined as a limitation about a study that is purposely not controlled and is assumed to be true (Best &Kahn, 2003; Davis & Parker, 1997; Glatthorn & Joyner, 2005). Participants' knowledge about effective teaching and learning for this quantitative study was aligned with other quantitative studies conducted on students' perceptions of interpersonal teaching behavior and student achievement in biology (Henderson, Fisher, & Fraser; 2000; Lee & Fraser; 2003; Telli, den Brok, & Cakiroglu, 2007). Within the system theoretical perspective of communication, the basis for this study, I assumed that participants would mutually influence each other. The behavior of the teacher influences that of the students (den Brok & Cakiroglu, 2007). The majority of the studies on students' perceptions of interpersonal teaching behavior using the QTI were done at the elementary and high school levels. In those educational environments, students spend considerably more time with the same teacher compared to the tertiary level. The survey for this study was conducted with students who had successfully completed an introduction to biology course in the prior semester and enrolled in upper level biology courses. I assumed that the students would have spent enough time in a classroom situation with the instructor to provide an honest report of

their perceptions of the teacher's interpersonal teaching behavior. To ensure participants answered the survey questions openly and truthfully, privacy of all participants was assured and maintained. Additionally, participants were made aware that as volunteers they would have the opportunity to withdraw from the study at any time without adverse consequences.

Limitations of the Study

Limitations are conditions that cannot be controlled and potential weaknesses of the study (Best & Kahn, 2003; Creswell, 2003; Pajares, 2007; Patton, 2002). The limitations in this study were the small number of participants, utility of theoretical frameworks, quantitative research design, narrow use of achievement outcomes, and generalizability. The research was limited to a quantitative study conducted a one college and limited to students taking an introductory biology course. The theoretical frameworks were limited only to the communications methods used by a teacher to students in a biology classroom.

Small number of participants. This quantitative study involved only a selected small number of students from a large population of students taking an introduction to biology course in one suburban community college in a Mid-Atlantic state.

Utility of theoretical frameworks. This study focused on only the interpersonal communication between teachers and students in a single semester in a single day of a typical introductory biology class and how that communication influenced both the teacher and student behavior.

Sampling method. Purposive, nonprobability, convenience sampling method was used to select participants for this study. Because participants were nonrandomly selected, results from this study cannot speak for the entire population of students taking introduction to biology courses at the community college.

Narrow use of achievement outcomes. This study included only those achievement outcomes that were measurable. Students' responses to survey questions were compared with their final grade in introductory biology courses at a suburban community college in a Mid-Atlantic state.

Generalizability. Generalization of this study to other populations was restricted by the type of sample (convenience) used. Convenience sampling is a nonprobability sampling technique where subjects are selected because of their convenient accessibility and proximity to the researcher (Pajares, 2007). Participants were selected because they were willing and available to be studied (Creswell, 1998). Because convenience sample may not be a true representation of the population being studied, the results of the study cannot speak for the entire population of students taking introduction to biology courses at community colleges in this region.

Delimitations

This study was specifically limited to the interpersonal teaching behaviors occurring between students and teachers in introductory biology classes. To narrow the focus, this study delimited itself to surveying 318 students taking introductory biology in a large suburban community college in a Mid-Atlantic state. The study was further limited because the data were recorded from the perspective of the students only.

Previous research has shown that students produce data that are more reliable and valid than teacher self-report data (Wubbels, Creton, Levy, & Hooymayers, 1993). While the study supported the fact that teacher interpersonal teaching behaviors impact students' attitude, the study did not make any claims regarding the causal nature of this relationship. Because it is very likely that positive attitudes may have an effect on teachers' interpersonal behavior as well, other types of analyses will be needed in future research to provide more insight on this issue.

Significance of the Study

A quantitative study of the effect of teacher interaction and student achievement in introductory biology in a suburban community college was significant because it contributed to the body of knowledge needed to address the problem of inadequate teacher-student interactions in undergraduate introductory biology classrooms and its link to poor student performance these courses. Community college classrooms are becoming more socially and culturally diversified, so understanding students' different perceptions about science learning and teaching would provide educators with valuable information that can be used to improve instruction and learning.

Application to a Local Problem

In the United States, more than 40% of students in undergraduate institutions attend community colleges (Cohen & Brawer, 2003; Kisker & Outcalt, 2005; Mellow & Heelan, 2008). While much is known from research studies about the demographic profile of students in these colleges (Chen, 2009; Moltz, 2008; Phillippe & Sullivan, 2005), research focusing on community college classroom practices and student

perceptions of teaching and learning, including factors that influence faculty interpersonal teaching style, has been lacking (Cohen & Brawer, 2003; Isaac & Boyer, 2007; Outcalt, 2005; Sperling, 2003). The results of this research study will contribute to current research on teaching and learning processes in community college classrooms from the prospective of students.

A study of the relationship between students' perceptions of interpersonal teaching behaviors and student achievement is very important for science educators as well as for other disciplines (Callahan, Clark, & Kellough, 2002; Fraser & Fisher, 1982; Telli et al., 2007). This study is important because it represents one of only a few studies in the United States that have focused on the science learning environment at the college level. The results of this study of instructor-student interaction in community college introductory biology classrooms help clarify the nature, level, and patterns of instructor-student interactions that are needed at the undergraduate level to increase student achievement. This study provided information that instructors can use to modify their interactions with students in order to cater more adequately to their learning needs. Arends (2001) stated that establishing authentic relationships with students is a prerequisite to everything else in teaching.

Professional Application

This study provided important useful information to the community college where the data were gathered that can be used to advance new strategies for improving classroom practices, management, and administration policies for introductory biology courses. The results of the study also offer a road map to other community colleges in the

region regarding improved student outcomes in introductory biology courses. Teachers are crucial to student perceptions of learning, inhibiting or facilitating student learning (Pekel et al., 2006). The outcomes of the study help to build more positive teacher–student relationships by improving the level of interactions.

Implications for Positive Social Change

Walden University (2006) defined positive social change as a deliberate process of creating and applying ideas, strategies, and actions to promote the worth, dignity, and development of individuals, communities, organizations, institutions, cultures, and societies. This study applies to Walden University's definition of social change in that the study addressed strategies and ideas of best practices in teaching to affect students' achievement and perceptions of science. As classrooms become more socially and culturally diversified, understanding students' different perceptions about science learning and teaching would provide educators with valuable information they can use to improve instruction and learning.

According to data from a national profile of community colleges (Phillippe & Sullivan, 2005) as well as a survey of American community colleges (Cohen & Brawer, 2003), the demographic breakdown of students at the suburban community college chosen for this study closely resembled that of similar community colleges throughout the United States. The findings from this study therefore may have applicability nationwide.

The study will contribute to positive social change for students and faculty by providing current research data that can be used to guide and encourage administrators to

support faculty development activities in pedagogy that will lead to increased student engagement, success, and retention in science majors not only in the community college where the study was conducted, but also in suburban community colleges in the United States.

Summary

The problem of inadequate teacher-student interactions in undergraduate introductory biology classrooms has been linked to poor student performance, resulting in fewer students pursuing advanced degrees and careers in life science (National Science Board, 2008; Wood, 2009). In a study of active learning in undergraduate biology classrooms, Taraban et al, (2007) found that classrooms in which the teacher acted as a facilitator, creating the learning conditions in which students actively engage in experiments and interpret and explain data, increased student achievement and retention. According to Wood (2009), most college science classes, particularly large introductory courses, are not designed around the principles of active learning, and this could be one reason for the high attrition rates. The purpose of this quantitative study was to examine if there was an association between community college introductory biology students' perceptions' of interpersonal teaching behaviors and their achievement in introductory biology courses in a suburban community college. The conceptual framework, Leary's (1957) theory on interpersonal communication and the systems communication theory of Watzlawick, Beavin, and Jackson (1967) explained how interpersonal communication between teacher and students can increase students' achievement in biology and why building a positive relationship between the teacher and students is very important as it

helps students become more successful in the classroom. Operational definitions explained the educational technical terms used throughout the study. The assumptions, limitations, scope, and delimitations of the study were clearly defined. Finally, the significance of the study and its application to a local problem, professional application, and contribution to social change were explained. Section 2 will present, analyze, and summarize the literature related to completed studies of teacher-student interpersonal behavior and cognitive achievement in biology. Literature supporting the validation and reliability of the study instrument QTI will also be reviewed. Section 3 will present the research design used for the study. Section 4 includes data analysis and research findings, and Section 5 includes conclusions and recommendations for future research.

Section 2: Literature Review

Introduction

Researchers have linked inadequate teacher-student interactions in undergraduate introductory biology classrooms to poor student performance, resulting in fewer students pursuing advanced degrees and careers in life science (Doyle, 2002; National Science Board, 2008). The purpose of this quantitative study was to determine relationships between students' cognitive outcomes and the quality of teacher-student interactions among students taking introductory biology courses in a suburban community college in a Mid Atlantic State. This research was intended to identify which forms of interactions were likely to promote better student outcomes in introductory biology courses in order to identify ways in which the college can enhance the teaching and learning process of students in introductory biology courses. The research questions for this study were developed to determine if students' perceptions of teacher interactions in introductory biology courses affected student achievement.

Content and Organization of the Review

Given the nature of the study, the review included literature on the science learning environment and teachers' interpersonal behavior and its impact on student achievement in biology; literature on student perceptions of teacher-student interaction and cognitive outcomes; and literature on the instruments used to assess students' perceptions of teacher interaction. This basic search resulted in many good current and old articles dealing with the concept of teacher interaction, cognitive outcomes, and the science classroom environment. The classroom environment is a very important

determinant of learning outcomes (Fraser, 1994 & 1998); therefore, the factors that contribute to a good classroom environment were reviewed. Finally, literature on the theoretical frameworks, interpersonal communication theory by Leary (1957) and the systems communication theory by Watzlawick et al. (1967), were reviewed. Both theories deal with how humans communicate with each other and have been shown to be applicable to educational settings. The section concludes with a summary of literature related to the methods chosen for the study.

Strategy Used for Searching the Literature

In collecting literature for this study, I began with a search request using the Google Scholar search engine. The following key words were used in this search: *classroom environment, teachers' classroom behavior and student achievement in science, teaching strategies, interpersonal teaching behavior, teacher student interaction and student achievement*, and *student perceptions of teaching and learning*. This basic search retrieved many viable articles introducing the concept of teacher interaction and cognitive outcomes and science classroom environment.

Current peer-reviewed journals were used to retrieve literature related to the association between students' personal perceptions of teacher-student interactions and their effect on student achievement in biology. The literature reviewed in this section was compiled using multiple author and keyword searches in Academic Search Premier, Education Research Complete, and the Educational Resource Information Center (ERIC), as well as SAGE Online Journals relating to education. Search terms included *interpersonal teaching behavior, learning environment, effective teaching, student*

perceptions of teaching and learning, student achievement, community college education, and *community college students and faculty*.

I also obtained copies of texts examining the works of Leary and Watzlawick et al dealing with interpersonal communication theory, and other print sources addressing the process of conducting a quantitative study.

Literature on Communications Theories

The systems communication theory (Watzlawick et al., 1967) and Leary (1957) model of interpersonal communication are two theories describing how teachers and students interact in the classroom. Research studies on the science classroom environment have shown that when analyzing teachers' contributions to relationships with students, their behavior can be considered a form of communication (Santiboon & Fisher, 2005; Wubbels & Brekelmans, 2005). Wubbels and Brekelmans (2005) examined teaching from an interpersonal perspective in terms of the relationship between teacher and students. They reported that there are two elements central to this viewpoint: the communicative systems approach and a MITB. While the systems approach focuses on the pragmatic aspects of communication—that is, the effects on the other person involved—the MITB focuses on the interpersonal aspects of communication (Wubbels & Brekelmans, 2005).Teaching and learning styles are communicative behaviors that occur when teachers and students interact in a classroom environment. Teaching behaviors reveal the beliefs and values that teachers hold about the learner's role in the exchange (Heimlich & Norland, 2002). Communication is an important part of the social interaction that occurs in an educational setting. Thus, the effectiveness of the teaching

and learning in the school environment is determined by the quality of the communication process.

The Systems Communication Theory

The conceptualization of teacher-student interpersonal behavior in relation to education evolved partially from the systems communication theory of Watzlawick et al. (1967), who conceived classroom groups as continuing systems. A systems approach to communication is a rewarding theoretical framework of reference for studying teacher behavior (Kim, Fisher, & Fraser, 2000; She & Fisher, 2002; Wubbels, Creton, & Holvast, 1988).

This approach to communication was originally designed by Watzlawick et al. (1967) in the context of family therapy. Using this approach to study teacher behavior in the classroom implies that the behavior of a person is not just as a characteristic of a person, but rather the characteristic of a communication that an individual has with others involved in the process. Within the systems perspective on communication, it is assumed that behaviors of participants influence each other mutually. The behavior of the teacher both influences and is influenced by the behavior of the students (Wubbels, Brekelmans, & Hooymayers, 1991). The result is a circular communication process that not only consists of behavior, but also determines behavior (den Brok, Fisher, & Scott; 2005).

According to the systems approach, every form of communication has a content and relation aspect (Watzlawick et al., 1967, Wubbels et al., 2006), also referred to as the report and the command aspects of behavior (La France & Mayo, 1978, Wubbels & Brekelmans; 2005). The content conveys information or description; the relational aspect

carries instructions about how to interpret the content. Consequently, in a class, teacher and students often communicate in ways that are outside the subject matter (content). The systems approach to communication breakdowns communication into three distinguishable levels.

The lowest level. The message level consists of one single unit of behavior that has a content and relation aspect. For instance, the words, "I want to help you to learn," can be combined with either a smile or a frown. In the latter case, the interpersonal aspect of this communication may be perceived as: "I think you are too stupid to learn" (Wubbels et al., 2006, p. 3; Burgoon et al., 2006, Marshall & Weinstein; 1986). The content of a message conveys information with words, while the relationship level of communication "refers to what sort of message it is to be taken as, and, therefore, ultimately to the relationship between communicants" (Watzlawick et al, 1967, p. 50). That is, every communication reveals not only explicit information, but also highlights the implicit beliefs each communicant holds about the relationship by the way he or she presents information. The relational aspect of communication includes nonverbal behaviors such as facial expression and putting vocal emphasis on specific words. Research showed that, more often than not, relational information was more important than content (Brekelmans, den Brok, Bergen, & Wubbels, 2004; Craig, 2007).

There have been very few studies on students' perceptions at the message level. Tartwijk (1993) and Tartwijk, Brekelmans, Wubbels, Fisher, and Fraser (1998) reported studies where an instrument was used to measure students' perceptions of interpersonal messages. In both studies observers were trained to assume the role of students. These

observers viewed lessons that had been videotaped from the back of the classroom and gave their estimation of the students' perceptions of teacher behavior. Different fragments of the video showing the teacher in various situations were viewed by the observers. In one a teacher is writing on the blackboard with his back to the classroom, and some students are listening, whereas others are talking. Another example shows the teacher speaking angrily to a student who was hitting another student with the class looking on. The studies showed a non-significant correlation between the perceptions of the observers and the students who actually sat through the teaching.

The second level. The second communicative level is called an interaction which is a series of exchanged interpersonal messages is called an interaction. An example of classroom interaction occurs when the teacher asks a specific student a question, and the student ignores the teacher. The teacher responds to the silent treatment by asking another student the same question, without paying any further attention to the first student. The students in the class will recognize from this event that the teacher wants to avoid a confrontation with the first student. Therefore, they may expect that they can determine their own activities in this classroom without a very high risk of confronting the teacher.

The third level. Pattern level is the third and most extended level of communication. The longer the students and the teacher interact, the more their behavior becomes predictable, because their mutual expectations get confirmed and reconfirmed. The pattern level is important in describing the stable interpersonal relationships that determine the working atmosphere of classrooms. This study will focus on students' perceptions of this last level of interaction.

Because of the availability of reliable measuring instruments such as the QTI, more research studies have been conducted looking at the perceptions of teachers and students at the pattern level (den Brok, Brekelmans, & Wubbels, 2004; Zhu, 2010; Petegem, Creemers, Rosseel, & Aelterman, 2007). Brok, Brekelmans, and Wubbels (2004), in a study of the effectiveness of secondary education teachers' interpersonal behavior on learning outcomes found that interpersonal behavior explained more than half of the variance in student outcomes at the teacher-class level. The outcomes suggested that interpersonal behavior as perceived by students may be an important variable for educational effectiveness researchers (Brok, Fisher, & Koul, 2006, Zhu, 2010).

Many research studies of biology classroom environment consistently show that interpersonal communication between teacher and students increases student achievement in the subject by motivating students (Aydogan 2008; Corrigan & Chapman 2008; Elias 2006; Smart, & Marshal, 2012). Building a positive relationship between the teacher and students is very important because it helps students become more successful in the classroom.

Interpersonal Communication Theory

Interpersonal teacher behavior refers to the relationship between the teacher and his students and expressed in the interaction between the personal communications that occur in the classroom (den Brok, Fisher, & Koul, 2006; Wubbels et al., 1985). The interpersonal teaching behavior model (Wubbels et al., 1985; Wubbels & Creton, 1990; Wubbels et al., 1993) is predicated on the communication theory of Leary (1957). This

model is based on Leary's research on the interpersonal diagnosis of personality and its application to teaching (Wubbels et al., 1985). The Leary model has been investigated extensively in clinical psychology and psychotherapeutic settings and has proven effective in describing different facets of human interaction (Foa, 1961; Lonner, 1980, & Strack, 1996). Although not conclusive, there is evidence from numerous studies that the Leary model is cross culturally generalizable (Brown, 1965; Dunkin & Biddle, 1974; Lonner, 1980; Segall, Dasen, Berry, & Poortinga, 1990).

In the Leary model, two dimensions of interpersonal communications are important. Leary called them Dominance-Submission and Hostility-Affection. Even though these two dimensions have occasionally been given other names-for example, Brown (1965) used Status and Solidarity while Dunkin and Biddle (1974) used Warmth and Directivity-they have generally been universally accepted as descriptors of human interaction. The two dimensions have also been applied to education. Slater (1962) used these dimensions to describe pedagogical relationships and Dunkin and Biddle (1974) demonstrated their importance in teachers' efforts to influence classroom events. Robertson (2002) used two similar dimensions, assertiveness and cooperation, to describe classroom management behaviors.

Literature on Learning Environments

In the past three decades, more attention has been paid to the study of learning environment by researchers, teachers, and administrators. The conceptual view of environment in relation to educational settings refers to the atmosphere, tone, or climate that permeates the particular setting. It is a place where learners and teachers interact with

each using a variety of tools and information resources in their pursuit of learning activities (Fout & Myers, 1998; Mucherah, 2008). Even though classroom environment is an understated concept, significant progress has been made over the last 50 years to conceptualize, assess, and research into it (Fraser, 200, Telli, den Brok, Tekkaya, & Cakiroglu, 2009). Classrooms are specific places in schools where the outcomes of education, that is, teaching, learning and application of knowledge is achieved, and these places have a lot of influence on students (Fraser, 1981). Historically research on learning environments has focused on the psychosocial dimensions, which is the facet of the environment concerned with human behavior in origin or outcome (Boy & Pine, 1988). Many research studies of science learning environment have focused on areas such associations between classroom environment and outcomes, evaluation of educational innovations, differences between students' and teachers' perceptions of classrooms, comparisons of actual and preferred environments, and using environment instruments to facilitate changes in classroom life (Dorman, 2002; Fraser, 1998, Goh & Khine, 2002; Khine & Fisher, 2003). The outcomes of these studies have reinforced the view held by educators that the quality of the classroom environment is a significant determinant of student learning.

Students spend a vast amount of time in school classrooms during primary and secondary schooling. As a result the quality of life in these classrooms is of great importance and students' reactions to and perceptions of their school experiences are significant (Mucherah, 2008). Research studies in the United States and other countries suggest that classroom environments have significant influences on student outcomes

(Adeyemo, 2010; Allen & Fraser, 2002; den Brok, Ruurd, & Fisher, 2010; Dorman, 2003; Umo, 2010). Pierce (1994) found that classroom climates that were high in cooperation and cohesion were linked with a reduction of inappropriate behavior, an increase in attendance, and a reduction in the number of assignments not completed. In a similar study, students who perceived their classroom to be high in cooperation experienced significant academic improvement and positive attitudes toward school (Johnson et al. 1983). Adeyemo (2010) in a study of the impact of background and classroom correlates on students' achievement in physics found that there is a significant association between classroom correlates and students achievement in physics. The outcome of the study showed that classroom interactions have a significant impact on students' achievement in physics rather than family background. The result of this study is consistent with other studies showing that when the learning environment is made conducive, that is, adequate school physical resources, teacher quality and children's demographic and family background, the learners becomes willing to study, which increases motivation that culminates into good academic performance.

Haukoos and Penick, (1983 and 1985) described the effect of two specific classroom environments on the learning of science process skills and content achievement in college level biology classes. In the study two classroom climates were established and designated as discovery classroom climate (DCC) and non-discovery classroom climate (NDCC). The term discovery denotes the degree of freedom the teacher established in classroom interactions, both verbal and nonverbal. Verbal interactions were monitored with the Science Laboratory Interaction Categories. These

data indicate that students in the two classroom climates achieved equally as well on learning of biological content of the course, but students in the discovery classroom climate achieved significantly higher scores in science process skills as measured by the Welch Science Process Inventory. In addition, the discovery climate facilitated the development of science process skills which were significantly better than the comparison class.

Student Perceptions About Learning

Allport (1966) defined perception as the way individuals' judge or evaluate others with whom they are familiar in everyday life. Eggen and Kauchak (2001) described the cognitive aspect of perception as the process by which people connect meaning to experiences. That is people go to certain stimuli in their sensory memories, and processing continues with perception. Perception is important because it influences the information that enters working memory. Student perceptions are thoughts, beliefs, and feelings about persons, situations, and events (Adediwura &Tayo, 2007; Schunk, & Meece, 1992). Prior to the1990s; very little consideration was given to the study of students' perceptions even though the practice of seeking a student's perception of instruction was introduced into higher education in North America in the mid-1920s (d'Apollonia & Abrami, 1997). The desire by educators clarify the correlation between effective teaching and learning outcomes in higher education has led to the acceptance and recognition that seeking students' perceptions may provide important information on teaching and the learning interaction in the higher education classrooms (Akey, 2006; Delaney, Johnson, & Treslan, 2010; Akoyunlu & Soylu, 2008; Payne &Wagner, 1998).

The call for shaping students' perspectives in education was recognized in the works of Bloom (1983), Combs (1982), Sizer 1992, and Marjoribanks & Mboya, 1997. Bloom (1983) said that student's motivation to learn new tasks is an affective characteristic. Combs (1982), described the affective domain as being an important component of the education process. Combs also said that good education cannot be achieved without addressing both the cognitive and affective domains. Affective factors involve the individuals' feelings and emotion towards a given set of circumstances or conditions. Examples of these factors include students' attitude towards their learning environment, motivation to learn, how they interact with one another and the relationships they share with their significant others, particularly their parents and teachers (Marjoribanks & Mboya, 1997). Sizer (1992) said that educational goals will vary as students themselves vary, and that learning should be personalized to the maximum feasible extent. Darling-Hammond (1996) wrote that the job of a teacher is complex and one skill they cannot afford to be without is the knowledge of the way students think and perceive learning. According to Schunk (1997), perceptions can assist teachers by showing how students think, which is helpful for teaching. These studies highlight the importance of seeking students' perceptions of their educational environment and its usefulness in modifying and improving the quality of educational environment.

Goodlad (1984) and Schneider (1996) in two independent studies noted that students' perceptions about learning are rarely sought, and students rarely make decisions about their own learning. Barell (1995) in describing the standard for effective learning

said that students; are in charge of their own learning essentially, directing their own learning processes. Aregbeyen (2010) investigated and analyzed students' perceptions effective teaching and effective lecturer characteristics. The study explored 35 critical teaching effectiveness elements organized into five major sub-headings that included analytical/synthetic approach, organization/clarity of teaching, lecturer-group interactions, lecturer-individual student interaction and dynamism/enthusiasm of the lecturer. In conclusion Aregbeyen wrote "effective teaching requires a lecturer to strike a good balance between his teaching methodology and his personality characteristics" (p.1). Beane (1993) said that the missing link in educational reform efforts at all levels is student perceptions. Beane concluded that suitable curriculum must begin with relevant, accurate, and up to date knowledge students' perceptions of effective teaching and learning. It is clear from the literature that educators should reconsider their view of the learning process in order to change students sense of alienation over what is happening to them academically (Adediwura & Tayo, 2007; Oerlemans & Jenkins, 1998).

In the last three decades there has been a gradual, but significant, increase in the number studies on the subject of student perceptions. More educational researchers are now attempting to study students' perceptions of the classroom learning environment than at any other time in the history of American education (Fraser, 1998). Recently, Giles (2009) investigated college students' perceptions about their workload and their academic performance. Johnson and Johnson (2006) sought to understand the relationships between college student perceptions of classroom climate and academic achievement. Brok, Fisher, Rickards and Bull (2006) examined factors that influence

Californian students' perceptions of their learning environment. Weglinsky (2003) analyzed teachers' classroom practices (teacher input and characteristic practices) and its impact on students' academic performance. Campbel, Smith and Boulton-Lewis et al (2001) considered students' approaches to learning in regard to their teachers' approaches to teaching. Marchant, Paulson, and Rothlisberg (2001) studied student perceptions of family and school and how these perceptions affected academic achievement. One common theme that permeates all these studies is that the climate of any learning environment is an important component of the educational experience. Learning environments are constructed by interactions that take place within a classroom between a teacher and students. It is within this environment that the foundation of learning transpires. In conclusion, student learning according to Wenglinsky (2003) is a product of the interactions that occur in the classroom between students and teachers, and both parties play a part in this interaction.

Cochran-Smith (2003) writing about the unforgiving complexity of teaching reminded educators of the complexity involved in teaching and the mishap we create by attempting to over-simplify descriptions of the process. The intent of this study is not to oversimplify effective teaching and learning in Community College introductory biology classrooms. Effective teaching is defined in this study as simply *the ability to help students learn effectively*. The focus of this study is on the impact of students' perceptions of effective teaching in community college introductory biology courses on student achievement.

Teacher-student Relationships and Student Achievement

Many research studies have shown that when students experience a sense of belonging at school and supportive relationships with teachers and classmates, they are motivated to participate actively and appropriately in the life of the classroom (Anderman & Anderman, 1999; Birch & Ladd, 1997; Skinner & Belmont, 1993). Although the vast majority of the research on social relatedness and engagement has been conducted with students in Grades 3 and higher, recent research suggests that children's social relatedness in the primary grades may establish patterns of school engagement and motivation that have long-term consequences for their academic motivation and achievement beyond grade school (Furrer & Skinner, 2003; Hamre & Pianta, 2001; Ladd, Birch, & Buhs, 1999; Stipek, 2002).

Many research studies looking into the impact teacher-student relationships have on student achievement have found that this variable has a significant influence on student achievement. According to Klem and Connell (2004), students need support from their teachers in order learn what effectively. Montalvo, Mansfield, and Miller (2007) said that teacher traits serve as strong indicators of students' like or dislike for school. Borich (2000) wrote, "A teacher who is excited about the subject being taught and shows it by facial expression, voice inflection, gesture, and general movement is more likely to hold the attention of students than one who does not exhibit these behaviors" (p. 25). Hallinan (2008) stated that when teachers meet students' needs to be valued and respected, their attachment to school increases.

In the past decade the use of data has become more central to how many educators evaluate their practices and monitor students' academic progress due to increasing pressure from federal, state, and local education policy makers to improve student achievement (Aarons, 2009, Sanders, 2000). Student achievement is typically in practice measured using standardized tests (Armrein & Berliner, 2002; Bastera, 1999; Dorn, 2003; Haydel & Roser, 2002). Using standardized tests to measure student achievement are questionable (Ballard & Bates, 2008; Bassett, 2002; Zwick, 2002). Research studies looking at the impact of standardized testing on learning outcomes have shown that it actually debilitates many students (Hamel & Hamel, 2003; Glass, 2003; Stiggins, 2002). There are many factors other than instruction that can influence how students perform on standardized tests. Motivation and responsibility of the individual student, socioeconomic status and parental level of education as well as the home/family background have been found to be uncontrollable factors in the classroom where standardized tests are used as the main measure of student achievement (Ballard & Bates, 2008). Glass (2003) called for a re-examination of assessment with great emphases on formative assessment and how assessment might improve student learning.

Standardized high-stakes tests limit the scope of the classroom instruction and student learning in undesirable ways (Stecher & Barron, 1999). Cankoy and Tut (2005) conducted a study to determine if there is correlation between students' performance on non-routine math story problems and how much class time they spent on taking skills. In the study one group spent 70% of class time on test-taking skills, a second group spent 50% of class time on test-taking skills, and a third group only spent 30% of class time on

test-taking skills. Test-taking skills in the study included completing test questions from former tests, giving tests for drill, teaching procedures for answering multiple-choice questions, and memorizing rules. The study found that there was no correlation between the amount of time and students performance. The study also found that there was no difference in the three groups' performances on non routine math story problems, and spending more class time on test-taking skills did not affect the non routine story problem solving.

In community colleges students taking developmental courses have to take standardized tests before placement regular credit courses. There is controversy over whether these tests reflect classroom instruction and student learning. Popham (2005) said that because these tests are one size fits all and test items are not always aligned with instruction, there is a mismatch between what is taught and what is tested. According to Vandevoort, Amrein-Beardsley, and Berliner (2004) the quality of a teacher in the classroom is the single most important factor in determining how well a child learns. Classroom environment research indicates that student perceptions can mediate the relationship of teacher behaviors to student achievement, thus reinforcing the notion that teaching can influence student perceptions, which in turn affects student achievement (Klem & Connell, 2004; Wubbel & Brekelmans, 2005; Schunk, 1992; Stronge, Ward &Grant, 2011). According to Klem and Connell (2004), student achievement increases when students feel that teachers are caring and that they are participants in a classroom where expectations are appropriate, fair and clearly communicated.

Literature on Interpersonal Teaching Behavior

Teaching is a complex activity that is affected by many factors such as classroom environment, subject matter, time availability, teacher character, learner disposition and availability of resources. Classroom environment from an interpersonal perspective on teaching according to Williams and Burden (1997), concerns creating and maintaining a positive, warm classroom atmosphere conducive to learning. The focus is on the relationship between students and teachers in terms of the direct and an indirect influence on students and the impact the contribution has on learning environment. Many studies have found that teaching behavior, teaching styles and student perception of the learning environment is related to student learning outcome (Bennet, 1976; Brophy & Good, 1986; Fraser et al., 1991; Houser & Frymier, 2009). The contribution made by teachers to students has been studied mainly in terms of imparting knowledge within the instructional framework (Galbo, 1984). Wang, Haertel, and Walberg, (1998) wrote that teachers not only impart knowledge and skills to students, but also serve as confidants and role models When students develop strong and meaningful relationships with their teachers, they not only identify with the school but also with their teachers (Nieto, 2000). According to Nieto, when students have frequent opportunities to interact socially with teachers it enhances their sense of belonging. While instructional methodology is an important consideration, exceptional teaching can also be described in terms of teacher-student relationships (Wubbels, Levy, & Brekelmans, 1997). Teacher interpersonal behavior is a major component of classroom management (Doyle, 1986). Positive teacher-student relationships and a positive classroom environment promote improved

student outcomes and are worthwhile process goals of education (Fraser& Walberg, 2005). Research on teacher-student interaction is not only of interest to educational researchers, but also to policy makers who wish to improve student outcomes through positive teacher-student interactions (Fraser & Walberg, 2005). Teacher behaviors have both direct and indirect influence on students and as a result they contribute to the learning environment of students. Many studies on science classroom environment show that teaching behaviors, teaching styles and student perceptions of the learning environment are related to student learning (den Brok, Fisher, & Koul, 2007; She, & Fisher, 2002; Wubbels, & Brekelmans, 2005).

The relationship between students and teachers is an important dimension of class climate (Moos 1979). According to Moos there are three dimensions of classroom atmosphere. The three dimensions are relationships within the classroom, personal development and goal orientation, and maintenance and changes within the system. From an interpersonal perspective, the first dimension is the focus of this study. This dimension focuses on the nature of the personal relationships within the classroom, specifically the support that a teacher offers his students. Based on these three dimensions, Maslowski (2003) described class climate as 'the collective perceptions of students with respect to the mutual relationships within the classroom, the organization of the lessons and the learning tasks of the students' (p. 2). That is the relationship between students and teachers is very much related to the classroom climate.

Teacher behavior influences that of students, and the behavior of students influences that of the teacher. In the classroom, the effects of this circular communication

process can lead to the creation and maintenance of a good classroom climate, and the behaviors that determine the quality of relationships and feelings (Georgiou, & Kyriakides, 2012; Petegem, Creemers, Rosseel, & Aelterman, 2007). The link between teacher behavior and student behavior suggests that teachers can benefit directly from knowing how their interpersonal behavior affects student behavior (Taylor & Parsons, 201; Wubbels & Levy, 1993). The classroom environment is very complex, and will require multiple perceptions to get a comprehensive image of the education process. Because perceptions are the result of an interaction between the person and his environment, they show how someone experiences a classroom situation.

Students and teachers spend a considerable amount of time in a formal school setting. Research studies show that teacher's behavior, when interacting with students, have a considerable impact on the nature of learning environment that is created (Brok, Brekelmans & Wubbels, 2004; Marzano, 2003; Nye, Konstantopoulos, & Hedges, 2004; Wubbels, & Brekelmans, 2005). According to Marzano (2003), teachers' actions in classrooms have twice the impact on student achievement as do school policies regarding curriculum, assessment, staff collegiality, and community involvement. In a meta-analysis study of more than 100 studies, Marzano, (2003) found that the quality of teacher-student relationships is the keystone for all other aspects of classroom management. According to Marzano, teachers who had high-quality relationships with their students had 31 percent fewer discipline problems, rule violations, and related problems over a year's time than did teachers who did not have high-quality relationships with their students.

QTI

The modern era of classroom environment research began with independent research agendas of Moos and Walberg in the USA in the 1960s and 1970s (Dorman, 2002). Since then, many instruments have been developed and used to conduct research focusing on the classroom environment. To describe the perceptions students have of teacher-student interpersonal behavior in the classrooms, Wubbels et al. (1985, as cited in Wubbels & Levy, 1993) developed a model for interpersonal behavior by applying the Leary (1957) general model for interpersonal relationships to the specific context of education. The Leary model has been extensively investigated in clinical psychology and psychotherapeutic settings (Strack, 1996). It has been proven and accepted as a complete model for describing interpersonal relationships (e.g., Foa, 1961; Lonner, 1980). The Leary model has two important dimensions. Leary called them the Dominance-Submission axis and the Hostility-Affection axis. While the two dimensions have occasionally been given other names, - Brown (1965) used Status and Solidarity, Dunkin and Biddle (1974) Warmth and Directivity - they have generally been accepted as universal descriptors of human interaction. The two dimensions have also been easily transferred to education. Slater (1962) used them to describe pedagogical relationships, and Dunkin and Biddle (1974) demonstrated their importance in teachers' efforts to influence classroom events.

Wubbels et al. (1993) relying on the Leary Model, developed the MITB and subsequently designed the QTI in the early 1980s. The original version of the QTI was in Dutch and it had 77 questions. An American version of the QTI was developed which

had 64 questions. The Australian version of the QTI contains 48 questions that are answered using a five-point response scale (Wubbels, 1993). Teacher behavior is mapped on a Proximity dimension [Cooperation or Opposition] and on an Influence dimension [Dominance or Submission] to form four quadrants. These are then divided into a total of eight sectors, each describing different behavior characteristics that a teacher may exhibit.

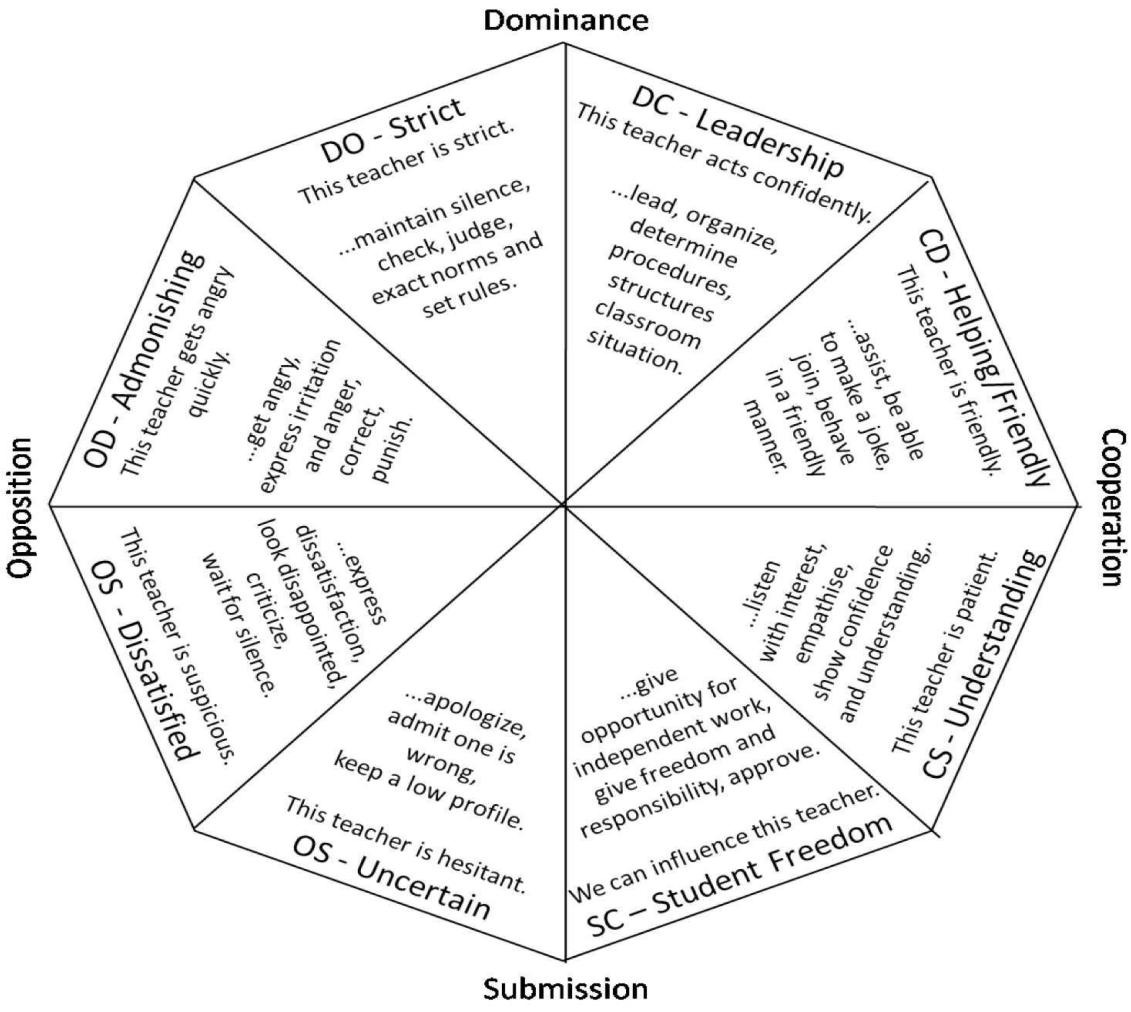

Figure 1. The model for interpersonal teacher behavior. From (Wubbels & Levy, 1993). Used with permission.

Since its development, the Questionnaire on Teacher Student Interaction (QTI) has been extensively used and accepted as a reliable research instrument. Wubbels and Levy (1993) reported the acceptable internal consistency reliabilities for the QTI as ranging from 0.76 to 0.84 for student responses. Research in the USA (Brok, Levy, Rodriguez, & Wubbels, 2002; Brok, Levy, Wubbels, & Rodriguez, 2003; Levy, Brok, Wubbels, & Brekelmans, 2003; Levy, Wubbels & Brekelmans, 1992; Wubbels & Levy, 1993) and in Australia (Fisher, Fraser, & Rickards, 1997; Henderson, 1995; Rawnsley & Fisher, 1997; Rickards, 1998; Rickards & Fisher, 1997; 2000) has shown that several student, class and teacher characteristics are related to students' perception of their teacher. Among these associated characteristics are student and teacher gender, student and teacher ethnic background, socio-economic status, attitude and achievement, age, teacher experience and subject taught.

Literature on Community College Education

Mission and Purposes of Community Colleges

According to the 2007 report of the American Association of Community Colleges (AACC) and Chen (2007), community colleges are diverse institutions that serve a wide variety of needs. These include the students who come to upgrade their skills for a particular job, students who are pursuing an associate degree to transfer to a 4-year institution and students who come to pursue a hobby (such as learning a language). The educational outcomes of community college students reflect this diversity. Vaughn (2006) described community colleges as centers of educational opportunity. They are an American invention that put publicly funded higher education at close-to-home facilities,

beginning nearly 100 years ago with Joliet Junior College. Since then, they have been inclusive institutions that welcome all who desire to learn, regardless of wealth, heritage, or previous academic experience (AACC, 2007).

The community college's mission is the fountain from which all of its activities flow. In simplest terms, the mission of the community college is to provide education for individuals, many of whom are adults, in its service region (Vaughan). According to AACC (2007), most community college missions have basic commitments to:

- serve all segments of society through an open-access admissions policy that offers equal and fair treatment to all students
- provide a comprehensive educational program
- serve its community as a community-based institution of higher education
- teaching
- lifelong learning

Bailey & Morest (2004) said that community colleges are a vital part of the postsecondary education delivery system. They serve almost half of the undergraduate students in the United States, providing open access to postsecondary education, preparing students for transfer to four year institutions, providing workforce development and skills training, and offering noncredit programs ranging from English as a second language to skills retraining to community enrichment programs or cultural activities.

Community College Students

According to current data from the American Association of Community Colleges and Community college survey of student engagement, the typical college student no

longer is an 18 to 24-year-old, living on campus and attending one school full time in the United States. In fact, that description applies to only one in six undergraduate students in the United States (AACC, 2011, CCSSE, 2010). Most community colleges in the United States have an open-door admission policy designed to provide education for all. Because of their open access admission policies and low tuition costs, community colleges attract a higher proportion of low-income and minority students than four-year institutions (Mellow & Heelan, 2008; Saenz, 2004; Zeidenberg & Bailey, 2010). The open-door policy provides access to college for low-income, immigrant, and first-generation college students. The average tuition in 2007 was about $2,500 a year, less than half the average tuition for public four-year institutions (AACC, 2011). Many studies have shown that lower tuition increases college enrollment (Long, 2009; Zeidenberg & Bailey, 2010). According to the National Science Board 2012 report, enrollment in U.S. institutions of higher education at all levels rose from 14.5 million students in fall 1994 to 20.7 million in fall 2009, with most of the growth occurring in the last 10 years. According to the NSB report 8.2 million or 40% of all students were enrolled in community colleges. These colleges serve diverse groups of students with lower college attendance rates in past generations. About 45% of all minority students in the U.S. attend a community college (AACC, 2010; Karp, 2008; Mellow & Heelan, 2008; Quigley & Bailey, 2003). Majority of community college students are not traditional. Over 60% of the credit students in community colleges are enrolled part time and majority of these students work full time or part time. Community colleges enroll many adult students and the average age of a community college student is 29, although a large fraction — 43 percent — are age 21 or

younger. Sixteen percent are age 40 or older. Most (60 percent) are women; 35 percent are minorities, and 39 percent are members of the first generation in their family to attend college (AACC, 2010). Even though diversity exists in age, gender, race, ethnicity, and academic preparation, critics have stated that "higher education has been slow to take diversity into account in the teaching/learning process" (Barrington, 2004, p. 425).

Many research studies on diversity in today's classrooms have concluded that people of different ages, gender, race, and culture have different needs in the classroom and that different people learn differently (Cohen & Brawer, 2003; Jones, Reichard, & Mokhtari, 2003; Mellow & Heelan, 2008; Milliron & De Los Santos, 2004; Mupinga, Nora, & Yaw, 2006). To meet the needs of these students, many community colleges have found that modifying existing general curriculum is an effective way to create more accessible learning environments to support all students and their teachers in various educational contexts. The curriculum modification involves change to a range of educational components in a curriculum, such as content knowledge, the method of instruction, and student's learning outcomes, through the alteration of materials and programs (Bailey, Jaggars, & Jenkins, 2011; King-Sears, 2001; MacMackin & Elaine, 1997; Reisberg, 1990).

As more students from diverse backgrounds populate 21st century classrooms, efforts to identify effective methods to teach these students and the need for pedagogical approaches that are culturally responsive intensify. To meet this challenge, teachers must employ not only theoretically sound but also culturally responsive pedagogy. To be successful teachers must create a classroom cultural environment where all students,

regardless of their cultural background, are welcomed, supported and provided with the best opportunity to learn. Because community college students have different needs in the classroom, there is no agreement in terms of which specific teaching and learning theories or any one method that a teacher should teach or be trained to ensure student learning. It is important that faculty be continuously trained on the latest teaching methodologies to increase student success.

In many community colleges, policies and services were developed and implemented based on the old profile of a "traditional" community college student, defined as white, male, and between 18-24 years of age (Jones et al., 2003). Community college students are now older than the traditional student and the number of female and minority students is increasing. Majority of community college students do not live on campus and many do not attend full-time. Teacher-centered strategies based on the traditional student are less applicable at community colleges today due to the diversity and uniqueness of their student population (Mellow & Heelan, 2008; Saenz, 2004).

Community College Faculty

Approximately one-third (31 percent) of the American professoriate teach at the nation's 1,449 community colleges ("Almanac," 2005, Huber, 1997; National Center for Postsecondary Improvement, 1998). "Community college faculty receive scant attention from postsecondary researchers--or worse, are simply dismissed as a separate, and by implication lesser class of college professors" (National Center for Postsecondary Improvement, 1998, p. 43). Even though this statement is more than 10 years old, it still holds true today, with few exceptions. What is intriguing about the neglect of community

college faculty members in the research literature and the lack of respect they often receive is that their numbers alone suggest they should at least merit attention. As of fall 2003, 43% of all full- and part-time faculty members in public, nonprofit higher education institutions were in public community colleges ("Almanac," 2005). In addition, community college faculty members teach around 37% of all undergraduates, including about half of all freshmen and sophomores. Among these students are more than half of all Hispanic and American Indian students and approximately 40% of African American and Asian students ("Almanac" 2005).

In reviewing literature, a clear demographic picture of community college faculty members, both full- and part-time emerges from the literature. The data consistently indicate that 80% of the community college faculty is White, a higher percentage than might be expected, given the demographics of the student body (Townsend & Wilson, 2006). The community college professoriate is evenly split between men and women, thus making this group of faculty members more gender balanced than the faculty members in any other higher education sector (Townsend & Twombly, 2007a). It is somewhat more difficult to determine the average age of community college faculty members. Some studies have shown the average age of full-time faculty members to be 50 (Rosser & Townsend, 2006). Looking at age in another way, the U.S. Department of Education (2005) determined that approximately 36% were younger than 44, whereas 32% were between the ages of 45 and 54 and 22% were between the ages of 55 and 64; only 8% were older than 65

In the past two decades, reform efforts in teacher education has led to the introduction of new teaching styles, learning styles, and student-centered learning methods, all of which have led to increase in motivation and student learning (Campbell, 2009). Community college faculty like many of their colleagues in higher education institutions bring very little experience and training to the teaching dimension of their roles (Grubb 1999, Stahl, Simpson & Hayes, 1992). In many institutions support for teachers and teaching though professional development is limited. Increase in enrolment and cuts in budget have decreased time and resources available to encourage faculty to adequately learn new teaching methods and technology (Barrington, 2004; Eddy, 2007; Gerstein & Ragey, 2008; Huber, 2008; Sperling, 2003). Sperling (2003) wrote, even though the primary goal of the community college faculty is teaching, the lack of support is contradictory. Barrington (2004) stated that there is a lack of institutional commitment to make the necessary improvement of teaching to help their faculty fulfill their primary function.

Faculties in many community colleges are not trained as educators and arrive with little to no background in pedagogy and curriculum design (Grubb, 1999; Wagoner, 2008). Hence they lack the training in effective teaching strategies designed to increase learning and achievement. Community college faculty are generally hired for their expertise in a specific content area, and then learn about teaching and learning through mentoring, peer observation, collegial discussion, and their own prior educational experiences (Boettcher & Conrad, 2004). According to Pratt (2002), in order to improve teaching and learning faculty must understand what they do and why.

In post secondary institutions including community colleges, majority of faculty still use traditional lecture methods to impart the knowledge they believe that students need (Colbeck, Cabrera, & Marine, 2002; Howell, 2002). Colbeck et al., in a study of classroom practices in higher education classrooms found that more than three-fourths of faculty in their study were using lecture as their primary teaching method. Howell (2002) argued that this traditional approach to teaching often leads to student disinterest and passivity leading to early students' withdrawal from school. To meet the learning needs of a diverse student population, faculties in community colleges must modify their approach to teaching. Brown (2003, p.1) said "how educators select their teaching strategies and implement techniques is a function of their beliefs and values regarding the methods and can be modified to fit within the unique belief system of the educator". The choice of method whether traditional lecture, discovery-based learning or discussion should be a reflection of the faculty's teaching philosophy (Heimlich and Norland 2002). Therefore as teachers attempt to develop more flexible teaching styles, it is important that they are receptive to the idea of change, beginning with a change in their beliefs about the students' roles in the learning environment.

Literature Related to the Methods

Several research studies were examined and analyzed for this literature review and they included reading of various quantitative, mixed-method and qualitative research approaches. The final research design chosen for this study as well as the specific research questions and goals for this study evolved from review of current literature relating to research design and methodology (Creswell, 1998, 2003; Hatch, 2002,

Johnson, Onwuegbuzie, & Turner, 2007; Johnson & Christensen, 2004; Weimer, 2006; Yin, 2003 Creswell (2003) suggested that when designing research, one should take into account the epistemology that informs the research, the theoretical perspective behind the questions to be answered, the methodology or plan of action that links the methods to outcomes, and the techniques and procedures intended to be employed to collect data.

McMillan and Schumacher (1993, p. 479) defined qualitative research as, "primarily an inductive process of organizing data into categories and identifying patterns (relationships) among categories." This definition implies that data and meaning emerge "organically" from the research context. Qualitative researchers focus on the way people interpret and make sense of their experiences and the world in which they live (Atkinson, Coffey, & Delamont, 2001). Qualitative researchers in attempting to understand the nature and reasons for human behavior generally focus on a smaller sample by using a case study, interviews, focus groups, or observation. One drawback to qualitative study, however, is that the rich description makes it difficult to determine the generalizable themes (Trochim, 2008) and "lacks quantitative research's power to generalize" (Seale, Gobo, Silverman, & Gurbium, 2007, p. 283). Qualitative research crosses disciplines, fields, and subject matter and has an "interconnected family of terms, concepts" (Denzin & Lincoln, 2000, p. 2) surrounded by assumptions. According to Thomas (2003), the qualitative approach describes the characteristics of people using an interpretive naturalistic approach, such as case studies, interviews, or observations.

Creswell (2003) defined quantitative research as a strategy of inquiry using experiments or surveys to collect data. According to Creswell (1994), quantitative

research is a type of research that explains phenomena by collecting numerical data that are analyzed using mathematically based methods (in particular statistics). A quantitative approach is easily replicable by other researchers and can be generalized to other persons and places (Thomas, 2003). Quantitative research summarizes large amounts of data to enhance the applicability and generalizations of findings (Trochim, 2008, Johnson, Onwuegbuzie, & Turner, 2007). Additionally, a quantitative approach based on the numerical data and scientific approach leads to scientific predictions (Black, 2002). Trochim (2008) favored the quantitative research method because of its confirmatory and deductive nature.

There is a very narrow distinction between qualitative and quantitative approaches due to their overarching characteristics. Qualitative data is always quantitatively coded, and, similarly, qualitative measures such as perception, beliefs, and attitudes are quantified, "opening for new possibilities for interpretation and all quantitative data is based on qualitative judgment" (Trochim, 2008, p. 9). Thomas (2003) recommended blending qualitative with quantitative research methods in dissertations, arguing that both the methods complement one another. Creswell (2009) noted that in a mixed method approach, the researcher brings together the best of both the approaches. According to Creswell (2003), the mixed-method in which quantitative and qualitative techniques are mixed in a single study is an attractive alternative (when it is appropriate) to quantitative and qualitative research. The goal of mixed methods research is not to replace either of these approaches but rather to draw from the strengths and minimize the weaknesses of

both in single research studies and across studies (Johnson, Onwuegbuzie, & Turner, 2007).

The goal of this correlational quantitative research study is to examine whether relationships exist between students' cognitive outcomes and the quality of teacher-student interactions among students taking introductory biology courses in a suburban community college in Mid-Atlantic state by gathering and analyzing data of students' perceptions of teacher-student interactions. Quantitative methodology will be used to determine the statistical association between students' perceptions of teacher interactions and student achievement in introductory biology courses. According to Williams, & Monge, (2001), statistics in the quantitative method is a powerful tool for a descriptive study or to find answers to the research questions. The survey approach is preferred as it is an "easier, quicker, less expensive, or more accurate way for getting accurate, reliable, and valid" needed information to answer important questions (Alreck & Settle, 2004, p. 3). Schuman and Presser (1996) justified the continued used of the survey method because researchers can obtain information efficiently and because the survey method allows the sampling procedure to represent a relatively small number to a much larger population. Thomas (2003) recommended a quantitative study and the use of a grounded theory in it "to extract theory out of the collected information itself (p. 3).

Explaining phenomena is a key element of all research, be it quantitative or qualitative (Creswell, 2003). When people set out to do research, they are always looking to explain something. The type of questions asked in the study determines the choice of method. The type of questions asked in the study determines the choice of method.

Examples of research questions in educations are: “Does increase in the frequency of teacher interaction in a biology classroom increase student achievement?” or “What factors influence student achievement in learning biology?” All research methods have strengths and limitations. The benefit of quantitative method is that it totally eliminates bias. By encouraging researchers to keep a short distance from the participating subjects, the researcher can more easily overcome biases and make inferences and evaluations about the subject(s) of study thereby improving the overall quality of research (Creswell, 2003; Johnson & Christensen, 2004).

Summary and Implications

Section 2 began with a summary of problem statement, purpose and research questions, followed by an explanation of the content and organization of the review. The strategy used for searching the literature was described and an extensive review of literature relating to the study problem was fully discussed.

Systems communication theory and Leary’s interpersonal communications theory are two theories used to describe how teacher and students interact in the classroom. Literature review of the two theories traced their origin from clinical psychology to their subsequent adaptation to education. Integration of the two theories helped explain the importance of teacher-student interpersonal relations in science classrooms.

A summary of literature relating to student perceptions of classroom environment and student cognitive achievement was also presented. A brief history of survey research that sought student perceptions from the 1970s to the present was presented. The review showed how listening to students and their perceptions is an integral part of research

efforts to improve science teaching and learning outcomes in biology classrooms in all levels of education. Examples of studies that sought to improve learning environments by way of survey instruments such as Questionnaire of Teacher Interaction (QTI) was provided. A brief introduction to QTI provided an explanation of how the survey can be used as a means to classify responses provided by students.

Mission and purposes of community colleges followed by a demographic profile of community college student and faculty was presented. The demographic profile showed that community college students are very diverse with regards to age, gender and race. The profile help explain why community college faculty have to use different teaching styles in the classroom to meet the different learning styles of their student.

Implications for the study suggest that researchers continue to conduct studies to understand what specific teacher interpersonal classroom behaviors have the most significant influence on student achievement in biology. Student perceptions of what goes on in the classrooms will provide teachers with the information and tools to improve learning outcomes. While data from this quantitative study may not apply to other community colleges, the process will provide guidance to other community colleges interested in conducting a similar study. Section 3 will explain the methodology to be used in this quantitative study.

Section 3: Research Method

The purpose of this quantitative study was to determine the relationships between students' cognitive outcomes and the quality of teacher-student interactions among students taking introductory biology courses in a suburban community college in a Mid-Atlantic state. This study was also designed to establish whether teacher-student interaction variables associated with community college introductory biology instruction could predict students' academic success in biology. The teacher–student interpersonal interaction extends beyond the biology classroom and the school community. This study focused on interactions between teachers and students in a single semester in a single day of a typical introductory biology class. Rather than focusing on individual students, this study examined whole classroom interactions and how students who successfully completed introduction to biology courses had perceived them. I conducted this study with community college students' who took introductory biology courses during the academic year the study data were collected.

Inadequate student-teacher interactions in undergraduate introductory biology classrooms have been linked to poor student performance in introductory biology courses, resulting in fewer students pursuing advanced degree and careers in life science (Doyle, 2002; National Science Board, 2008; Wood, 2009). Research studies on student perceptions of teacher interactions in biology classrooms linked adequate teacher interaction to improved student performance in the subject (Blickenstaff, 2005; Nelson et al., 2009). The majority of these studies focused on the elementary and high school

levels. However, few researchers have examined the same problem at the tertiary level of education, particularly in community colleges in the United States.

I chose a correlational, quantitative methodological approach for this study. I used a survey instrument, the QTI, to collect data on students' perceptions of teacher interaction behaviors and their impact on achievement in introductory biology courses. The QTI was developed in the early 1980s in the Netherlands, relying on the Leary model for interpersonal teacher behavior (Wubbels et al., 1985). Since its development, the QTI has been extensively used and accepted as a reliable research instrument. The original version of the QTI was in Dutch and had 77 questions. Later, an American version of the QTI was developed that had 64 items (Wubbels & Levy, 1991). The Australian version of the QTI contains 48 questions on a 5-point response scale (Wubbels, 1993). A review on the validity and reliability of over 20 studies that have used the QTI at all levels of education (primary, secondary, and tertiary) during the last 20 years showed that reliability of the eight scales (sectors) is satisfactory and consistent across classes (den Brok, 2001). In each of these studies, the Cronbach alpha reliability for each scale was greater than 0.70 at the student level and greater than 0.80 at the class level. The internal consistencies (Cronbach's α) usually are above 0.90.

Creswell (2003) wrote "the main purpose of the survey approach is to generalize from a sample to a population so that inferences can be made about some characteristic attitude or behavior of this population" (p. 154). I used the survey approach to quantify students' perceptions of teacher interaction behavior. According to Creswell (2003), quantification of the perceptions helps the researcher in a quantitative study to establish

the relationship between variables. It was critical to understand the impact of teacher interaction behaviors from students' perspectives because this understanding would provide classroom teachers with important data that they can use to change their approach to teaching in order to increase student achievement. Students' learning, according to Wenglinsky (2003), is a product of the interactions that occur in the classroom between students and teachers, and both parties contribute to this interaction.

Description of the Research Design and Approach

I used a quantitative method with a correlational design for this research study to determine if teacher-student interaction had an impact on student achievement in introductory biology courses. According to Cook and Cook (2008), a quantitative study with correlational research design is useful in finding relationships among variables and describing a phenomenon. I chose a quantitative approach over other methods because it allowed me to identify a cause-and-effect relationship between the two variables of teacher interaction and student achievement from the perceptions of a large population of students who have taken introductory biology courses in a suburban community college. Other reasons for choosing quantitative method were that data generated often reveals measurements that provide meaningful information about the subject(s) of the study, and also statistics used in quantitative research allow for inferences and evaluations to be made about the subject(s) of study. Creswell (2003) noted that the choice of research approach depends on "research problem, personal experiences, and audience" (p. 23). The quantitative survey approach was most suitable for answering the research questions for this study because it was time efficient and cost effective. Several studies have used

the quantitative survey design to gather numerical data on students' perceptions of teacher interactional behavior in science classrooms (Creemers, Rosseel, & Aelterman, 2006; Crews, 2007; She & Fisher, 2002). Malmberg (2008) noted that a key approach for the success of the study is to develop an accurately designed research model.

This correlational quantitative research study was conducted in two phases. In the initial phase, I administered the anonymous survey to students (ages 19 to 45 years old) who took introduction to biology courses in a suburban community college in a Mid-Atlantic state and volunteered to participate in the study. The survey was used to gather data on students' perceptions of teacher-student interpersonal interaction behaviors and their impact on student achievement. I chose survey method because it allowed for a large population to be studied in a relatively short time frame. The survey method is an appropriate choice when the goal of the research and researcher is to "apply the findings beyond research participants and to influence policymakers" (Hesse-Biber & Leavy, 2006). Surveys provide descriptive data (Cook & Cook, 2008). The second phase of the study involved statistical analysis comparing the perceptions data to students' final grade which they self-reported on the survey form, to determine if there was a correlation between the two variables.

Setting and Sample

Description of the Population

The site for this study was a large suburban community college in a Mid-Atlantic state. According to data from Middle States Commission on Higher Education (2010), the college had a population of 26,425 students enrolled in credit courses on three campuses

and two extension centers. In any given semester, about 2,000 students are enrolled in introduction to biology courses across all three campuses and two extension centers. In terms of gender, 62% of the students are female and 38% are male. The racial breakdown is 49% White, 38% African American, and 13% other races. The age range of the students is 19 to 45 years. The population for this quantitative study was drawn from a population of about 2,000 students who had successfully completed introductory biology courses and volunteered to participate in the study.

Sampling Method

I used a single-stage purposive sampling method to select participants for this study from a population of about 2,000 students who take introduction to biology courses every semester at the college. Purposive sampling is a non-probability sampling method in which a researcher knowingly selects specific elements or subjects for inclusion in a study in order to ensure that the elements will have certain characteristics that is relevant to the study (Patton, 2002). The research questions answered by this study required input from community college students. The specific characteristics of the desired population were students who had successfully completed introduction to biology courses and were currently enrolled in other biology courses at the college.

For practical reasons, it was not possible for me to obtain a random sample of students for this study due to the large number of students enrolled in these courses, time constraints and the long distance between the three main campuses and the two extension centers that make up the community college where the study was conducted. The sample for this study was therefore drawn from two of the three main campuses. Babbie (1990)

wrote that this method is useful if a researcher wants to study "a small subset of a larger population in which many members of the subset are easily identified but the enumeration of all is nearly impossible" (p. 97).

Sample Size

The sample size for the quantitative study was 318 students who were non-randomly selected to participate in the study. The sample size was based on a sample size calculator (American Research Group, 2000), which recommended the size of the sample to be about 318, at a confidence level of 95% with a margin of error of 5% for a population size of 2000.

Eligibility Criteria for Participants

Eligibility criteria required that the participants be currently enrolled in the college and have successfully completed an introduction to biology course in the semester before data collection, and volunteered to participate in the study. This sample frame corresponded to the population I wanted to explore and describe because the participants had recently spent several months in a classroom setting with their teachers. The eligibility criteria therefore ensured that participants chosen for the study were qualified to provide an honest and objective evaluation of the nature of their interactions with their introduction to biology teachers including any effect it may have had on their success.

Characteristics of the Selected Sample

The participants in this study were first or second year students taking upper level biology courses at a suburban community college in a Mid-Atlantic State. Because

purposive non-probability convenient sample was used for this study, the characteristic description of the participants was generated from the demographic information they provided when they completed the survey. That information is included in the final summary of the study.

Instrumentation and Materials

The instrument used to collect quantitative data on students' perceptions of teacher interpersonal teaching behaviors is the QTI. The QTI was developed by Wubbels et al. (1985) specifically for evaluating teacher-student relationships in secondary classrooms. It focuses on the nature and quality of interpersonal relationships between teachers and students. The QTI was originally developed in the Netherlands, and a 64-item American version was also constructed in 1988 (Wubbels & Levy, 1991). The questionnaire for this study consists of 48 items on a 5-point Likert-type scale with options from 0 (*never*) to 4 (*always*). The items are divided into eight subscales including Leadership, Helpful/friendly, Understanding, Student responsibility/freedom, Uncertain, Dissatisfied, Admonishing, and Strict.

The eight subscales of the QTI describe the extent to which the teacher is perceived to have or demonstrate certain behavioral characteristics (Coll, Taylor, & Fisher, 2002; Fisher & Rickards, 1996). The eight subscales and the characteristics of each are described as follows:

Leadership items are designed to describe the extent, to which the teacher leads, organizes, gives orders, and determines procedures and structures in the classroom.

Helpful/friendly describes the extent to which the teacher shows interest behaves in a friendly or considerate manner, and inspires confidence and trust.

Understanding describes the extent to which the teacher listens with interest, demonstrates empathy, shows confidence and understanding, and is open with students.

Student responsibility/freedom items are designed to describe the degree to which the teacher provides opportunities for independent work and gives freedom and responsibility to students.

Uncertain describes the extent to which the teacher behaves in an uncertain manner and keeps a low profile.

Dissatisfied describes the degree to which the teacher expresses dissatisfaction, criticizes, and looks unhappy.

Admonishing describes the level at which the teacher gets angry, expresses irritation and anger, or forbids and punishes.

Strict describes the extent to which the teacher checks, maintains silence, and strictly enforces the rules.

Even though the strict dimension may be considered a negative trait, research indicates that students prefer teachers who are strict (Muller, Katz, & Dance, 1999). Fisher and Rickards (1996) indicated that students consider the best teachers to be those who are strong leaders, more helpful/friendly, and more understanding than the average teacher. Student responsibility/freedom was seldom mentioned as a significant factor in existing research.

Reliability and Validity of the Instrument

Several studies have confirmed the reliability and validity of the QTI (Brekelmans, Wubbels, & Creton, 1990; Creton & Wubbels, 1984; Wubbels et al., 1985). A review on the validity and reliability of over 20 studies that have used the QTI at all levels of education (primary, secondary and tertiary) during the last 20 years showed that reliability of the eight scales (sectors) is satisfactory and consistent across classes (den Brok, 2001). The review also showed that the theoretical configuration of the MITB was represented in the items and scales of the instrument. In each of these studies, the Cronbach alpha reliability for each scale was greater than 0.70 at the student level and greater than 0.80 at the class level. The internal consistencies (Cronbach's α) usually are above 0.90. Other strengths of the measure are its length, simplicity of the items, and ease of scoring. The questionnaire instructs students to respond to a statement on a scale with five choices, A through E, with A being *never* and E being *always*. The scoring guide indicates that items are scored as follows: 0 (*never*) to 4 (*always*). The subscale item scores are added and the sum is divided by the number of items to make a profile.

Because the instrument was used in this study without alteration, calculation of Cronbach's alpha reliability test to measure internal consistency, and determine the degree to which items in the same scale measure the same aspects of students' perception of teacher behavior was not necessary.

An external validity estimate confirmed the extent to which the perception of the 318 participants applies to all community college students in the Mid-Atlantic States. External validity refers to the extent to which a research result can be generalized to

beyond the sample used in the study (Burn & Grove, 2001). The external validity of a research project can be threatened by several factors, the Hawthorne effect, the type of sampling method used, and the validity of the research instrument. The Hawthorne effect is the behavior that is displayed by participants just because they are aware that they are involved in a study (Polit & Hungler, 1999). All students taking courses at the college complete an evaluation of their instructors every semester making this a less likely threat as the participants being upper level students have had more than one opportunity to participate in evaluation. A valid instrument measures the concept in question accurately (De Vos, 1998). In this study the validity of the measuring instrument has been found in several studies to be consistently valid, predictive and reproducible (Brekelmans et al., 1990; Creton & Wubbels, 1984; Wubbels et al., 1985). Because the instrument will be used in this study without alteration makes it a less likely threat. The most likely threat to external validity of this study is the sampling method. According to Polit and Hungler (1999), the type of sampling method used in a study affects the generalizability of the research result findings to the entire population, thereby threatening the external validity of the results. A non-probability convenient sampling method was used in this study and therefore the results obtained may not apply to other students taking introduction to biology in other community colleges in the Mid-Atlantic States.

Data Collection and Analysis

Data Collection

The data collection strategy chosen for this quantitative correlational study was the administration of a questionnaire. After fulfilling the requirements to obtain

university internal review board and college approval, I collected data from student participants who have successfully completed the introduction to biology course in a prior semester and enrolled in upper level biology courses. The rationale for choosing this group of students was based on the fact that it takes a number of lessons (weeks or months) for the students to develop ideas about their emerging relationship with their teacher (Telli, den Brok & Cakiroglu; 2007). Once students' ideas become stabilized, they can tell what kind of teacher they had. This gradual stabilization of perceptions applies equally to the teachers as well as to the students and once the tone is set, it is difficult to modify, and both students and teachers resist changes (Telli, den Brok & Cakiroglu, 2007).

The QTI, which is similar to a psychometric test on a 5-point Likert scale, was employed to measure students' perceptions. The participants were asked to rate each of the six items arranged into eight scales corresponding to the eight interrelated sections of the MITB on a 0-to-4 response scale (0 = *never*; 4 = *always*). According to McCall (2001), a properly developed Likert scale is a useful tool in "addressing the need to consider opinions and attitudes towards potential policy decisions" (p.1). The scale enabled the students to rate each of the variables in this study with a degree of certainty, as perceived by them. All data collection took place at the end of regular scheduled classes or laboratory sessions. The impact of the research on instructional time was minimal. Prior to data collection, all participants were given consent forms to review prior to completing survey. Completion and submission of survey was used as implied consent attesting to their agreement to take part in the study.

Data Analysis

This study was designed to test two hypothesized relationships, teacher interpersonal teaching behavior and effective teaching and learning. The main predictor variables were teacher characteristics, as measured by student ratings on each of the eight scales of QTI. The QTI is a survey instrument that looks at the nature of interactions between teacher and students at a classroom level. The items on QTI are intended to extract the perceived nature of the classroom environments from the perspectives of the students.

The appropriate level of analysis was the individual student because it is the individual students' perceptions of teacher's interpersonal teaching behaviors that were assessed by the QTI. I analyzed all data with the Statistical Analysis Package for the Social Scientist, version 22 (SPSS). Because I collected data in one interval, I tested the proposed hypothesis with Nonparametric Spearman's correlations to examine the relationships between student achievement (continuous grades) and the 8 interpersonal behaviors examined. Mann-Whitney U tests was conducted to examine differences in the 8 interpersonal behavior variables based on whether students scored high or low in the course. Nonparametric Spearman's rank correlations' was chosen because it allowed me to examine the strength of relationships between student grades and student perceptions of teacher interpersonal behaviors. Spearman Rank Correlation Coefficient is the recommended data analysis method because of its ability to identify and test the strength of a relationship between two sets of data. (Gravetter & Wallnau, 2005). In analyzing the

data, I was mindful of overestimation of the influence of interpersonal teacher behaviors on student achievement (den Brok, Fisher, & Scott, 2005).

To answer the first research question (How do students perceive of the interpersonal behaviors of the instructors of their introductory biology courses?), descriptive statistics were used to examine means, standard deviations, minima, and maxima for the 8 interpersonal behavior variables to determine how students perceive of their biology instructors. To answer the second research question (What is the relationship between students' perceptions of teacher interpersonal teaching behavior and student achievement in introductory biology courses?), I performed Nonparametric Spearman's correlations to examine the relationships between student achievement (continuous grades) and the 8 interpersonal behaviors examined. For Research Question 3, I performed Mann-Whitney U tests to examine differences in the 8 interpersonal behavior variables based on whether students scored high or low in the course.

Protection of Participants

Ethical Considerations

I made every effort to protect the rights and privacy of participants during all stages of the study, including data collection, data analysis and interpretation, as well as the writing and distribution of the research. According to the *Ethical Standards of the American Educational Research Association* (AERA), "It is of paramount importance that educational researchers respect the rights, privacy, dignity, and sensitivities of their research populations and also the integrity of the institutions within which the research occurs (American Educational Research Association, 2002, p. 3). Creswell (2003) wrote,

"As researchers anticipate data collection, they need to respect the participants and the sites for research" (p. 64). According to Creswell many ethical issues arise during this stage of research and therefore it is important not to put participants at risk, participation should be voluntarily and participants must be informed that they have a right to withdraw at any time. They should also understand the purpose and procedures of the study. Creswell also noted that permission of the individuals in authority at the data collection site must be gained to provide access to study participants prior to initiating data collection. I took several steps to secure the ethical protection of the research participants. All of the materials and the research design methodology used in this study were reviewed by the Institutional Review Board (IRB) where the study was conducted (See Appendix D for approval letter). This study was also approved by Walden University IRB, approval number 08-27-13-0123018. The IRB application described the objectives of the research study and the researcher's role. If additional questions and concerns of research procedures needed to be clarified, the researcher's contact information was given to the chairman, the committee members, and the IRB.

In other to maintain confidentiality and honest feedback from the students, participants remained anonymous because they were not required to identify themselves either by name or student identification number. All data collected are locked in a locked file cabinet and on a personal computer at the researcher's home and will remain there for five years after the dissertation is approved. I will have access to the collected data. I treated all participants in accordance with the ethical standards of the American Psychological Association (APA) and Code of Conduct (APA, 2001).

Role of Researcher in Data Collection

Data were collected in the form of paper surveys by me with the help of course instructors whose role was limited to distribution of survey. I performed all statistical analysis using Statistical Package for the Social Sciences (SPSS) software. I will personally be responsible for storing the generated statistical data in a locked file for five years, accessed solely by myself. Individual participants and the college where the study was conducted would receive upon request a copy of the cumulative results of this study.

Role of Researcher in Past or Current Professional Roles and Implications

I am currently a biology professor and I also teach two online sections of introductory biology courses every semester at the college where the study will be conducted. Because I have taught introduction to biology courses there is a possibility that some of the student participants may have taken the course with me. The College has three big campuses that were formally three independent Community Colleges merged into one college. Majority of students enrolled in the college take courses on the same campus during their tenure at the college. Therefore, in an effort not to compromise the findings and eliminate any issues related to bias, data was gathered from the two campuses where I do not teach. To maintain anonymity, student participants were not required to identify themselves either by name or student identification number on the survey. Student participants were not required to indicate on the questionnaire the name of the professor who taught them the course. The students were not interviewed and they self reported their final grade on the survey instrument. My role with data collection was strictly limited to handing out and collecting the anonymously completed survey

instrument. These efforts helped generate confidence in the accuracy of the results findings.

Summary

This quantitative research study investigated whether relationships exist between students' cognitive outcomes and the quality of teacher-student interactions among students taking introductory biology courses in a suburban community college in Mid-Atlantic state. This section addressed the methods and procedures I used in the study to determine if there is an association between the two variables in the study, teacher interaction and cognitive outcomes. I also included information relative to study sample, research design, instrumentation, data collection, and data analysis. In Section 4, I reported the research results. In Section 5, I made interpretations and drew conclusions.

Section 4: Results

The purpose of this correlational quantitative study was to determine the relationships between students' cognitive outcomes and the quality of teacher-student interactions among students taking introductory biology courses in a suburban community college. An additional purpose of the study was to examine whether teacher-student interaction variables associated with community college introductory biology instruction could be used to predict students' academic success in introductory biology courses. The QTI developed by Wubbels et al. (1985) specifically for evaluating teacher-student relationships was used to collect data on students' perceptions of teacher interaction behaviors and their impact on achievement in introductory biology courses.

Summary of Research Questions and Hypotheses

The following research questions and hypotheses guided this exploration:

Research Question 1: How do students perceive of the interpersonal behaviors of the instructors of their introductory biology courses?

For Research Question 1, the hypothesis is exploratory in nature, and no specific hypothesis is stated.

Research Question 2: What is the relationship between students' perceptions of teacher interpersonal teaching behavior and student achievement in introductory biology courses?

$H_0$2: Student perceptions of teacher interpersonal teaching behavior will not be related to student achievement.

$H_1$2: Students' achievement will be positively related to students' perceptions of teacher interpersonal behaviors in introductory biology courses. In other words, the higher students' grades are in the course, the more positively they will rate their teachers' interpersonal behaviors.

Research Question 3: Do student perceptions of teacher interpersonal behavior differ based upon student achievement levels in introductory biology courses?

$H_0$3: Students' perceptions of teacher interpersonal behavior will not differ based on students' achievement levels in introductory biology courses.

$H_1$3: High achieving students (attaining grades of As and Bs) will rate their teachers' interpersonal behavior significantly more positively than low achieving students (students receiving grades of Cs, Ds, and Fs).

The independent variable for this study was students' self-reported final grades and the dependent variables were students' perceptions of teacher behavior measured by the QTI (see Appendix A for complete instrument). The questionnaire for this study consisted of 48 items, each with a 5-point Likert-type scale. Options range from 0 (*never*) to 4 (*always*). The items are separated into eight subscales including Understanding, Leadership, Helpful/friendly, Student uncertain, Dissatisfied, Responsibility/freedom, Admonishing, and Strict. The research questions in this study addressed the relationship between students' cognitive outcomes and the quality of teacher-student interactions among students who took introductory biology courses in a suburban community college. This section will describe the sample, present an overview of the statistical procedures,

and report the findings related to each research question. Section 5 will present the interpretation of the findings.

Research Tool

The instrument used to collect quantitative data on students' perceptions of teacher interpersonal teaching behaviors was the QTI (Wubbels & Levy, 1993). The QTI was designed to evaluate teacher behavior inside the classroom, their communication with their students, and the diverse perceptions or responses to these communications. The theoretical frameworks were based on the conceptualization of teacher-student interpersonal behavior as partly having evolved from a systems approach to communication (Watzlawick et al., 1967), and the Leary-based model for interpersonal behavior. The QTI instrument evolved from the model for interpersonal behavior developed in 1993 by Wubbels et al. (Lourdusamy & Swe-Khine, 2001). The QTI (Wubbels & Levy, 1993) used in this study contained 48 items aligned to eight domains: Leadership, Understanding, Helpful/friendly, Dissatisfied, Admonishing, Strict, Uncertain, and Student/responsibility/freedom. The 48-question, Australian version, which uses a 5-point Likert scale, was used for this study with no modification. Because no adjustments or modification were made to the instrument, there was no need to determine validity and reliability of the instrument because several studies have confirmed the reliability and validity of the QTI (Brekelmans et al., 1990; Creton & Wubbels, 1984; Wubbels et al., 1985).

A review on the validity and reliability of over 20 studies that have used the QTI at all levels of education (primary, secondary, and tertiary) during the last 20 years

showed that reliability of the eight scales is satisfactory and consistent across classes (den Brok, 2001). In each of these studies, the Cronbach alpha reliability for each scale was greater than 0.70 at the student level and greater than 0.80 at the class level. Because the instrument has been found to be consistently valid and reliable, the findings in this study were consistent with other studies done with this instrument (Brekelmans et al., 1990; Creton & Wubbels, 1984; Wubbels et al., 1985). Permission to use the instrument was requested and granted (see Appendix B for the approval letter).

I collected data that were used to statistically determine the relationship between students' perceptions of teacher interpersonal teaching behaviors and cognitive outcomes. Both descriptive and nonparametric measures were used to answer the research questions in the study.

Characteristics of the Sample

The population for this study included first- or second-year students who had successfully completed introductory biology courses and were currently enrolled in upper level biology courses at a suburban community college in a Mid-Atlantic state. I collected the data after permission to collect and use the data was granted by the IRB of Walden University and the community college where the data were collected. The target sample size for this quantitative study was 302 students who were nonrandomly selected to participate in the study. To ensure that 302 properly completed survey questionnaires were returned to me, 400 students were given a consent form and survey questionnaire to complete. Of the 340 completed and returned questionnaires, 22 of them were rejected

because they were improperly completed. The final size of the data sample used for statistical analysis was 318.

Overview of the Statistical Procedures

Data collected from 318 students were used to create one master data set. Eight other data sets based on scores to questions related to each of the eight sub-scale dimensions of teacher behavior were also created. The results were analyzed using SPSS. Descriptive statistics were used to examine means, standard deviations, minima, and maxima for the eight interpersonal behavior variables to determine how students perceive of their biology instructors. Nonparametric Spearman's correlations were then conducted to examine the relationships between student achievement (continuous grades) and the eight dimensions of interpersonal behaviors were examined. Finally, Mann-Whitney U tests were conducted to examine differences in the eight interpersonal behavior variables based on whether students scored high or low in the course.

Results for Research Question 1

Research Question 1: How do students perceive of the interpersonal behaviors of the instructors of their introductory biology courses?

For Research Question 1, the hypothesis is exploratory in nature, and no specific hypothesis is stated.

Descriptive statistics were conducted to determine how students perceive the interpersonal behaviors of their introductory biology course instructors. Students' grades ranged from 0 being an F to 4 being an A ($M = 2.87$, $SD = .77$). Participant's scores on the leadership subscale ranged from 0 to 4 ($M = 2.88$, $SD = .93$), scores on the

understanding subscale ranged from .33 to 4 (M = 2.93, SD = .93), and scores on the uncertain subscale ranged from 0 to 3.17 (M = .69, SD = .77). Participants' scores on the admonishing subscale ranged from 0 to 4 (M = .76, SD = .84), scores on the helping/friendly subscale ranged from 0 to 4 (M = 2.76, SD = 1.03), and scores on the Student Responsibility subscale ranged from 0 to 4 (M = 1.17, SD = .68). Finally, participant's scores on the dissatisfied subscale ranged from 0 to 4 (M = .82, SD = .93) and scores on the strict/freedom subscale ranged from 0 to 4 (M = 1.90, SD = .85). The means and standard deviations for the continuous independent and dependent variables are displayed in Table 1.

Table 1

Means and Standard Deviations for Continuous Independent and Dependent Variables

	N	*M*	*SD*	Min	Max
Grade	318	2.87	.77	.00	4.00
Leadership	318	2.88	.93	.00	4.00
Understanding	318	2.93	.93	.33	4.00
Uncertain	318	.69	.77	.00	3.17
Admonishing	318	.76	.84	.00	4.00
Helping/Friendly	318	2.76	1.03	.00	4.00
Student Responsibility	318	1.17	.68	.00	4.00
Dissatisfied	318	.82	.93	.00	4.00
Strict/Freedom	318	1.90	.85	.00	4.00

In review of the overall means and standard deviations results, it appeared that the community college students perceive their introductory biology teachers as having strong skills in leadership, understanding, and helpfulness domains of teacher behavior. The understanding behaviors domain with a mean of 2.93 would suggest that community colleges students perceive their teachers as empathetic, patient, understanding, open, and attentive. The students reported a mean of 2.76 in the helpful/friendly behaviors domain and a mean of 2.88 in the leadership behaviors domain. These ratings suggest that teachers inspire confidence and trust, structure in the classroom situation, lead, organize, assist, and show interest in the students. Also, the negative aspects of the teacher-student interaction were rated fairly low by the students as teachers seldom exhibit admonishing behavior (mean: 0.76), are less dissatisfied (mean: 0.82) and less uncertain (mean: 0.69). This result is consistent with recent studies of science classroom environment using QTI. (Gupta & Fisher, 2011, den Brok, Taconis, & Fisher, 2010)

Results for Research Question 2

Research Question 2: What is the relationship between students' perceptions of teacher interpersonal teaching behavior and student achievement in introductory biology courses?

$H_0$2: Student perceptions of teacher interpersonal teaching behavior will not be related to student achievement.

Nonparametric Spearman correlations were conducted to examine the relationship between students' perceptions of teacher interpersonal teaching behaviors and student achievement in introductory biology courses. The null hypothesis states that student

perceptions of teacher interpersonal teaching behavior will not be related to student achievement. As shown in Table 2, the results revealed a significant positive correlation between grades and students' perceptions of teacher leadership, understanding, and helpful/friendly subscales (all ρs, $p < .001$), suggesting that as grades increased, students perceived their teachers as being higher in leadership, understanding, and helpfulness/friendliness. In addition, grades were negatively correlated to student perceptions of teacher uncertain, admonishing, dissatisfied, and strict/freedom subscales (all ρs, $p < .001$), suggesting that as grades increased, students perceived their teacher as being less uncertain, admonishing, dissatisfied, and strict. However, there was no significant correlation between grades and student perceptions of teachers' insistence on student responsibility, $p > .05$. Overall, these results reject the null hypothesis by supporting the alternative hypothesis that student achievement is positively related to students' perceptions of teacher interpersonal behavior in introductory biology courses.

Table 2

Spearman's Rank Correlations Among Teacher Interpersonal Behaviors and Student Achievement

	Grade	Leadership	Understanding	Uncertain	Admonishing	Helping/ Friendly	Student Responsibility	Dissatisfied
Leadership	.366 **							
Understanding	.338 **	.812**						
Uncertain	-.244 **	-.675**	-.585 **					
Admonishing	-.220 **	-.479**	-.633 **	.606 **				
Helping/ Friendly	.356 **	.714**	.795 **	-.500 **	-.565**			
Student Responsibility	-.019	.053	.189 **	.206 **	-.034	.305**		
Dissatisfied	-.277 **	-.538**	-.654 **	.596 **	.729**	-.609**	.064	
Strict/Freedom	-.164 **	-.207**	-.341 **	.288 **	.556**	-.395**	-.197 **	.577**

Note. $^{**}p < .01$. $^{***}p < .001$.

The results show that the three scales of leadership, understanding and helping/friendly is absolutely important which implies that understanding of students' needs and providing them with care and support may aid in increasing their academic achievement scores. On the other hand, uncertain and admonishing behavior by the teacher may lead to a decline in academic achievement.

Results for Research Question 3

Research Question3: High achieving students (grades of As and Bs) will rate their teachers' interpersonal behavior significantly more positively than low achieving students (grades of Cs, Ds, and Fs).

$H_0$3: Student perceptions of teacher interpersonal behavior will not differ based on student achievement levels in introductory biology courses.

The nonparametric Mann-Whitney U tests were conducted to test if student perceptions' of teacher interpersonal behavior differed based on student achievement levels in introductory biology courses. The null hypothesis states that student perceptions of teacher interpersonal behavior will not differ based on student achievement levels in introductory biology courses. As shown in Table 3, the results revealed a significant difference between grade level and student perception of teacher leadership, U = 7284.500, $p < .001$. The mean rank for students who received a high grade were significantly greater (MR = 179.48, Sum of Ranks = 37331.50) than were the mean ranks for students who received a low grade (MR = 121.72, Sum of Ranks = 13389.50). Results also revealed a significant difference between grade level and student perception of teacher understanding, U = 7778.00, $p < .001$. The mean rank for students who received a

high grade were significantly greater (MR = 177.11, Sum of Ranks = 36838.00) than were the mean ranks for students who received a low grade (MR = 126.21, Sum of Ranks = 13883.00). Results also revealed a significant difference between grade level and student perception of teacher helping/friendliness, U = 7718.00, $p < .001$. The mean rank for students who received a high grade were significantly greater (MR = 177.39, Sum of Ranks = 36898.00) than were the mean ranks for students who received a low grade (MR = 125.66, Sum of Ranks = 13823.00).

Results also revealed a significant difference between grade level and student perception of teacher uncertainness, U = 8730.00, $p < .001$. The mean rank for students who received a low grade were significantly greater (MR = 184.14, Sum of Ranks = 20255.00) than were the mean ranks for students who received a high grade (MR = 146.47, Sum of Ranks = 30466.00). Results also revealed a significant difference between grade level and student perception of teacher admonishing, U = 9104.50, $p < .05$. The mean rank for students who received a low grade were significantly greater (MR = 180.73, Sum of Ranks = 19880.50) than were the mean ranks for students who received a high grade (MR = 148.27, Sum of Ranks = 30840.50). Results also revealed a significant difference between grade level and student perception of teacher dissatisfaction, U = 8285.50, $p < .001$. The mean rank for students who received a low grade were significantly greater (MR = 188.18, Sum of Ranks = 20699.50) than were the mean ranks for students who received a high grade (MR = 144.33, Sum of Ranks = 30021.50). Finally, results revealed a significant difference between grade level and student perception of teacher strictness/freedom, U = 9331.00, $p < .05$. The mean rank for

students who received a low grade were significantly greater (MR = 178.67, Sum of Ranks = 19654.00) than were the mean ranks for students who received a high grade (MR = 149.36, Sum of Ranks = 31067.00). However, there was no significant difference between grade level and student perception of student responsibility, $p > .05$. Overall, these results reject the null hypothesis by supporting the alternative hypothesis that high-achieving students rate their teachers' interpersonal behaviors significantly more positively than low-achieving students.

Table 3

Mann-Whitney U Tests Between Teacher Interpersonal Behaviors and Student Achievement

	N	*M*	*SD*	*MR*	*U*	*p*
Leadership					7284.50	< .001
Low Grade (C, D, F)	110	14.87	5.98	121.72		
High Grade (A, B)	208	18.54	4.87	179.48		
Understanding					7778.00	< .001
Low Grade (C, D, F)	110	15.37	6.15	126.21		
High Grade (A, B)	208	18.71	4.84	177.11		
Uncertain					8730.00	< .001
Low Grade (C, D, F)	110	5.56	5.32	184.14		
High Grade (A, B)	208	3.36	4.04	146.47		
Admonishing					9104.50	.002
Low Grade (C, D, F)	110	6.13	5.99	180.73		
High Grade (A, B)	208	3.77	4.24	148.27		
Helping/Friendly					7718.00	< .001
Low Grade (C, D, F)	110	14.29	6.29	125.66		
High Grade (A, B)	208	17.72	5.77	177.39		
Student Responsibility					10908.50	.494
Low Grade (C, D, F)	110	7.24	4.25	164.33		
High Grade (A, B)	208	6.92	4.00	156.94		
Dissatisfied					8285.50	< .001
Low Grade (C, D, F)	110	6.84	6.39	188.18		
High Grade (A, B)	208	3.91	4.77	144.33		
Strict/Freedom					9331.00	.007
Low Grade (C, D, F)	110	12.46	5.63	178.67		
High Grade (A, B)	208	10.86	4.76	149.36		

These results show students scoring high grades (As or Bs) rated their teachers as significantly higher in leadership, understanding, and helping/friendly than students scoring low grades (Cs, Ds, or Fs). Specifically students with high grades perceived that their teachers were better leaders, more understanding, and more helping/friendly.

Summary

The purpose of this correlational quantitative study was to determine whether relationships exist between students' cognitive outcomes and the quality of teacher-student interactions among students taking introductory biology courses in a suburban community college. This section presented the statistical analysis procedures used in this research and the facts obtained from those analyses. Data were methodically collected and analyzed with descriptive statistics to examine means, and standard deviation, for the 8 interpersonal behavior variables to determine how students perceive of their biology instructors. Nonparametric Spearman's correlations were then conducted to examine the relationships between student achievement (continuous grades) and the 8 dimensions interpersonal behaviors examined. Finally Mann-Whitney U tests was conducted to examine differences in the 8 interpersonal behavior variables based on whether students scored high or low in the course.

The research study findings revealed significant relationships between students' perceptions of teacher interpersonal teaching behaviors and student achievement in introductory biology courses. The findings associated with hypothesis one revealed a significant positive correlation between grades and students' perceptions several interpersonal teaching behaviors. The nonparametric Spearman's correlations revealed a

significant correlation between grades and students' perceptions of teacher Leadership, Understanding, and Helping/Friendly subscales (all ρs, $p < .001$), suggesting that as grades increased, students' perceived their teachers as being higher in leadership, understanding, and helpfulness/friendliness. In addition, grades were negatively correlated to student perceptions of teacher Uncertain, Admonishing, Dissatisfied, and Strict/Freedom subscales (all ρs, $p < .001$), suggesting that as grades increased, students perceived their teacher as being less uncertain, admonishing, dissatisfied, and strict. The findings allowed the researcher to reject the null hypothesis by supporting the alternative hypothesis that student achievement is positively related to students' perceptions of teacher interpersonal behavior in introductory biology courses.

The findings associated with hypothesis two revealed significant effect of grades on several teacher interpersonal behaviors. The nonparametric Mann-Whitney U tests revealed a significant difference between grade level and student perception of teacher leadership, U = 7284.500, $p < .001$, understanding, U = 7778.00, p < .00, and helping/friendliness, U = 7718.00, $p < .001$. The results also revealed a significant difference between grade level and student perception of teacher admonishing, U = 9104.50, $p < .05$, dissatisfaction, U = 8285.50, $p < .001$, strictness/freedom, U = 9331.00, $p < .05$. However, there was no significant difference between grade level and student perception of student responsibility, $p > .05$. In other words, students with high grades perceived that their teachers were better Leaders, more Understanding, and more Helping/Friendly. Further, students scoring high grades rated their teachers as significantly lower in Uncertain, Admonishing, Dissatisfied, and Strict than students

scoring low grades. The findings allowed the researcher to reject the null hypothesis by supporting the alternative hypothesis High achieving students (grades of As and Bs) will rate their teachers' interpersonal behavior significantly more positively than low achieving students (grades of Cs, Ds, and Fs).

Section 5 will present detailed interpretation of findings in the context of the literature, discuss practical implications for social change and recommendations for further research.

Section 5: Discussion, Conclusions, and Recommendations

Inadequate teacher interactions in undergraduate introductory biology classrooms have been linked to poor student performance in introductory biology courses resulting in fewer students pursuing advanced degree and careers in life science (National Science Board, 2008; Wood, 2009). According to data from IDEA (2001), approximately 50% of undergraduate students with an initial major in science switched to a nonscience major within the first 2 years of enrollment. Studies showed that students with caring and supporting interpersonal relationship with their teachers reported more positive academic attitudes and satisfaction with school (den Brok, Taconis, & Telli, 2010; Klemm & Connell, 2004; Koul & Fisher, 2004).

Many different factors influence student achievement. The first goal of this study was to understand students' perceptions of their teachers and get a better knowledge of the dynamics of student-teacher relationships and their effect on student achievement. The second goal of the study was to determine whether teacher-student interaction variables associated with community college introductory biology instruction could predict students' academic success in introductory biology courses. The independent variable for this study was students' self-reported final grades and the dependent variables were students' perceptions of teacher behavior measured by the QTI (see Appendix A for complete instrument). The scope of this correlational quantitative study was to administer and analyze a teacher interaction survey to correlate students' perceptions of teacher interaction behaviors to achievement in introductory biology courses. The research questions in this study addressed the relationship between students'

cognitive outcomes and the quality of teacher-student interactions among students who took introductory biology courses in a suburban community college in a Mid-Atlantic state.

Data generated with the QTI survey were analyzed using nonparametric statistical measures. The decision to use nonparametric measures was made after cleaning and prepping the data for analyses and examining the distributions of the variables (grades and the eight QTI subscales); I determined that responses on most of these subscales (all except Strict and Student responsibility/freedom) were nonnormally distributed. Specifically, they either showed ceiling or floor effects. Therefore, parametric statistics measures became an invalid method of examining the data. The data set was analyzed to determine association between community college introductory biology students' perceptions of interpersonal teaching behaviors and their achievement in introductory biology courses.

Descriptive statistics were used to examine means, standard deviations, minima, and maxima for the eight interpersonal behavior subscales to determine how students perceived their biology instructors. Nonparametric Spearman's correlations were then conducted to examine the relationships between student achievement (continuous grades) and the eight dimensions of interpersonal behaviors examined. Finally, Mann-Whitney U tests were conducted to examine differences in the eight interpersonal behavior subscales based on whether students scored high or low in the course.

Limitations of the Study

In addition to the design and methodology weaknesses anticipated prior to the study, this study was further limited because the data were collected from students who had successfully taken an introductory biology course within one year of the date of data collection. Because of that it is possible some of the students' recollections of their interaction may not be as clear had they taken the course the prior semester. Data collection process was the most challenging part of the research project. Even though the data was collected from the type of environment most supportive of this study, a large sub-urban community college, the size, multi campus structure required traveling long distance to multiple campuses which extended the time it took to complete data collection. Future studies on this topic would do well to make an effort to avoid or overcome this limitation. Finally, by not requiring students to provide demographic information on the survey may have failed to capture what may be a discriminating factor. To extend the research on this subject I would enlarge the survey to explore if there are differences in students perceptions of teacher behavior based on demographic factors such as race and gender.

Interpretation of Findings

Research Question 1

How do students perceive of the interpersonal behaviors of the instructors of their introductory biology courses? For Research Question 1, the hypothesis is exploratory in nature, and no specific hypothesis is stated.

As demonstrated in Section 4, the result of descriptive statistics of means and standard deviation conducted to determine how students perceived the interpersonal behaviors of their introductory biology course instructors showed that community college students perceived their introductory biology teachers as having strong skills in leadership, understanding, and helpfulness/friendly domains of teacher behavior. The result also showed that negative aspects of the teacher-student interaction were rated fairly low by the students as teachers seldom exhibited admonishing behavior (mean: 0.76), were less dissatisfied (mean: 0.82), and less uncertain (mean: 0.69). Scores on most scales were similar to those found in other studies (Brekelmans et al., 2002; den Brok et al., 2004; den Brok, Fisher, Brekelmans, Wubbels, & Rickards, 2006), Wubbels & Levy 1993). These mean scores would imply that the community college students in this study did not regularly perceive their teachers as angry, punishing, critical, and apologetic.

The Theoretical framework discussion for research question 1 was based on the systems communication theory (Watzlawick et al., 1967) and Leary (1957) model of interpersonal communication. They are two theories describing how teachers and students interact in the classroom and formed the basis of the model of interpersonal teaching behavior. Communication is an important part of the social interaction that occurs in an educational setting (Brekelmans, Wubbels, & Rickards, 2006). A major conclusion from the overall descriptive statistical analysis of means and standard deviation is that community college introductory biology students generally perceived that their science teachers displayed cooperative behaviors (Leadership, Helping/Friendly

and Understanding), rather than oppositional behaviors (Uncertain, Dissatisfied, Admonishing).

Research Question 2

What is the relationship between students' perceptions of teacher interpersonal teaching behavior and student achievement in introductory biology courses?

$H_0$2: Student perceptions of teacher interpersonal teaching behavior will not be related to student achievement.

As demonstrated in Section 4, the result of nonparametric Spearman correlations revealed a significant positive correlation between grades and students' perceptions of teacher Leadership, Understanding, and Helping/friendly subscales (all ρs, $p < .001$), suggesting that as grades increased, students perceived their teachers as being higher in leadership, understanding, and helpfulness/friendliness. In addition, grades were negatively correlated to student perceptions of teacher Uncertain, Admonishing, Dissatisfied, Strict, and Student responsibility/freedom subscales (all ρs, $p < .001$), suggesting that as grades increased, students perceived their teacher as being less uncertain, admonishing, dissatisfied, and strict.

The Theoretical framework discussion for research question 2 was based on the Leary (1957) model of interpersonal communication. Leary said that people communicate according to two dimensions – a dominance/submission (influence) and cooperation/opposition (proximity). The influence dimension focuses on who is controlling the communications while proximity focuses on how much cooperation is present between the people who are cooperating. The findings in this study showed a

significant positive correlation between grades and students' perceptions of teacher Leadership, Understanding, and Helping/friendly subscales adjacent to each other satisfied the assumptions of Leary's (1963) that there was a higher correlation between scales adjacent to each other and that the correlations became smaller for scales located further from each other.

Many research studies in the past have indicated that a teacher's interpersonal behavior is strongly related to students' achievement at various grade levels of education. The findings in this study were consistent with two studies published in 2010 (Aldridge, Fraser, and Soerjaningsih, 2010), and 2011(Fisher and Gupta, 2011) looking at the relationship between students' perceptions of teacher interpersonal teaching behavior and student achievement in science classrooms using QTI.

In a study that examined associations between perceived interpersonal instructor behavior and students' cognitive outcomes at the university level in Indonesia using QTI, Aldridge, Fraser, and Soerjaningsih (2010) found significant association between teacher interpersonal teaching behaviors and student achievement. Using the individual student as component of analysis, they performed simple correlation analysis to determine which teacher behavior scales were significantly correlated to student course achievement scores. The results showed that Leadership, Helpful/friendly and Understanding scales of QTI were statistically significant and positively related to student course achievement scores, while Dissatisfied, Admonishing, and Strict scales were also statistically significant but negatively associated to student course achievement scores.

In a study looking at teacher student interaction in a technology supported science classroom in India, Fisher and Gupta (2011) found a significant correlation between several teacher interpersonal teaching behaviors and student achievement. Analyzing QTI data from 705 students, simple and multiple correlation analysis revealed that seven of the eight scales of the QTI had a significant relationship with the academic achievement scores. The scales of Leadership, Helping/friendly, Understanding, and Student responsibility/freedom were positively correlated and Uncertain, Dissatisfied, and Admonishing were negatively correlated with achievement scores. The Strict scale showed no association.

In conclusion, results from this study together with support from other studies demonstrated that understanding of the needs of students, and giving them some freedom, opportunities and responsibility, and providing them with care, may assist in increasing their academic achievement scores. On the other hand, admonishing and uncertain behavior by the teacher may lead to a decrease in their academic achievement.

Research Question 3

Do student perceptions of teacher interpersonal behavior differ based upon students' achievement levels in introductory biology courses?

$H_0$3: Student perceptions of teacher interpersonal behavior will not differ based on student achievement levels in introductory biology courses.

As established in section 4, the results of nonparametric Mann-Whitney U tests conducted to test if student perceptions' of teacher interpersonal behavior differed based on student achievement levels in introductory biology courses revealed significant effect

of grades on several teacher interpersonal behaviors. Specifically, students scoring high grades (As or Bs) rated their teachers as significantly higher in Leadership, Understanding, and Helping/Friendly than students scoring low grades (Cs, Ds, or Fs). In other words, students with high grades perceived that their teachers were better Leaders, more Understanding, and more Helping/Friendly. Further, students scoring high grades rated their teachers as significantly lower in Uncertain, Admonishing, Dissatisfied, and Strict than students scoring low grades. Whether students had high or low grades was not related to their perceptions of teachers' insistence on Student Responsibility.

These findings show that leadership, understanding, and helping/friendly teacher behaviors positively influenced the students' final grade, whereas uncertain, admonishing, dissatisfied and strict teacher behaviors negatively influenced the students' final grade. While prior researchers had examined the Proximity and Influence axes collectively (e.g., Aldridge, Fraser & Soerjaningsih, 2010; Fisher and Gupta, 2011; Wubbels & Brekelmans, 1997; Fisher & Rickards, 1998; den Brok, Brekelmans & Wubbels, 2004), this author investigated all of the dimensions individually to gain a better knowledge of teacher behavior effects on student achievement.

Analyses of QTI data from 318 community college students in this study satisfy the assumptions of the theoretical frameworks that anchor this investigation, Leary's (1957) theory on interpersonal communication and the systems communication theory of Watzlawick et al. (1967). The prototype of scale inter-correlations for the QTI in general satisfy the supposition of Leary's model of interpersonal human behavior that there was a higher correlation between scales adjoining to each other and that the correlation became

smaller for scales located further from each other (Aldridge, Fraser & Soerjaningsih, 2010)

The findings in this study further validates many past research studies that have consistently replicated the advantages of positive teacher-student relationships and a positive learning environment in promoting better student achievement in science classrooms. Developing positive teacher-student relationships should be one of several goals to help develop new teachers and maintain effective tenured teachers in community colleges.

Implications for Positive Social Change

This research study found a strong correlation between teacher interpersonal teaching behaviors and student achievement. Because undergraduate introductory biology courses often serve as the best opportunity to interest students in a biomedical research or other life science career signifies that change must occur in the way introductory biology courses are taught in community colleges. A very significant element of the research is the fact that a plethora of information is available on what constitutes "quality teaching" (Aldridge, Fraser & Soerjaningsih, 2010; Fisher & Gupta, 2011; Wubbels & Levy, 1993). According to 318 community college introductory biology students, the finest teachers are powerful classroom leaders who are more understanding and friendlier, and they are less critical uncertain, and dissatisfied, than the majority teachers. In general, good teachers are both highly dominant and highly cooperative (den Brok, Brekelmans, Levy & Wubbels, 2002).

This study applies to Walden University's definition of social change in that the study addressed strategies and ideas of best practices in teaching to affect students' achievement and perceptions of science. In the past two decades community college science classrooms have become more socially and culturally diversified. The findings in this study will lead to positive social change for students and faculty by providing current research data that can be used to guide and encourage administrators to support faculty development activities in pedagogy that will lead to increased student engagement, success and retention in science majors not only in the Community College where the study was conducted, but also in other sub-urban Community Colleges in the United States.

Recommendations for Action

Recommendation1:

The findings in this study further validates the use of the QTI as a statistically dependable and a useful tool that can be used by teachers effectively as a feedback tool for self-reflection. The information derived from this instrument has the potential to promote changes in teacher actions that can positively influence students on a day-to-day basis. The findings support their use as a tool for instructive development and improvement. To fulfill one of the IRB requirements about disseminating the study findings I plan to present it to the faculty at the Community College where the study was conducted. Based on the results of this study, I will recommend to the academic leadership to integrate components of QTI findings as part of a sequence of professional development tools for introductory biology faculty. Interaction is one of the most

important factors in teaching as it directly relates to order in the classroom, one of the most common problem areas in education according to teachers (den Brok, et. al., 2010; & Veenman, 1984). Teachers can use these findings to modify their interactions with their students and to work toward increasing student achievement in introductory biology courses possibly leading increased retention.

Recommendation 2:

This study will also provide important useful information to the Community College in which data was gathered that can be used to advance new strategies for improving classroom practices, management and administration policies for introductory biology and other science courses. My recommendation is that the results of the study be used as a road map for other suburban Community Colleges in the Mid-Atlantic States regarding efforts to improve student outcomes in introductory biology courses. Teachers are crucial to student perceptions of learning, inhibiting or facilitating students' learning (Pekel et al., 2006). The outcomes of the study can help to build more positive teacher–student relationships by improving the level of interactions.

Recommendations for Further Studies

The QTI has been proven over and over again to be a useful self-reporting questionnaire for assessing teacher behavior inside the classroom, their interaction with their students and the varied perceptions or responses to these interactions. The results of this study highlight the need for more extensive research in this domain.

Recommendation 1

A future path for this study would be to continue the perceptions studies of high and low achieving students in introductory biology courses in rural and urban community colleges. Use of tests scores from a standardized common final exam can be used to measure academic success rather than students' self-reported final grade. Because final grade determination can vary from one instructor to another, I recommend using a common assessment will provide a more reliable means of assessing the impact of teacher behavior on achievement. Better insight into other introductory science courses such as chemistry, physics and mathematics would also be useful as the present data is limited to the subject area of biology.

Recommendation 2

Another extension of the QTI would be to look into differences in students' perceptions based on race and gender, where there is little available data in the United States on the relationship between teacher behavior dimensions as defined by the QTI model and student outcomes among students of different gender and ethnic backgrounds.

The United States is currently experiencing racial and ethnic gaps in education outcomes. Nowhere is this more pronounced than in suburban Community colleges with large minority student populations where more than one half of the students are enrolled in development math courses. The quality of teacher-student interactions is another area that has the potential to improve the mathematics achievement of minority students (Holloway, 2004). Many research studies have found that teacher behaviors make a

difference in minority student achievement in mathematics and that minority students benefit from teachers who expect students of all racial, ethnic, and cultural backgrounds to achieve (Holloway, 2004; Lubienski, 2002; & Robelen, 2012). Closing achievement gaps and improving science learning outcomes for all students are educational priorities, I recommend expanding the use of QTI to examine if there are differences in students' perceptions of teacher behavior in science classrooms based on race and gender.

Conclusion

The focus of this correlational quantitative study was to determine whether relationships exist between students' cognitive outcomes and the quality of teacher-student interactions among students taking introductory biology courses in a suburban community college. An additional focus of the study was to determine whether teacher-student interaction variables associated with community college introductory biology instruction can be used to predict students' academic success in introductory biology courses.

A comparison of community college students' introductory biology final grades and the main teacher-student relationship traits, as indicted by the QTI can be used to predict student achievement. The findings revealed that teacher leadership, understanding, and helping/friendly behaviors had a significant impact on the prediction for student success. Teacher behaviors have both direct and indirect influence on students and as a result they contribute to the learning environment of students. Many studies on science classroom environment show that teaching behaviors, teaching styles and student perceptions of the learning environment are related to student learning (den Brok, Fisher,

& Koul, 2007; She, & Fisher, 2002; Wubbels, & Brekelmans, 2005). According to Fraser and Walberg, 2005, positive teacher-student relationships and a positive classroom environment promote improved student outcomes and should be a worthwhile process goal of education.

Community college students taking introductory biology courses spend a vast amount of time in the classroom and laboratory every semester. As a result the quality of life in these classrooms is of immense importance and students' reactions to and perceptions of their school experiences are important. Research studies in the United States and other countries suggest that classroom environments have significant influences on student outcomes (Adeyemo, 2010; Allen & Fraser, 2002; den Brok, Ruurd, & Fisher, 2010; Dorman, 2003; Umo, 2010). The findings in this study of instructor-student interaction in community college introductory biology classrooms provides information needed to clarify the nature, level and patterns of instructor-student interactions needed at the undergraduate level to increase student achievement.

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Appendix A: Student QTI

Dear Student:

You have been selected to complete the attached questionnaire as part of a Research Study that is being conducted through the XXXXXX. This questionnaire asks you to describe the behavior of your **BIOL 110** professor.

This is **NOT** a test. Your opinion is what is wanted.

On the next few pages you will find 48 sentences about your biology professor. For each sentence circle the number corresponding to your responses.

	Always				Never
1. This teacher talks enthusiastically about her/his subject.	0	1	2	3	4
2. This teacher trusts us.	0	1	2	3	4
3. This teacher seems uncertain.	0	1	2	3	4
4. This teacher gets angry unexpectedly.	0	1	2	3	4
5. This teacher explains things clearly.	0	1	2	3	4
6. If we don't agree with this teacher, we can talk about it.	0	1	2	3	4
7. This teacher is hesitant.	0	1	2	3	4
8. This teacher gets angry quickly.	0	1	2	3	4
9. This teacher holds our attention.	0	1	2	3	4
10. This teacher is willing to explain things again.	0	1	2	3	4
11. This teacher acts as if she/he does not know what to do.	0	1	2	3	4
12. This teacher is too quick to correct us when we break a rule.	0	1	2	3	4
13. This teacher knows everything that goes on in the classroom	0	1	2	3	4
14. If we have something to say, this teacher will listen.	0	1	2	3	4
15. This teacher lets us boss her/him around.	0	1	2	3	4
16. This teacher is impatient.	0	1	2	3	4

17. This teacher is a good leader. 0 1 2 3 4

18. This teacher realizes when we don't understand. 0 1 2 3 4

19. This teacher is not sure what to do, when we fool around. 0 1 2 3 4

20. It is easy to pick a fight with this teacher. 0 1 2 3 4

21. This teacher acts confidently. 0 1 2 3 4

22. This teacher is patient. 0 1 2 3 4

23. It is easy to make a fool out of this teacher. 0 1 2 3 4

24. This teacher is sarcastic. 0 1 2 3 4

25. This teacher helps us with our work. 0 1 2 3 4

26. We can decide some things in this teacher's class. 0 1 2 3 4

27. This teacher thinks that we cheat. 0 1 2 3 4

28. This teacher is strict. 0 1 2 3 4

29. This teacher is friendly. 0 1 2 3 4

30. We can influence this teacher. 0 1 2 3 4

31. This teacher thinks that we don't know anything. 0 1 2 3 4

32. We have to be silent in this teacher's class. 0 1 2 3 4

33. This teacher is someone we can depend on. 0 1 2 3 4

34. This teacher lets us fool around in class. 0 1 2 3 4

35. This teacher puts us down. 0 1 2 3 4

36. This teacher's tests are hard. 0 1 2 3 4

37. This teacher has a sense of humor. 0 1 2 3 4

38. This teacher lets us get away with a lot in class. 0 1 2 3 4

39. This teacher thinks that we can't do things well. 0 1 2 3 4

40. This teacher's standards are very high. 0 1 2 3 4

41. This teacher can take a joke. 0 1 2 3 4

42. This teacher gives us a lot of free time in class. 0 1 2 3 4

43. This teacher seems dissatisfied. 0 1 2 3 4

44. This teacher is severe when marking papers. 0 1 2 3 4

45. This teacher's class is pleasant. 0 1 2 3 4

46. This teacher is lenient 0 1 2 3 4

47. This teacher is suspicious. 0 1 2 3 4

48. We are afraid of this teacher. 0 1 2 3 4

*****Please the FINAL GRADE YOU RECEIVED IN BIOLOGY COURSE110: _A _B _C _D_ F**

Appendix B: Permission Request to use QTI Instrument

From: Victor Madike XXXXX
Date: woensdag 10 oktober 2012 05:56
To: Theo Wubbels XXXXX
Subject: Permission Request for QTI Instrument

Dear Dr. Theo Wubbels,

My name is Victor Madike and I am a doctoral candidate for the degree of doctor of education at The Richard W. Riley College of Education and Leadership at Walden University. Walden University is an internationally recognized educational institution based in Minneapolis, Minnesota, USA. The Richard Riley College of Education and Leadership and its faculty are dedicated to improving educator effectiveness and preparing educators who make a positive impact on student achievement.

As part of the requirements for the completion my degree, I am requesting your permission and support to use The Questionnaire on Teacher Interaction (QTI), which according to my research was adapted from the Leary Model by yourself (Wubbels), Creton, Levy, and Hooymayers and published in 1993.

I am planning to conduct a quantitative study to examine whether relationships exist between students' cognitive outcomes and the quality of teacher-student interactions among students taking introductory biology courses in a suburban community college in a mid-Atlantic state in the United States. Research conducted over the past 30 years in the United States and around the world has shown that the quality of the classroom environment is a significant determinant of student learning (Dorman, Aldridge, & Fraser, 2006, Fraser, 1998, Khine, 2002, 2005, & Chua, 2009).

My plan is to use the Questionnaire on Teacher Interaction (QTI) to collect data on students' perceptions of teacher interaction behaviors and their impact on achievement in introductory biology courses. Since its development, the Questionnaire on Teacher Student Interaction (QTI) as you are aware has been extensively used and accepted as a reliable research instrument for measuring teacher interpersonal behaviors in the classroom. The use is non-commercial as it will only be used for my research and study. I will be using the Australian version of the QTI, which contains 48 questions that are answered using a five-point response scale. I will be adding demographic questions as well as questions about the students' final grade. These questions will not change the meaning of the survey.

You will be fully acknowledged as the author/publisher/copyright owner of the work and that the work is used with your permission. If you require a specific style of citation, I can comply with your preference.

If you do not own copyright in this material, do you have any information about who the correct copyright owner is?

If you require any further information about this query, or if there are any other conditions that would facilitate the permissions process, please contact me by email at XXXXXX or XXXXXXX .

Thank you for considering my request. I appreciate your contribution to the development of research in this area.

Yours Sincerely,

Victor Madike M.S

Original E-mail

From : "Wubbels, T. (Theo)" [XXXXXX]

Date : 10/10/2012 08:40 AM

To : Victor Madike XXXXX]

Subject : Re: Permission Request for QTI Instrument

Dear Victor,

I'm happy to grant you permission to use the QTI for your research and hope that your studies will be successful.

Best regards,
Theo
Theo Wubbels | **Associate Dean Faculty of Social and Behavioural Sciences | Utrecht University | XXXXXX**

Dear Dr. Wubbels,

Thank you for granting me permission to use QTI. If you will be interested I will be happy to send you a copy of the outcome of my studies when completed.

Again, thank you for the work you have done in the field of educational classroom environment research.

Victor Madike

Yes Victor, I'm very interested, thus please send the report.

Groet
Theo
Theo Wubbels | **Associate Dean Faculty of Social and Behavioural Sciences | Utrecht University | XXXXXX**

Appendix C: Consent Form

You are invited to participate in a research study looking at the effects of teacher classroom interactions on students' achievement in community college introductory biology courses. You are selected as a possible participant because you have successfully completed BIOL 110 and currently enrolled in an upper level biology course. Please read this form and ask any questions you may have before agreeing to be part of the study.

This study is being conducted by Victor N. Madike, a doctoral candidate at Walden University. I am also an assistant professor of biology XXXXXX and can be reached at XXXXXX (work) and XXXXXX(cell). You may already know the researcher as biology professor, but this study is separate from that role.

Background Information:

The purpose of this study is to determine from students' perceptions whether relationships exist between students' achievement and the quality of teacher-student interactions among students taking introductory biology at XXXXXX.

Procedures:

If you agree to be in this study, you will be asked to:

- Read the Consent Form which outlines the protocol for the study.
- Complete a Questionnaire on Teacher Interaction that will take about 30 minutes to do.

Voluntary Nature of the Study:

Your participation in this study is strictly voluntary. Your decision whether or not to participate will not affect your current or future relations with XXXXXX and none of your professors in BIOL
110 will have access to any of the materials. No one at XXXXXX will treat you differently if you decide not to participate in the study. If you initially decide to

participate, you are still free to withdraw at any time prior to completing and submitting the survey. Once the survey is completed and submitted you cannot withdraw. Since there are no identifiers on the survey there will be no way of knowing which of the survey belongs to you.

Risks and Benefits of Being in the Study:

There are minimal risks associated with participating in this study. This study requires you to provide answers to questions on a survey, and if you determine after reading the consent form that participation may course stress or anxiety, you can decide not to participate. You may also refuse to answer any questions you consider invasive or stressful. Even though there are no immediate benefits associated with participating in this study, the outcome of this study will potentially benefit the larger educational community by will clarifying the nature, level and patterns of instructor-student interactions that are needed at the undergraduate level to increase student achievement.

Compensation:

There will be no compensation provided for your participation in this study.

Confidentiality:

Any information you provide will be kept confidential. The researcher will not use your information for any purposes outside of this research study. Also the researcher will not include your name or any personal information that could identify you in any publications or reports of the study. Research records will be kept in a locked file, and only the researcher will have access to the records.

Contacts and Questions:

The researcher conducting this study is Victor N. Madike. The researcher's faculty advisor is Dr.Wallace Southerland III. You may ask any questions you have now. If you have questions later, you may contact the researcher at XXXXXX (cell) or by e-mail at XXXXXX or the advisor by e-mail at XXXXXX. If you want to talk privately about your

rights as a participant, you can call Dr. Leilani Endicott. She is the Walden University representative who can discuss this with you. Her phone number is XXXXXX. Walden University's approval number for this study is **08-27-13-0123018** and it expires on **August 26, 2014.** The researcher will give a copy of this consent form to keep.

Statement of Consent:

In order to protect your privacy, your name and signature will not be required on the consent form. Your completion of the survey will be used as an indication of your consent to participate in this study. I have read the above information and I understand the study well enough to make a decision about my involvement this study. I have received answers to any questions I have at this time. You may keep the Consent Form for your record.

Appendix D: Letters of Support

June 15, 2012
Dr. XXXXXX
Director of Educational Research
Community College XXXXX
XXXXXX
XXXXXX

Dear Dr. XXXXXX

I am currently pursuing my Ed. D degree in Teacher Leadership at Walden University. As part of the requirements for the completion this degree, I am requesting your permission and support to conduct a research project which will be carried out this year.

My research problem is to determine the effects of teacher interactions on students' achievement in community college introductory biology courses for majors. Research studies have linked inadequate teacher interactions in undergraduate introductory biology classrooms to poor student performance in introductory biology courses, resulting in less number of students pursuing advance degrees and careers in life science (National Science Board, 2008, &Wood, 2009). I will conduct a quantitative study to examine whether relationships exist between students' cognitive outcomes and the quality of teacher-student interactions among students taking introductory biology courses at XXXXXX. I will use the Questionnaire on Teacher Interaction (QTI) to collect data on students' perceptions of teacher interaction behaviors and their impact on achievement in introductory biology courses. Since its development, the Questionnaire on Teacher Student Interaction (QTI) has been extensively used and accepted as a reliable research instrument for measuring teacher interpersonal behaviors in the classroom.

My plan is to survey students who have successfully completed introduction to biology course for majors in the semester before data collection and are currently enrolled in an upper level biology course. The study plan will require that approximately 300 students

complete the survey instrument during one sitting which will take about thirty minutes. Faculty teaching the sections chosen will not be involved in the data collection process. Prior to data collection, I will personally deliver consent forms to all the participants. This form will convey to the participants and the college administration that I will take every precaution to protect the students and their anonymity as participants. All students will be informed that their responses will be confidential. They will be further assured that teachers will never see any of their responses or individual scores. Once the students give their consent to participate in the study, they will be asked to sign the consent form and I will collect them from the students.

As a faculty member who teaches BIOL 110, I have witnessed first-hand the high failure rate in these courses. It is my belief that the outcome of this study will provide important useful information to the college that can be used to advance new strategies for improving classroom practices, management and administration policies for introductory biology courses. Your permission and support will allow me to work with my department chair and biology coordinators on all three campuses to schedule data collection with minimal disruptions to classroom activities. For your review, I am attaching a copy of my study proposal, survey instrument and consent form that all participants will review and sign prior to participating in the study. Any questions about the study can directed to study Chair, Dr. Wallace Southerland III at Walden University. He can be reached by e-mail at XXXXXX.

Thank you for your continued support and concern for improving student success at XXXXXX.

Sincerely,

Victor Madike, M.S.

MEMORANDUM

TO: Victor Madike

FROM: Natasha Miller, Ph.D.
Institutional Review Board

RE: IRB review

DATE: October 15, 2013

The Institutional Review Board has approved your application to conduct research at the You may now proceed with your data collection. This approval expires on October 15, 2014.

Please do not hesitate to contact me if you have any questions at

From: Madike, Victor N. Sent: Tue 9/4/2012 1:33 PM
To: O'Neill, David
Subject: Letter of Support

Dear Dr. O'Neill,
I am currently working towards completion of my Ed. D degree in Teacher Leadership/Science education at Walden University. As part of the requirements for the completion this degree, I am requesting your support to conduct a research project which will be carried out this year.

My research problem is to determine the effects of teacher interactions on students' achievement in community college introductory biology courses for majors. Research studies have linked inadequate teacher interactions in undergraduate introductory biology classrooms to poor student performance in introductory biology courses, resulting in less number of students pursuing advance degrees and careers in life science (National Science Board, 2008, &Wood, 2009). I will conduct a quantitative study to examine whether relationships exist between students' cognitive outcomes and the quality of teacher-student interactions among students taking introductory biology courses at XXXXXX. I will use the Questionnaire on Teacher Interaction (QTI) to collect data on students' perceptions of teacher interaction behaviors and their impact on achievement in introductory biology courses. Since its development, the Questionnaire on Teacher Student Interaction (QTI) has been extensively used and accepted as a reliable research instrument for measuring teacher interpersonal behaviors in the classroom.

My plan is to survey students who have successfully completed introduction to biology course for majors in the semester before data collection and are currently enrolled in an upper level biology course. The study plan will require that approximately 300 non-randomly selected students complete the survey instrument during one sitting which will take about thirty minutes. Faculty teaching the sections chosen will not be involved in the data collection process.

I have discussed my proposal with Dr. XXXXXX, Director of Planning and Research at XXXXXX and she told me that the college will support my research proposal if I successfully complete Walden University Institutional Review Board (IRB) process and receive approval.to proceed (see attached letter).

As a faculty member who teaches BIOL 110, I have witnessed first-hand the high failure rate in these courses. It is my belief that the outcome of this study will provide important useful information to the college that can be used to advance new strategies for improving classroom practices, management and administration policies for introductory biology courses. Your support will allow me to work with my department chair and biology coordinators on all three campuses to schedule data collection with minimal disruptions to classroom activities. Any questions about the study can directed to me or my study Chair, Dr. Wallace Southerland III at Walden University. He can be reached by e-mail at wallace.southerland@waldenu.edu.

Thank you for your continued support and concern for improving student success at XXXXXX.

Sincerely,
Victor N. Madike M.S

9/06/12 VM

Walden University Institutional Review Board

Dear Colleagues:

I am writing in support of Mr. Victor Madike's proposed dissertation research project. I understand that the purpose of the study is to document whether there is correlation between student engagement and success in Introductory Biology courses. Mr. Madike will administer the Questionnaire on Teacher Interaction (QTI) to 300 BIOL 110 Students to get a measure of student perception of Teacher Interaction.

Here at [redacted] offer about 125 sections of BIOL 110 each year to about 2,500 students. In one semester we evaluated, 58 % of the students earned A, B, C or D grades and of those 10% were D. Only 48% of the students were "successful) and earned an A, B or C. In some sections only 25% of the students were successful. Consequently we are vitally interested in examining pedagogical techniques that facilitate learning and student success and among other initiatives are stressing increasing student engagement.

There is a lot of diversity among faculty when it comes to adopting or revising pedagogical techniques. My experience as a chair and dean suggests to me that some faculty tend to accept that novel (to them) techniques when there is data to support the value of the change. I expect that faculty here will be even more willing to innovate if data is collected here and they observe the study being conducted. Consequently, while I applaud the idea of the study I am particularly enthusiastic about Mr. Madike's study because it is happening here.

The data collection plan does impinge on teaching time, but the amount of time is small in relation to the course and the potential value of the outcome outweighs the cost in lost instructional time. I hope that the study provides evidence linking pedagogical techniques with improved success and even a relatively modest but statistically significant gain in success rates would have an important impact on a large number of students here.

In conclusion, I support this study. Further this project has the support of the Biology Chairperson and campus coordinators. We will enthusiastically collaborate with Mr, Madike to insure that faculty enable the necessary sample of students to complete the survey.

Please contact me should I be able to provide any more information regarding our enthusiastic support of this project.

Sincerely yours.

David J. O'Neill
Assistant Dean of Science

[redacted]

The incredible value of education.

Curriculum Vitae

Victor Madike (vmadike@ccbcmd.edu)

Contact Info: 156 Langdon Farm Circle (443) 840-3968 (work)
Odenton, MD, 21113 (410) 874-8260 (Home)

Education:

2007-Present Walden University Minneapolis, MN
Ed. D. Teacher Leadership
1984- 1986 Alabama A&M University Huntsville, AL.
M.S. Microbiology
1980- 1983 Alabama A&M University Huntsville, AL.
B.S. Biology

EXPERIENCE:

2005-Present - Community College of Baltimore County, MD
Associate Professor/Physical Sci. Coordinator, Dundalk, Campus

2004-2005 - Morgan State University, Baltimore, MD
Research Associate/Manager Molecular Biology Core Facility

1998-2004 - National Institutes of Health, Bethesda, MD
Research Molecular Biologist

1994-1998 - Human Genome Sciences, Rockville, MD
Research Associate Scientist, Molecular Genetics Unit

1992-1994 – Johns Hopkins Univ., Sch. of Med. Baltimore, MD
Research Technician, Yeast Molecular Genetics Unit

2008-1992 – St Paul's College, Lawrenceville, Va.
Biology Instructor

1988 – 1988 - Alabama A&M University, Huntsville, AL.
Research Assistant upon graduation

AWARDS:

1984-1987 USDA Graduate Research Fellowship
1995-1998 Performance cash and stock award: HGS
1999-2003 NIH Intramural Research Staff Recognition cash award

PUBLICATIONS: 1997-2003 7 Research publications in peer reviewed science Journals.