ABSTRACT

BROWN, LAUREN HADLEY. Using personality type to predict student success in a technology-rich classroom environment. (Under the direction of Duane Akroyd.)

The purpose of the research has been to determine whether personality type has predictive ability in student success in a high-technology classroom. Previous research in this area has focused on professor personality type and their teaching method, how student personality type matches their comfort levels with technology, or the effect of a high technology environment on personality type. The current study looks at the predictability of personality type on student success in a high-technology academic environment.

The Myers-Briggs Type Inventory (MBTI) was used to assess student personality type while end-of-course grade in Chemistry 101, a technology-rich course, was used to measure success. Controlling variables were gender and SAT total score. Regression analyses showed that students who possessed the Sensing (S) personality type over the Intuiting (N) personality type performed significantly better in the high-technology classroom. Similarly, students who were Thinking (T) as opposed to Feeling (F) also did significantly better in a high-technology environment.

Analyses also showed differences in the means for groups participating in this research. Males had significantly lower grades than females in Chemistry 101 but scored significantly higher than females on SAT total. Males were significantly more likely to be T than F and also were significantly more T than females. Gender differences on the MBTI, specifically the Thinking vs. Feeling scale, that are prevalent in the literature and nationwide data, were also found in this study.

Implications for the use of this study are numerous. The most important application of this prediction would be for advisers to assist their students in choosing the best academic path and future career options. College departments who give the MBTI also can have a use for the results beyond the normal personality type descriptions.

USING PERSONALITY TYPE TO PREDICT STUDENT SUCCESS IN A TECHNOLOGY-RICH CLASSROOM ENVIRONMENT

by

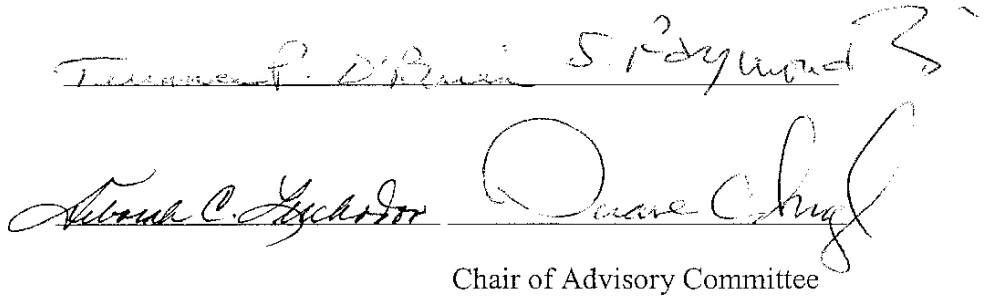
LAUREN HADLEY BROWN

A dissertation submitted to the Graduate Faculty of North Carolina State University in partial fulfillment of the requirements for the Degree of Doctor of Education

ADULT AND COMMUNITY COLLEGE EDUCATION

Raleigh

2006



Chair of Advisory Committee

BIOGRAPHY

Lauren Brown was born and raised in Syracuse, NY. She left the winter weather to attend college in Virginia at the College of William and Mary. Lauren graduated with a dual degree in Psychology and Elementary Education, but by that time had already decided that her calling lay elsewhere. She continued on to North Carolina State University (NCSU) to pursue a Masters degree in Higher Education- Student Affairs. While completing this degree, she worked or interned in several offices to get a sense for where her future may be. During this time Lauren had the support of many people on campus and was able to spend time in Admissions, Career Services, Supplemental Instruction, and Academic Advising. It was during her time in the College of Management that she found her true passion, advising students.

Lauren followed her passion and after graduation continued to pursue a career in advising. Through the support of her adviser, Duane Akroyd, she decided to continue her education in the field of Higher Education Administration while at the same time looking for a full-time job. The generosity of the College of Management led to a wonderful opportunity to work with admissions, advising, and leading a student group in that office. Within the past two years, Lauren applied for and was offered a job that combined all of her interests into one position, in the First Year College at NCSU. There she works with first-year undecided students to help guide them on a path to making a decision about their future major and career.

The position also allows her to return to her roots as a teacher but with a different population of students. Lauren teaches her advisees in a year-long course which is built on the idea that students need to first learn about themselves, then their major and career

options, before making any decision about their future. She enjoys the close contact she has with her students on a regular basis and all of the additional opportunities working in that office allows. Since beginning in the First Year College, she has taken ownership of the advising duties for the student government. Lauren has also been given the opportunity to attend and present at several conferences, including the National Academic Advising Association and the National Resource Center for the First Year Experience and Students in Transition. She has a special interest in student self-portfolios and educates others across the country about that tool.

Lauren was recently nominated by her peers for a national academic advising award. The award, given by the National Academic Advising Association (NACADA) required her to gather over 30 pages of material, including references from employers, administrators, peers, students and parents. In gathering the material, Lauren was reminded of why she chose the path of an academic adviser and just how rewarding helping students can be. Lauren found out in early April 2006 that she was one of 6 advisers nationwide to receive a Certificate of Merit for this award.

ACKNOWLEDGMENTS

I would first and foremost like to thank my family for their guidance over the last 23 straight years that I have been in school. It is amazing to think of how long a journey this has been and what it took to get me to this point! I would have never been able to take that journey without the support (of all forms) and encouragement of my parents, Dr. H. James and Babette Brown. I would also like to thank my sister, Alison Brown. Although we didn't *always* get along growing up, I was constantly reminded of the duties of being a good role model for my younger sibling. Although we took extremely different paths in our lives, we have both ended up in a setting we love, higher education. Who knew? I also want to thank Bailey for her unconditional love and her ability to cheer me up no matter what is happening in my life. No wonder dog is said to be man's best friend!

I would also like to thank my grandparents, Eileen and Frank Hocevar and Harold and Isabelle Brown. I was blessed to have grandparents who constantly reminded me of how proud they were of my accomplishments. This pride was especially evident whenever I went to visit them and all of their friends could recite my achievements by heart. They also all provided assistance along the way, anything from proofreading my papers and resume to sending me notes with words of encouragement. Although Grandpa Frank and "Gram" Isabelle are no longer with us, the memories of their support are always with me.

Dr. Duane Akroyd has given me immeasurable support along my academic journey. I have been with him since my first semester at State when I took a class with him online. It was a very unusual experience to take an entire class without once meeting

the professor, but my success in that class was the start of what has been a long adviser/advisee relationship. I most want to acknowledge Dr. Akroyd for encouraging me to enter the Ed.D. program in the first place. Obtaining my doctorate was never a serious goal of mine. I thought it would be a great accomplishment at some point in the future, I never imagined that I would start working on it directly after my Masters and finish by the age of 30. None of that would have happened without his guidance and for that I am grateful.

The other members of my committee have also been a great help along this academic journey. Dr. Deb Luckadoo was one of my first instructors in the Higher Ed Masters program. At that time, she single-handedly ran the Student Affairs courses in our program in addition to her duties as full-time Director of Student Activities on this campus. Her passion for students and her ability to encourage all of us to share that passion with her is what convinced me that I was in the right place. I am overjoyed that I now get to work with her as a colleague on many issues related to the students on this campus. Dr. Raymond Ting was my first professor in my minor area, Counselor Education. I ended up taking two classes from him because I enjoyed his teaching style immensely. I was also lucky to have the opportunity to work with him on a large research project he was doing. By getting that opportunity, I was able to take my first step into applying what I had learned in class. Most students don't get the opportunity to work on research in that way and I am thankful that he included me in his study. Finally, Dr. Terrance O'Brien was the most influential person on my committee in terms of the direction my research went in. I was so fortunate to have him attend a presentation I did of my original research proposal. At first he scared me a bit when he told me that my

idea was a good one but I could not base an entire dissertation on the original theory I had chosen because it was not reliable or valid enough. However, making the change was the most beneficial thing I did related to this dissertation. At the time I was not exactly happy to be scrapping months of research I had done, however, his insight into the Myers-Briggs and its uses and applications along with the many references he lent me have been the basis of this entire paper. I am grateful to him for his willingness to be a part of my research and especially my committee. His insights have been priceless.

Finally I want to thank my co-workers that have supported me on this journey. Gilroy Zuckerman has been one of my biggest supporters along the way. He constantly challenges me to do more and strive for bigger and better goals. Although I no longer work in his office under his supervision, we are in constant contact. He has asked me how I am doing on my dissertation and offers help at every step of the way. It is a wonderful feeling to know, although I am so far away from home, I always have someone to turn to when I need help. My other co-workers in that office, Millie Herget and Erin Dixon have made a tremendous impact on my life. They freely offered me insight and, more importantly, opportunities, and I am forever thankful to them for that.

The First Year College as a whole has been extremely supportive, especially in these later stages of my academic career. The staff has served as a sounding board for my ideas and has helped immeasurably. I especially want to thank Carrie McLean, our director, for encouraging me to take all the time I needed in order to complete my dissertation. Dr. Keith Powell has graciously helped me in the final stages by reading my work and challenging me to make it better. Chris Chafin has been my dissertation partner; it has been nice being able to talk to someone who is in the same stage as I am,

even if it is just to complain! Finally, I could not have made it through this process mentally without the support and comic relief of Donna Burton, Kimberly Franklin, and Shannon Brandt. Thank-you!

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INTRODUCTION

The New Students-Significance

Colleges and Universities are being faced with new challenges with each entering freshman class. Every year the student body changes, new students bring unique characteristics and skill sets with them, and everyone has to adjust to the changes in popular culture.

Today's incoming students are largely part of an ever-growing population of "Gen-Xers and Millenials" that are in our institutions (Oblinger 2003). Gen-Xers grew up experiencing the fall of the Berlin Wall, the emergence of AIDS and the World Wide Web (WWW) (Oblinger 2003). Millenials, people born after 1982, have even different characteristics from their predecessors (Oblinger 2003). In general, these individuals may comprise the most supervised and scheduled child generation ever (Williams 2004). Millenials have been more "fussed over" than any other generation and have in turn developed a stronger relationship with their parents (Williams 2004). They also have more of a respect for authority than any other generation (Williams 2004). Millenials have an aversion to being "ordinary" and look for a relaxed environment in which to work (Williams 2004). These students have been heavily influenced by technology in many different aspects of their lives (Oblinger 2003). Technology is a part of their education, their communication with friends and teachers, and their home lives (Oblinger 2003). In contrast to this, most current higher education administrators, faculty, and staff are part of a much different generation (Oblinger 2003). The average age of these professionals is over 50 with college graduation dates during the 1970s (Oblinger 2003). It is because of these differences in experiences with technology that professionals in

higher education need to work to get to know their students in every way possible, thus allowing them to more easily counsel these individuals.

Millenials and Technology

One of the most important areas of difference is technology. Millenials have also been called things such as the Digital Generation or the DotCom Generation (Hoke 2004). This generation is the first to grow up completely "online" (Hoke 2004). Even if a student doesn't have access to technology in their household, most school systems now own computers that students can use on a regular basis (Hoke 2004). College students today incorporate some sort of technology into every aspect of their lives; most see it as a natural part of the environment (Oblinger 2003). In fact, the younger the age group, the more likely there is to be a higher percentage of students that use the Internet for school and other aspects of their lives (Oblinger 2003). Students currently in college use these technological advances to their benefit, especially when dealing with classmates and faculty/staff members. On a more personal level, many students use the Internet to express ideas that they would not normally feel comfortable saying in class (Oblinger 2003). These are all concepts that may be foreign to educators and advisers that are not typically part of the Millennial generation. Although members of other generations view these students as tech savvy and reality based, many continue to feel uncomfortable in their dealings with this unique group (Hoke 2004).

Personality Theory

In order to best serve these students, those working in higher education need to get to know them as well as possible. This can be done in many different ways, but one of the most widely assessed traits in college-aged students that is used to understand them

better is personality type. An astounding amount of research went into creating and perfecting personality theory. Significant research has also been based on the theory since its conception. Theory in the area of personality type was based in the work of psychologist Carl Jung (Capraro & Capraro 2002). Jung suggests that human behavior is not random but in fact is predictable and classifiable (Denham 2002). He stated that this pattern of behavior reflects the person's preferences for taking in information and making decisions, and also the environment in which the person feels the most comfortable (Dewar 2000). Jung postulated that there are three different personality dimensions and that each individual has a preference for one type or another in each of these three areas (Capraro & Capraro 2002).

MBTI Dimensions

The first of Jung's dimensions looks at whether one's general attitude toward the world is oriented outward to other people and objects or inward toward one's own thoughts and feelings (Capraro & Capraro 2002). The former would be Extraverted (E) and the latter Introverted (I) (Capraro & Capraro 2002). Extraverts prefer to obtain information from others while Introverts prefer to gather information on their own (Briggs-Myers & McCaulley 1985). The next dimension, SN, shows whether a person prefers to rely on facts that they can gather through the five senses or on insight (Capraro & Capraro 2002). This dimension describes people ranging from Sensing (S) to Intuitive (N) (Capraro & Capraro 2002). Sensors prefer empirical data and Intuitors enjoy using hunches or a "sixth sense" (Briggs-Myers & McCaulley 1985). The final area in Jung's research involves how a person goes through the decision-making process; someone is either Thinking (T) or Feeling (F) (Briggs-Myers & McCaulley 1985). Thinkers make

decisions logically and with their heads while Feelers rely more on a subjective, interpersonal approach, they decide with their hearts (Briggs-Myers & McCaulley 1985). Thinkers are logical and analytical and Feelers are more personal and evaluative of another's situation (Carlson 1989).

Isabel Myers and Katherine Briggs-Myers added a fourth dimension through their research (Briggs-Myers & McCaulley 1985). They spent several years watching the people around them, such as family and friends, and found that there was one more area in which people could be classified. This is the Judging (J) and Perceiving (P) dimension and it relates to a person's general lifestyle (Capraro & Capraro 2002). Judgers prefer to make prompt decisions, an to plan and organize everything whereas Perceivers prefer to be flexible and spontaneous in what they do (Capraro & Capraro 2002).

There have been many studies pertaining to and using the ideas of Myers and Briggs over the years. Several have looked at the general differences amongst people on the four different personality dimensions. Cummings (1995) looked at whether personality types stay consistent with age. He found that there are some significant differences between population estimates of personality type frequency and their appearance in different age groups (Cummings III 1995). Further research has been done to explore the disparity between males and females on the Thinking vs. Feeling scale (Rideout 1989). Males score significantly more as Thinkers than Feelers (Rideout 1989). They also score significantly more as Thinkers than their female counterparts (Rideout 1989).

Personality Theory in the Classroom

General research has linked student personality types to their preferred learning methods and classroom success. Carrell & Monroe (1993) did a study on students taking English as a second language (ESL). They studied the students' writing style and effectiveness and found that ESL writers who were Intuitive, Feeling and Perceiving tended to use greater diversity in their writing and more complex terms (Carrell 1993). They explained this using the personality types (Carrell 1993). These students tend to be more flexible, creative, insightful, and less concrete than their counterparts (Carrell 1993). The authors provided an excellent description of personality types and their preferred learning methods (Carrell 1993).

Another researcher, Schroeder (1993), looked specifically at new groups of students entering higher education institutions. He postulated that personality differences between students and instructors can lead to problems such as low morale, discouragement and despair for both student and instructor (Schroeder 1993). Schroeder found that students who prefer the Introverted Intuiting (IN) pattern make the highest overall grades and those with the Extraverted Sensing (ES) pattern make the lowest (Schroeder 1993). Interestingly, faculty in general tended to prefer the IN pattern (Schroeder 1993). Conversely, the smallest number of faculty tested as ES (Schroeder 1993). It is important to notice that the students who have ES patterns do not have many faculty members who share their type, and also perform more poorly in school than any other group. This again stresses the importance of studying current and future college-aged students to help understand in which environments they learn best, especially when students' preferences differ from those of their faculty members.

Technology in the Classroom

Because of the critical nature of understanding today's college students in the environment in which they function, many researchers have focused their work on the students' use of technology in different areas of their lives. Flowers et al. (2000) discuss the history of computer use in classrooms. They specifically look at student familiarity with computers, their access to computers, and how their success is based on computer use (Flowers 2000). Their research is based on a study by Kuh and Vesper which showed a significant positive relationship between familiarity with computers and self-reported gains in self-directed learning, writing clearly and problem solving (Flowers 2000). Flowers et al. (2000) built on this research by trying to estimate the extent to which computer and email use influenced cognitive and/or intellectual growth during the first year of college. They used the College Student Experiences Questionnaire developed by Kuh and Pace in 1979, and a Computer Use Scale to obtain their information (Flowers 2000). The most important result of this study was an apparent significant effect of age on computer use; the older a student was, the less likely it was for computers to have a positive effect on his or her learning experience (Flowers 2000).

Galowich (1999) looked at how teachers are effectively integrating technology into classrooms. He found that there was a relationship between the teachers' attitudes towards technology and their willingness to use it in their classrooms (Galowich 1999). Gilbert and Han (1999) discuss a specific program, Arthur, which delivers information online to students taking the same course. This online program modifies its delivery method based on the learner's responses and alters the style of teaching based on the students' learning methods (Gilbert 1999). Shaw and Marlow (1999) looked at the

research that linked optimal learning environments with the use of information and communication technology. The researchers specifically found that learning method was positively linked to student attitude towards the use of information technology (Shaw 1999).

Personality Theory and Technology in the Classroom

Although many studies have linked certain general learning methods to ease of use and attitude towards technology, few, if any, link specific Myers Briggs personality types to success in a high-technology environment. Chambers (2003) looked at teachers' personality type and how it related to their use of technology in the classroom. She found that the Intuitive and Thinking types were more likely to use technology than others (Chambers 2003). In an analysis of different research in the area of technology and personality type, Dewar and Whittington (2000) found that many researchers suggest that Introverts are over-represented as compared to population norms in the online environment (Dewar 2000). Some researchers suggest that there is a difference in how these two types enter into the virtual community; Introverts are typically more comfortable spending time thinking about a decision before they respond to it (Dewar 2000). They are therefore more likely to be at ease online where they can take time to process information, make decisions, and come to a conclusion (Dewar 2000). Extraverts are less likely to act this way and therefore are more likely to be impatient with the online environment (Dewar 2000).

Several other studies have suggested that Intuitives are also over-represented in terms of people using the internet to learn (Dewar 2000). Researchers postulate this might be because the internet environment is better suited to people who learn globally as

opposed to Sensors who like step-by-step methods better (Dewar 2000). Jones (1994) also looked at several studies in this area. He found some inconclusive or inconsistent information in the literature (Jones 1994). Some research postulated that those with preferences for Sensing and Thinking would be less likely to have anxiety about computers but they found exactly the opposite (Jones 1994). Others showed that among people working with computers as their profession, there is a higher proportion of Thinkers and Intuitives than their opposite counterparts (Jones 1994).

Although this research is useful, there is little research connecting students' personality types to their ability to be successful in a high-technology classroom. In addition, there is not clear information on which personality type specifically is more useful in making this prediction.

MBTI Scales and Technology

Although the Myers-Briggs Type Indicator has four different scales as part of its measure, this research study will focus specifically on two, the Sensing vs. Intuiting (SN) and Thinking vs. Feeling (TF) scales. There are several reasons for narrowing the scope to these two areas, including prior research and applicability to technology more specifically. The SN dimension specifically measures a person's preference in relation to cognitive perception (O'Brien et al., 1998). Someone who is Sensing usually relies more on his or her five senses to interpret information whereas someone who is Intuiting uses a more abstract, internal process (O'Brien et al., 1998). The TF dimension looks at how an individual makes decisions, either on the basis of logic and facts (T) or their values (F) (O'Brien et al., 1998).

Prior research has focused in these dimensions because they most closely relate to how a person actually learns and takes in information in a classroom setting, especially when it involves technology. Although some of the research in the previous section has found significant results on other scales (Chambers 2003, Dewar and Whittington 2000), most find significance specifically on the Thinking vs. Feeling and Sensing vs. Intuiting scales (O'Brien et al. 1998, Dewar and Whittington 2999, several studies as cited in Jones 1994).

Several studies Dewar and Whittington (2000) found suggested that Intuitives may be overrepresented because the holistic and hypertext environment is more suited to Intuitives as opposed to Sensing types who seek a linear or step-by-step environment (Dewar 2000). The same is said for Thinkers and their over-representation, although there is not as much data available that actually explains this (Dewar 2000).

Problem Statement

Students coming into colleges and universities today have a much broader understanding of technology than ever before. University advisers constantly have to keep up with this ever-changing high-technology population of students, however, there is not currently an effective way to assess student needs while at the same time keeping their best interests in mind. There are numerous learning and personality theories in the literature, many of which are used in practice on college campuses (Mizell 1990; Lockitt 1997; Miller 2001; Muir 2001). None of these theories is more widely used and validated than Carl Jung's which was furthered by the research of Myers and Briggs (Shuit 2002).

Furthermore, there is little, if any, research on how a student's Jungian personality type can affect their success in a higher education course that uses a large amount of

technology. Consistent and relevant research is also lacking that specifically links a student's learning style to their acceptance and aptitude with technology in the classroom. Research has shown that a teacher's learning style can effect their teaching methods and openness to using technology (Smith 1995; Galowich 1999; Grasha 2000; Chambers 2003) and that learning styles can potentially be altered by the use of technology (Cohen 1997; Cohen 2001). Other studies have looked at the Myers-Briggs Type Indicator and how it accurately predicts a student's comfort level with the internet or a high-tech environment (Jones 1994; Dewar 2000; Grasha 2000; Russell 2002). Few, if any, have looked at whether a student's personality type can predict their level of success in a technology-rich environment. Those that did have not specifically studied the relationship between the personality type variables and outcomes in an actual class, basing results on final course grades. Specifically on the Thinking vs. Feeling variable, additional challenges have entered into the prediction because of the significant difference normally found between the genders (Briggs-Myers & McCaulley 1985).

Further, no research has specifically studied this factor using regression analyses to test the personality type while controlling for other factors such as gender and intelligence. Having more reliable and valid information about college-aged students is critical to advisers and educators in general whose primary responsibility is the growth of their students.

Purpose

The purpose of this research is to further investigate whether a student's personality type, specifically on the Sensing vs. Intuiting and Thinking vs. Feeling scales, can be used to predict success in a technology-rich classroom environment.

Research Questions

1) What is the predictive value of an individual's preference for Sensing vs. Intuiting on achievement in a model that controls for gender differences and SAT score?
2) What is the predictive value of an individual's preference for Thinking vs. Feeling on achievement in a model that controls for gender differences and SAT score?

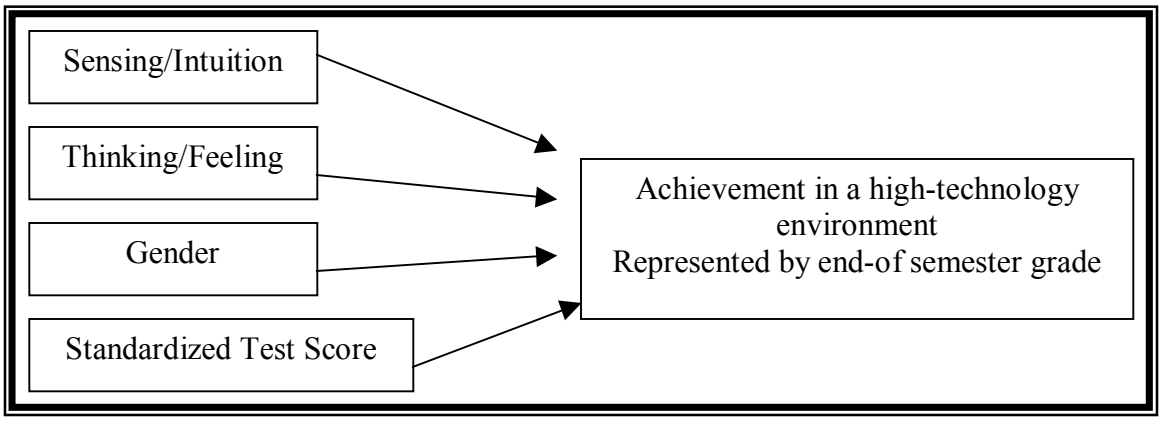

Figure 1. Conceptual Framework

Definitions (in order of their appearance)

Millenials- the cohort of people born after 1982 who possess a unique set of characteristics including: overprotection by their parents, a strong sense of authority, technology as a major influence in their lives, and a problem with being "ordinary."

Higher education professionals- refers to anyone working in higher education that has interaction with students, more specifically: advisers, counselors, staff, and professors.

Technology- refers to any advanced electronic method of information transmission, including via the internet, computer, PowerPoint presentations, video, teleconferencing, and Instant Messenger.

Personality theory- the idea first initiated by Carl Jung that suggests that human behavior is not random but in fact is predictable and classifiable; this pattern of behavior reflects the person's preferences for taking in information and making decisions and reflects where a person feels the most comfortable.

Personality dimension- refers to one of the four scales of personality type included in the Myers-Briggs Type Inventory: Introversion vs. Extraversion, Sensing vs. Intuition, Thinking vs. Feeling, or Judging vs. Perceiving.

Delimitations and Limitations of this Study

This research is limited in scope to the freshman student population in the First Year College at North Carolina State University who are enrolled in Chemistry 101. One limitation of the MBTI instrument that applies here is that younger students yield scores with lower reliability coefficients than do adults aged 20 or older. The use of Chemistry 101 may add a confounding factor to the research because it is known as a difficult course for freshmen. Although a random sample will be taken to obtain this group, the sample will only be taken from a portion of the First Year College students, the ones who have taken Chemistry 101. First Year College students will be used because they are the only group of freshmen on campus that takes the MBTI as part of their curriculum.

These students are also typically automatically enrolled in Chemistry 101 before orientation, because of that course's ability to count as a natural science for every major on campus. This will put some limitation on the research's generalizability to the population.

LITERATURE REVIEW

Millennials and Virtual Communication

In studying students who are approaching college age, researchers discovered that 94% of respondents use the Internet for school research and that 78% felt that the Internet helped them with schoolwork (Oblinger 2003). Seventy percent of these students use some form of instant messaging to communicate, something with which most older generations are either not familiar or not comfortable (Oblinger 2003). A good percentage, 41%, of respondents mentioned using either email or instant messenger to contact their teachers or schoolmates about class work including some who are just entering high school (Oblinger 2003). Maybe most surprisingly to current administrators, faculty, and staff, is that over half (56%) of these students prefer communicating by email rather than the telephone (Oblinger 2003).

Although only 19% of students in college communicate with their professors more over email than face to face, over half set up these meetings through email (Oblinger 2003). 75% of students use e-mail to help clarify assignments and almost 90% have received class announcements via e-mail (Oblinger 2003). An overwhelming 73% of students are more likely to use the Internet for research than actually go to the library (Oblinger 2003). Millennials in general thrive on change and expect to change jobs, environments, and situations often in their lives (Hoke 2004). The internet is an environment that changes along with them and in turn, they feel more comfortable in cyberspace (Hoke 2004).

Millennials and the Classroom

One phenomenon that specifically relates to the Myers-Briggs Type Indicator (MBTI) in college-aged students is the difference in characteristics of college students in the Millennial generation. Schroeder (1993) discusses this new generation that is currently in our higher education institutions. He points out the problems these students are causing; differences between students and their instructors that might cause low morale, a sense of discouragement, and tendencies toward despair that are prevalent across the country (Schroeder 1993).

The researchers studied over 4000 entering students, all of whom were given the MBTI (Schroeder 1993). Schroeder focused many of his initial studies on the categories of Sensing and Intuiting and the learning methods of these students (Schroeder 1993). The researcher found that Sensing students are characterized by a preference for direct, concrete experiences, moderate to high degrees of structure, linear, sequential learning, and often, a need to know why before doing something (Schroeder 1993). In general, these students prefer the concrete, practical and the immediate (Schroeder 1993). They lack confidence in their intellectual abilities and are uncomfortable with abstract ideas (Schroeder 1993). These students can have difficulty with complex concepts and have a low tolerance for ambiguity (Schroeder 1993). Often, they are less independent in thought and judgment and more dependent on the ideas of those in authority (Schroeder 1993). Sensing students are also more dependent on immediate gratification and exhibit difficulty with basic academic skills such as reading and writing (Schroeder 1993). They find security in structure and clarity and will often request specific information on the length of writing assignments, the content of examinations and what they should know

from lectures (Schroeder 1993). These students often indicated that they came to college for the end reason of being well-off financially and to have administrative responsibility (Schroeder 1993).

In contrast, the researcher found that Intuiting students are generally global, big picture learners (Schroeder 1993). They prefer to focus their perceptions on imaginative possibilities rather than on concrete realities (Schroeder 1993). Intutitives love the world of concepts, ideas, and abstractions, usually going from theory to practice (Schroeder 1993). They prefer open-ended instruction to highly structured instruction and prefer diversity in ideas and learning options (Schroeder 1993). They are not uncomfortable with ambiguity (Schroeder 1993). These students indicated that their reason for going to college primarily was to become accomplished in the performing arts, contribute to scientific theory, develop a philosophy of life, write original works, or create artistic works (Schroeder 1993). In general, in the national data among college-aged students, Sensing is the more prevalent personality type on campuses (Schroeder 1993).

Faculty and Millennials

It is important to consider the faculty who teach this new generation of students in their courses. Faculty in general tended to prefer the Introverted Intuiting (IN) pattern (Schroeder 1993). In fact, MBTI data collected over several years revealed that over 75% of faculty preferred Introverted with a majority combining this with Intuiting (Schroeder 1993). Fewer than 10% of these faculty preferred the Extraverted Sensing (ES) pattern (Schroeder 1993). For students who preferred the ES pattern, experiential learning that actively engages their senses in the subject matter is often highly effective (Schroeder 1993). However, this is not often found because of the very small amount of

faculty who share this preference (Schroeder 1993). New students preferred concrete learning experiences on which they could build toward an abstract understanding (Schroeder 1993). Compared to their predecessors, these new students also preferred a higher degree of personalized attention (Schroeder 1993). The researchers suggested further study to help faculty, administrators and staff to understand this gap that exists and to help find ways to bridge it (Schroeder 1993).

Jungian Theory- the Dimensions

In the midst of their research on the reliability of the Myers-Briggs Type Indicator (MBTI), Capraro and Capraro (2002) discussed the foundation of the instrument: the theory in which it is grounded. Myers and Briggs based their research on Carl Jung's personality theory (Capraro & Capraro 2002). They designed the MBTI to report a person's preferred way of attending to work and making decisions based on psychological types (Capraro & Capraro 2002). It measures the basic preferences of people in regard to perception and judgment (Capraro & Capraro 2002). It is important to note, however, that although everyone has a preference in each of the categories towards one way or another, a person's inferior function does develop in some respect (Folger 2003). It is a little like being right or left-handed, one is preferred but the other is used to some extent.

The Extrovert vs. Introvert (EI) dimension focuses on whether one's general attitude toward the world is oriented outward to other persons and objects or is internally oriented (Capraro & Capraro 2002). The Sensing vs. Intuition (SN) dimension reflects whether a person prefers to rely primarily on observable facts detected through one or more of the five senses or relies on insight and a so-called "sixth sense" (Capraro & Capraro 2002). The Thinking vs. Feeling (TF) dimension involves the logical thinking

and decision processes or a more subjective, interpersonal feeling approach (Capraro & Capraro 2002). The Judging vs. Perceiving (JP) is the decision-making attitude portion and shows a preference for making prompt decisions, for planning and organizing activities or a preference for flexibility and spontaneity (Capraro & Capraro 2002).

In the context of exploring the validity and reliability of the MBTI, Carlson (1989) discusses the different personality dimensions in detail. The SN scale relates to a person's preference either for empirical, sense-based data or for self-generated information hunches (Carlson 1989). The TF scale attempts to measure the difference between the respective tendencies of some people to prefer logical, synthetic, or analytical approaches to information and the preferences of other people for more personal, subjective, and evaluative assessments of information (Carlson 1989).

Jungian Theory- Type Data

Denham (2002) discussed some of the important basics of the Jungian theory. Jung suggested that human behavior is not random but is in fact predictable and therefore classifiable (Denham 2002). He postulated that people differ from each other in basic ways, although we all have the same sort of underlying instincts (Denham 2002). Jung thought that the most important thing is how we, as humans, prefer to function (Denham 2002). Each of us can be described as having a unique, specific personality type based on our preferences (Denham 2002).

Cummings (1995) researched to see if MBTI Types did actually stay consistent with age. He used data from the Center for the Applications of Psychological Type, one of the main centers in the country for the study of Jungian theory co-founded by Isabel Briggs Myers and Mary McCaulley (Cummings III 1995). Cummings (1995) focused on

the 16 tables from the MBTI Atlas of Type Tables which classifies type by age and sex (Cummings III 1995). Type tables are a method of looking at the 16 types for multiple people at once (McCaulley, 1990). Because these tables can display type information for a number of individuals simultaneously, researchers and counselors have a graphical means of exploring data for groups (McCaulley, 1990). Type tables give counselors an increasing understanding of individuals, groups, and families, by showing them a general set of normative expectations (McCaulley, 1990).

The particular tables Cummings used reflect eight different age groups ranging from 15 to 60+ and reflect data from Forms F and G of the MBTI given from 1971 to December 1982 (Cummings III 1995). He also chose several other groupings of participants in order to have groups to compare results (Cummings III 1995). In addition, he wanted to see how this information effected the population estimates for MBTI types (Cummings III 1995). Critical normative data was discussed including that 70-75% of the population preferred Sensing to Intuition (Cummings III 1995). The TF scale was about 50/50, however, 60-70% of men preferred Thinking whereas 60-65% of women preferred Thinking (Cummings III 1995). The most Ss were found in the younger and older age groups; these extremes were at the ends while those groups in the middle ages produced significantly less S results (Cummings III 1995). The same relationship with the opposite effect was found within the Ts, where there were the most in the middle age group (Cummings III 1995).

The authors gave several reasons why these results might have been found (Cummings III 1995). There might be a true developmental change in people's personality type (Cummings III 1995). Over time, people's willingness to self-report

certain behaviors might differ (Cummings III 1995). There might be an inherent difference between generations, especially in their values (Cummings III 1995). Finally, there could be some sampling differences between age groups (Cummings III 1995).

MBTI and Giftedness

Folger (2003) did a study to further investigate claims that most gifted students had Thinking personality types. In the introduction, he discussed Jung's personality functions as opposite sides of the personality (Folger 2003). Even though the inferior function does develop, its effectiveness as a part of the personality is less so than the other dominant function (Folger 2003). This particular study used a five year group of college scholars (N=93) from Central Michigan University from 1990-1994 (Folger 2003). This group was compared with data from the Center for the Applications of Psychological Type (CAPT) national average data to see if the scholars' types, especially on the TF scale, were different (Folger 2003). Some would postulate that most scholars would be Ts, but surprisingly, this was not the case (Folger 2003). Over 50% of the individual scholars assessed devalued the decision-making function T (Folger 2003).

Going further, using Chi Square analyses to look at combinations of personality types, Folger (2003) found additional interesting information. Compared to the CAPT national data, Introverted Perceivers were over-represented amongst this group of scholars (Folger 2003). Sensing Thinkers were under-represented, Intuitive Perceivers were over-represented and introverted sensors were under-represented (Folger 2003).

MBTI and Ideal Learning Environments

Brownfield (1993) discussed the MBTI in general and also linked Jungian personality types with learning methods in students. She discussed each personality type

and the learning preference that matched it (Brownfield 1993). Brownfield (1993) believed it is critical to be able to use MBTI personality types to describe a student's learning to allow educators to understand how their students process and use the information they are given, and to give ideas on how to best reach all students in the classroom.

Brownfield found that students who were Sensing liked to look at the reality of a particular situation and see the world as it truly is (Brownfield 1993). They preferred to work with theories and procedures and learned best when they could work with something concrete that can be seen, heard and handled (Brownfield 1993). Sensors could easily memorize facts and numbers and excel in subjects that play on this talent (Brownfield 1993). They were not very imaginative as opposed to their Intuitive counterparts who were more likely to look at the big picture of what they were learning (Brownfield 1993). Intuitors tried to grasp the overall relationship between ideas and trusted hunches that they may have (Brownfield 1993). An average classroom can hinder these students because they can not be as creative as they might like to be (Brownfield 1993).

The Thinking vs. Feeling scale measures how students like to make decisions (Brownfield 1993). Thinking students made decisions after a good amount of analysis, weighing of the outcomes, and thinking about what might be truly "right" (Brownfield 1993). They performed best when given a set of criteria or expectations and worked without thinking about their own or others' feelings (Brownfield 1993). Feelers, on the other hand, were much more motivated by feelings when making decisions, either their own or others involved (Brownfield 1993). They did not typically enjoy a strict, rigid

classroom and liked to use communication (Brownfield 1993). When they learned something new, they preferred to understand where it fit into the overall scheme of humankind and learned best when they are personally encouraged (Brownfield 1993).

MBTI and General Classroom Success

Carrell (1993) studied students' MBTI scores and their success in an English Composition course. More specifically, she focused on students who were studying English as a second language (ESL) (Carrell 1993). In introducing the research, she acknowledged that individual differences in learners themselves influenced the effectiveness of various instructional methods (Carrell 1993).

The study itself centered around students taking a composition class and specifically, how effective their writing was (Carrell 1993). The subjects were students from nine sections of first-year writing classes at the University of Akron (Carrell 1993). There were three different types of classes represented, Basic Writing, Composition I and ESL Composition I (Carrell 1993). Each of the participants took the MBTI Form G which is specially designed for ease of use with non-native speakers (Carrell 1993). Results were reported, and more importantly, the MBTI raw scores were also used (Carrell 1993). This allowed the researchers not only to use a participant's personality type, but also to factor in the clarity of that type (Carrell 1993). A writing sample was also collected from each student and scored by a panel of raters (Carrell 1993).

Among the ESL students, there was a great deal of homogeneity; only eight of the sixteen possible type combinations were represented (Carrell 1993). There were several different smaller significant results found, however, more importantly, the researchers found that ESL writers who were Intuitive, Feeling and Perceiving tended to use greater

lexical diversity in their writing (Carrell 1993). An explanation for this may be that these students tend to be less concrete and more flexible, creative, esthetic, insightful and imaginative in their style (Carrell 1993). One limitation might be that unlike the other groups of students, the ESL papers were written solely in class (Carrell 1993). Also, only one of the three groups of students had types that were similar to national MBTI data among college-aged students (Carrell 1993).

Borg and Shapiro (1996) specifically looked at students' MBTI scores and their level of success in economics. They used 119 students at the University of North Florida who were enrolled in a Principles of Macroeconomics course (Borg 1996). The researchers found that personality type had an effect on how professors taught and how students learned economics (Borg 1996). More specifically, when the students' temperament type matched the professor's, they performed significantly better in the class (Borg 1996).

Gender Differences in the MBTI

Rideout and Richardson (1989) discussed the disparity between males and females on the TF scale. Their research focused on teambuilding, however, they included some important general information (Rideout 1989). Approximately 60% of the male population preferred Thinking while about 65% of the females preferred Feeling (Rideout 1989) They paraphrase to say that normally the Thinking function is thought of as the analytic factor while the Feeling function is thought of as the bonding factor (Rideout 1989). Thinking types contribute to society through intellectual criticism while Feeling types normally contribute through support of good works (Rideout 1989).

General Computer Use in the Classroom

Flowers et al. (2000) discussed the history of computer use in classrooms, including percentages of use over time. They did an extensive literature review that included substantial work focusing on computer use in courses and its influence on learning in that course (Flowers, 2000). Student familiarity, access to and use of computers and success based on computer use were further investigated to determine if there was a cognitive effect (Flowers, 2000). They specifically discussed Kuh and Vesper's study that showed a significant, positive relationship between familiarity with computers and self-reported gains in self-directed learning, writing clearly, and problem solving (Flowers, 2000).

Their research built on that idea by estimating the extent to which computer and email use influenced standardized measures of cognitive or intellectual growth during the first year of college (Flowers, 2000). The participants were first-year students at 18 four-year and five two-year colleges and universities all over the United States (Flowers, 2000). The schools were chosen so that a wide array of institutions and institutional variables were represented (Flowers, 2000). A group of 3840 students were paid for their participation in the study, which included taking a reading comprehension test, the College Student Experiences Questionnaire and a Computer Use Scale (Flowers, 2000). The most important independent variables that were looked at in the study were extent of computer use and extent of email use (Flowers, 2000). There was an initial testing phase along with a follow-up session (Flowers, 2000).

Several regression analyses were used to analyze the data (Flowers, 2000). The researchers found that there was significantly more computer use at the four-year

institutions than in the two-years ones (Flowers, 2000). However, when student differences were controlled for, this difference disappeared (Flowers, 2000). Gender did not seem to play a factor in predicting computer use (Flowers, 2000). They found no difference in the 4-year students but some in the 2-year students (Flowers, 2000). Age seemed to be a factor in creating differences among the participants (Flowers, 2000).

Personality Type and Computer Use

Russell (2002) explored students' experiences with asynchronous interactions with other students and their instructors during an online study module. The study was designed to assist people in understanding how knowledge of the MBTI could be used to promote partnerships (Russell, 2002). He provided useful information on personality types and their relationship to technology (Russell, 2002).

Geisert (1991) researched whether specific computer software responded to how an individual learned and if that depended on the learning method of the student. He said that most computer programs are designed for sequential (Sensing) learners and are best for this group because they think in a step-by-step pattern (Geisert, 1991). This is completely opposite from how global (Intuitive) processors think (Geisert, 1991). Analytic thinkers focus on details, which is very difficult for global learners to do (Geisert, 1991). The researcher also discussed how there are auditory, visual and tactile learners and each did better when learning new material if they were presented the material in their preferred style first (Geisert, 1991).

Chambers (2003) did a study using the MBTI to predict teachers' use of technology. The MBTI was used along with a questionnaire designed to determine their willingness to use technology (Chambers, 2003). Overall, the findings indicated the

Intuitive and Thinking types were more likely to use technology while the Sensing and Feeling were the least likely (Chambers, 2003).

Grasha (2000) discussed technology and learning methods. He used the Grasha-Riechmann Student Learning Styles Scale and the MBTI to do the research (Grasha, 2000). In the study, he connected teaching styles with the learning styles they reinforced (Grasha, 2000). Questionnaires were given to instructors delving into the different types of instructional technology they used (Grasha, 2000). A majority of the instructors reported that they used email, internet, video, and PowerPoint in the classroom (Grasha 2000). Others reported even more technology, such as news groups, distance learning, and an electronic classroom (Grasha 2000). The research looked at the patterns of student grades in the classes with and without technology and their learning styles (Grasha, 2000). There were no statistically significant differences in grade distribution between the technology and non-technology classes (Grasha 2000).

Jones (1994) did research that attempted to identify variables that help to predict attitudes toward computers and computer use. He cited several studies he used that were inconclusive in the past such as Rosen and Weil (1990) who found that efforts to identify the key features that limit use of computers have been inconclusive (Jones 1994). Some have suggested that persons with negative attitudes toward computers were likely to be more intolerant of ambiguity and more alienated (Jones 1994). However, it is noted that these people are not inflexible, disorganized persons who dislike attending to detail (Jones 1994).

Jones (1994) also discussed the work of Igbaria and Parasuraman who did a major study on MBTI type and how it correlated to computer attitudes. They initially thought

that persons with S and T codes would experience less computer anxiety and be more positive than those with N and F codes (Jones 1994). However, although they found significant results, it was exactly the opposite of what they thought (Jones 1994). Lower anxiety was found with the N and F types than the S and T (Jones 1994).

Other studies have also suggested a relationship between SN and TF dimensions and computer use in careers; finding a higher proportion of T codes in computer technicians than in the general population (Jones 1994). He saw another that found a higher incidence of both T and N codes among programmers than among the general population (Jones 1994).

In Jones' (1994) study, he looked at approximately 150 students in undergraduate and graduate courses that he taught. The participants overall reported highly positive attitudes, a score of 17.6, toward computers on a scale with a maximum score of 20 (Jones 1994). Gender differences were significant on only one of the questions that was designed to elicit probability of computer use (Jones 1994). Their overall data did not support differences comparing SN and TF codes, however, that changed when they looked at just those students who would meet criteria for clear or very clear preference, as opposed to moderate or lower preference (Jones 1994). There were significant differences on the SN dimension in reported likelihood to buy or borrow a computer and to complete a major task using a computer (Jones 1994). There were also significant differences on the TF dimension in reported likelihood of experimenting with a new computer package (Jones 1994). The more positive attitudes were associated with the N and T preferences (Jones 1994).

There are some important limitations of this study. A majority of the participants were female and all were seeking teacher licensure (Jones 1994). The instrument was self-reporting and the design was group-oriented instead of what might have been a more useful single-subject design (Jones 1994).

MBTI Types and Online Learning

Dewar and Whittington (2000) used the MBTI to look at online personality types. Specifically, they saw how participants used their MBTI type to deal with the challenges of learning in an online environment (Dewar 2000). There are some interesting facts in the background of this article (Dewar 2000). First, they discuss the importance of interpersonal relationships in education (Dewar 2000). They point out that only within trusting, real and empathetic relationships can true education take place (Dewar 2000). This is especially true in an online context, so it is important to understand how these relationships form, which is why the MBTI is critical (Dewar 2000).

Several studies Dewar and Whittington (2000) found have suggested that Intuitives may be overrepresented online because the holistic and hypertext environment is more suited to Intuitives as opposed to Sensing types who seek a linear or step-by-step environment (Dewar 2000). The same is said for Thinkers and their over-representation, although there is not much data out there that actually explains this (Dewar 2000). In a study they cite, Frederick Bail analyzed personal email with his students over several semesters and found some important results (Dewar 2000). Intuiting (N) students sent more replies and tended to write more non-required replies to peers that were longer (Dewar 2000).

Dewar and Whittington (2000) looked at graduate students who were studying at a Canadian University. The participants were previously given workshops about the MBTI and were well-informed on the concepts relating to the test (Dewar 2000). The program these students were in included classes during the summer that were given in person along with those during the year that were online (Dewar 2000). The participants were sent an invitation via email to participate in a "virtual" discussion over a three week period, 21 of those invited accepted and participated (Dewar 2000). One problem with the research was that one of the co-researchers was also a participant (Dewar 2000). The participants were presented a discussion paper that showed applications of their MBTI type to the online learning environment along with a list of personality type learning characteristics and were asked to reflect on these ideas (Dewar 2000).

In the study, three of the Intuitives commented on Sensing, suggesting that they had developed some Sensing traits to help them in the online environment (Dewar 2000). As in other studies, there was a marked gender difference in the TF scale, which unfortunately breeds stereotypes (Dewar 2000). This often causes the generalizations to pass over women with Thinking and men with Feeling because those might not fit the stereotypes (Dewar 2000). In this area, a number of the research participants disagreed with the accuracy of the characteristics given for each group (Dewar 2000). Feelers tended to agree that they found online communication cold and impersonal and would choose face to face over online in general (Dewar 2000). The Thinking students loved that they could debate ideas in a semi-anonymous way (Dewar 2000).

The participation patterns varied in the study (Dewar 2000). Feeling types showed a clear preference for the more informal portions of the conference while the

Thinking types participated little in the informal areas (Dewar 2000). When they did make comments in the informal areas, Thinkers were normally confined to the ideas of the research (Dewar 2000). For Feeling types, informal chat areas were vital, however, this may have disadvantaged Thinking types (Dewar 2000). This study's quantitative evidence showed that each group participated equally in different manners. Their experiences varied from person to person (Dewar 2000).

There are some limitations to the research of Dewar and Whittington (2000). The data may have been skewed because the research participants were enrolled in a leadership program that emphasized the value of developing collaborative relationships (Dewar 2000). Participants were all graduate students who were familiar with the MBTI and online learning (Dewar 2000). They were sent an email to participate in a virtual discussion over a three-week period (Dewar 2000). Not all types were represented in the study; in particular, Sensing types were underrepresented (Dewar 2000). There were also a limited number of participants and the participants knew one of the researchers well (Dewar 2000).

SAT Score as a Controlling Variable

Research on SAT score has shown that students' scores are good predictors of success in their first year of college. Success is measured by the students' grade point averages at the end of their first two semesters (Rigol 1997). Different factors such as sample size, gender, self-selection, interests, aspirations, and unequal educational opportunities among others cause score differences (Rigol 1997). Sample size can differ greatly by state (Rigol 1997). For example many more students in California (45%) take the SAT than students in other states such as Kansas (9%) (Rigol 1997). Reasons for

this include the number of students staying in state for college as opposed to those higher-level students who leave Kansas for highly selective schools out of state (Rigol 1997).

There are both racial and gender-based differences in terms of student choice of math and science courses and the general rigor of the courses they choose (Rigol 1997). This difference persists into the choice of major in these groups (Rigol 1997). For example, males choose Engineering, Business and Health and Allied Services as their top three majors while females choose Health and Allied Services, Social Sciences and History, and Business as their top three majors nationally (Rigol 1997). Student grades and preparedness levels vary from teacher to teacher, by academic area, and by school (Rigol 1997). Grades sometimes measure what a student has actually learned while other times measure amount of homework completed, class participation, or other class factors (Rigol 1997). Students also have unequal educational opportunities across the country (Rigol 1997). Differences in funding, teacher education, physical attributes of the school, class size, parental involvement and other factors play a role (Rigol 1997). For example, the higher the level of parental education, the more likely the students are to have been in settings with the best educational resources and opportunities (Rigol 1997). This is not always true, sometimes students from poorer backgrounds score at the highest levels (Rigol 1997).

One of the major SAT differences that has been studied nationally is in the area of gender. Previously, the major choices between genders were described, but there are other factors on which the genders differ (College Board 1998). The SAT better predicts how well females will do in college over males (College Board 1998). In research done

by the College Board Office of Research and Development (1998), a correlation of .62 was found between female SAT scores and first-year GPA (College Board 1998). In the same study, a correlation of .56 was found for males (College Board 1998). When high-school GPA is also factored in, the correlations jump to .71 and .65 respectively (College Board 1998). The SAT slightly under predicts GPA for females; this is made better when high school GPA is also factored into the equation (College Board 1998).

Females take the SAT more than males (College Board 1998). In recent years, 75,500 more females on average took the test than males (College Board 1998). The extra females tend to be less likely to have taken rigorous academic courses than other students (College Board 1998). This is because a greater proportion of low socioeconomic status females with less preparation attend college than males (College Board 1998). Females, in recent years, have been quickly closing the traditional gap with males in the math/science courses (College Board 1998). However, males tend to pick more math and science courses and more rigorous courses than females in their first semester (College Board 1998).

SAT alone is also the best predictor of student grades in most individual freshman courses for both genders, with the exception of English and other languages (College Board 1998). Additionally, SAT is the only way to compare students from different schools with different curricula that is both objective and subjective, especially when considering grade inflation (College Board 1998).

The Educational Testing Service ensures that psychometric validity and fairness in the SAT for all groups of people (College Board 1998). Validity is something that is critical to report for any test, especially one that is given on such a large scale. The SAT

has been found to be the best predictor of college GPA than any other single measure (Rigol 1997). Its prediction power is better with science, math, and other quantitative classes as well as with more highly selective and larger institutions (Rigol 1997).

Summary

In summary, many researchers agree that studying computer use in the classroom is an important direction to head in due to the Millennial generation of students we are educating on our campuses. There are many factors that enter into the student/professor relationship in a high technology environment including; what technology is used, what the personality type of the teacher is, what the personality type of the student is, the gender of the student, the level of preparedness of the student (including intelligence), and a student's willingness and ability to comfortably use technology as a part of their learning experience. Much of the research that exists in this area focuses on the student, teacher, or classroom from a current or past experiential point of view. In order to be able to better assist our students, research needs to be done that adds to our ability to predict student performance in the high-technology classroom environment.

METHODOLOGY

Survey Design

The research design is quantitative. Quantitative procedures generally involve predetermined, instrument-based questions along with performance and census data and statistical analysis. Response data were gathered using a survey tool, which is a useful method for gathering information from a large number of respondents.

According to Johnson (2001), all non-experimental and quantitative research can be sorted into groups based on two dimensions, time and purpose of research. He postulated a series of questions to help researchers decide what type of study they are using (Johnson 2001). For this study, the design is cross-sectional and predictive. The participant information was gathered at one specific point in time and is intended to be used to help predict behavior for the population of first-semester freshmen in the First Year College at North Carolina State University.

The Population and Sample

In this study, the population is First Year College students at North Carolina State University. There were approximately 3800 freshmen at North Carolina State for the 2004-2005 school year with 700 of those students enrolled in the First Year College (UPA 2004). These enrollment numbers are similar to those over the past five years, with just a slight increase each year. The sample of 660 students was randomly selected from a group of students who have been in the First Year College that have taken Chemistry 101 (CH 101) during their freshman year between the years of 2000-2005. CH 101 was selected because of its use of technology in all aspects of the course. The students were presented new information in class through PowerPoint presentations; they

used remote controls in class to answer questions and take attendance, and the students did homework on Web Assign, an online web-based application.

A record of all students taking the MBTI over the past 5 years was obtained from the Consulting Psychologists Press, the online site where the test is administered. The initial spreadsheet contained 4697 participants. A sample of 2000 students was selected using a random number table from a spreadsheet where all the students were included. Once selected, the student grades were gathered using their student ID, a number NC State randomly assigns to each student when they enter the University. Each student ID was found by looking the students up using their names. In cases where it was unclear if a student name matched the data we had, for example, when 20 people had the same name, that data was not used in this research. Once the students were found, each student's transcript was looked up in order to ascertain whether or not they had taken Chemistry 101. From the group of students that had taken Chemistry 101, each was further investigated to see if they had an SAT score in the system. Those that had both were used in this research (N=660). Once the Chemistry 101 grade and SAT score were gathered, all student names and ID numbers were deleted from the spreadsheet, protecting anonymity.

Instrumentation

The Myers-Briggs Type Indicator (MBTI) was designed by Kathryn Myers and Isabel Briggs-Myers, a mother-daughter team (Briggs-Myers & McCaulley 1985). They researched Carl Jung's personality types and spent over 20 years doing what they termed "type watching" (Briggs-Myers & McCaulley 1985). After observing those around them that they knew well, they noticed the behaviors that these people exhibited (Briggs-Myers

& McCaulley 1985). They subsequently started to formulate questions that would be able to identify those behaviors as Jungian personality types (Briggs-Myers & McCaulley 1985).

There are four scales on the MBTI; it measures four different aspects of a subject's personality (Carrell 1993). This study will focus on two of those aspects. A person can either be Sensing (S) or Intuiting (N), which refers to how someone prefers to take in information, either through the five senses or through what is like a "sixth sense" or intuition (Carrell 1993). They can also be either Thinking (T) or Feeling (F) which measures how someone prefers to make decisions, with their head or heart (Carrell 1993).

Myers and Briggs-Myers had several important requirements when formulating their test. Justice had to be done to both opposing viewpoints (Briggs-Myers & McCaulley 1985). The choices between the alternatives in the questions needed to be equally strong and the choices needed to both be legitimate (Briggs-Myers & McCaulley 1985). No inferiorities could be implied and no question could be too extreme (Briggs-Myers & McCaulley 1985). Most importantly, the content of the questions was not nearly as critical as the response it evoked (Briggs-Myers & McCaulley 1985). They had to accurately classify people into the different types (Briggs-Myers & McCaulley 1985).

The MBTI is the most widely used and popular personality assessment tool of its kind with more than 2.5 million tests given each year worldwide (Shuit 2002). Many Fortune 500 companies, including 89 of the Fortune 100, use the test as part of their hiring practices (Shuit 2002). A survey of counseling professionals showed that the MBTI is the third most frequently used test administered by counselors trailing the

Wechsler Intelligence Scale for Children- Revised and the Strong-Campbell Interest Inventory (Jones 1994).

The general form of the test is Form G, which has a reading level of at least 4th grade and is most appropriate for high schoolers and adults (Briggs-Myers & McCaulley 1985). Items in Form G and any later tests were rearranged from previous tests so that the questions that best predict a participant's type were located at the beginning of the test (Briggs-Myers & McCaulley 1985). This ensures that if someone does not finish completely, they still can receive an accurate measure of their personality type (Briggs-Myers & McCaulley 1985).

The students in this study took a modified form of the MBTI that is closely associated with Form G, called Form M. Form M is available for testing on the Consulting Psychologists Press (CPP) website, www.cpp.com (2004). You can purchase an instrument, take it, and get results on the website (CPP 2004). Each subject receives a multi-page report including a description of their type, a graph showing the strength of their preference, information about their characteristics, and career-related descriptions (CPP 2004).

Form M is an updated and revised version of the prior Form G which was created with the aide of Item Response Theory (IRT) to help update and improve the instrument (Pinfold 2004). The IRT allows for a selection of items that give better information about someone's preferences which leads to more accurate scoring (Pinfold 2004). It was developed after doing a large nationwide study with a sample of a few thousand adults in the United States (Pinfold 2004). By using IRT, the measurement properties on Form M were greatly improved as will be noted in the following sections (Pinfold 2004)

The MBTI offers subjects a series of forced-choice responses which prevents there being any type of bias or middle ground (Briggs-Myers & McCaulley 1985). Form M has 93 questions, both open phrased and word pairs (Briggs-Myers & McCaulley 1985). Phrased questions give participants a phrase such as "When you go somewhere for the day, would you rather…" and two choices to complete the sentence (Briggs-Myers & McCaulley 1985). Word pairs ask those taking the test to choose "which of these words appeals to you more…" (Briggs-Myers & McCaulley 1985). No items have more than two responses (CPP 2004). Each of the choices in both types of questions reflects a different side of one of the scales, E or I, S or N, T or F, and S or J (Carrell 1993). When a person gets his or her results they get a combination of the letters, leading to a 4 letter type of which there are a possible 16 (Carrell 1993). There are a number of different reports available including the report our participants receive, the Career Report (CPP 2004).

Operationalization of Variables

Someone is Sensing as opposed to Intuiting if they answer more of the questions dealing with this preference in the same way that the MBTI creators purport that Sensors would. The score for the Sensing responses is compared to the Intuiting responses to gauge relative strength of that preference. The same is true for the Feeling and Thinking scale. The score shows what preference an individual has. Each individual has aspects of both sides, however, the test measures toward which they have a tendency to lean. In addition, the test gives students a clarity index that indicates how clear their preference for a certain type is. There are different levels of clarity, ranging from low to high.

Gender is a self-reported variable on the MBTI itself and is collected through the CPP website. The participants' SAT score is a combination of their SAT Verbal and Math subscores as reported to the University during the Admissions process.

MBTI Reliability

Capraro & Capraro (2002) did a meta-analytic study on the reliability of the Myers-Briggs Type Indicator across many different research articles. Using ERIC and PsycLit databases, they searched for any articles between 1998 and September 2001 that mentioned the Myers-Briggs Type Indicator (Capraro & Capraro 2002). A total of 284 articles were found, of which 210 were available (Capraro & Capraro 2002). The remaining articles were coded for several criteria, including, most importantly, whether there was a reliability estimate (Capraro & Capraro 2002). Of these studies, only 7% estimated reliability for their own data and 26% reported any reliability (theirs or otherwise) at all (Capraro & Capraro 2002). The vast majority either didn't mention reliability at all (56%) or simply stated that the MBTI was reliable (Capraro & Capraro 2002).

These researchers mention it is most appropriate to speak of reliability as a factor of test scores or measurement rather than of the actual instrument itself (Capraro & Capraro 2002). It is important to find out what the typical score reliability estimate across administrations of a measure with respect to various study features is and also what the variability in score reliabilities across administrations is (Capraro & Capraro 2002). They also point out that substantive study characteristics may influence reliability estimates (Capraro & Capraro 2002).

In their research, younger students yielded scores with lower reliability coefficients than did adults aged 20 or older (Capraro & Capraro 2002). Higher achieving students' scores generated higher reliability indices than did those of underachieving students (Capraro & Capraro 2002). Many of the reliability estimates were inconsistent, ranging from .55 to .97 (Capraro & Capraro 2002). The lowest tended to be on the TF scale and the particular study that found a .55 had a very homogenous group of subjects in terms of ethnic background and gender (Capraro & Capraro 2002). On the test-retest reliability, the scores suggested consistency over time (Capraro & Capraro 2002). However, when respondents did show a change in type, it was usually only in one preference and also in the scales where they were originally not strongly differentiated (Capraro & Capraro 2002). In general, their results support the concept that a more heterogeneous sample often yields higher reliability (Capraro & Capraro 2002). The TF scale had the lowest reliability of any of the four scales; it was the only one that averaged below the acceptable .80 mark (Capraro & Capraro 2002).

Carlson (1989) embarks on a wide literature review of his own due to his skepticism of the MBTI and its merit as a personality test. He was surprised to find that in the literature, the MBTI showed favorable results (Carlson 1989). In his research, he found evidence of test-retest reliability, most importantly in a study that looked at scores of a group of people over five weeks (Carlson 1989). In each week, the subjects' moods were altered purposefully, however, their MBTI results remained the same (Carlson 1989).

Zemke (1992) reviewed the National Research Council's findings on the MBTI that were conducted by a panel of 14 psychologists. He pointed out both positive and

negative aspects of the MBTI, including the idea that the personality types are "memorable" which means people can easily recall information about each (Zemke 1992). A large percentage of people taking the test saw the results as valuable and confirmatory (Zemke 1992). There was also a high level of perceived impact on the individuals taking the test; it impacted their behavior in a good way after getting their results (Zemke 1992).

Although there were a lot of positive comments made, the overall report had a somewhat negative skew (Zemke 1992). Zemke (1992) reports that one of the most widely questioned aspects of the MBTI is whether the test can be easily manipulated to match what the respondent wants it to show (Zemke 1992). He also revealed that at least 37% of people taking the test for a second time had at least one factor changed (Zemke 1992).

Ring discussed several aspects of the reliability of the MBTI which had always been widely tested and evaluated, starting in its very early years (Ring 1998). The original tests had fairly strong reliability estimates with an internal consistency ranging from .75 to .85 except for the TF index which has a coefficient of .48 (Ring 1998). The reliabilities discussed were consistent with those of other personality inventories (Ring 1998). The researcher mentioned that there were generally lower reliabilities with younger respondents and those whose types were not well-defined (Ring 1998). The test-retest reliabilities of the different type categories generally showed consistency over time and changes were likely to occur in only one preference area, especially if that preference was low in the first place (Ring 1998).

Since the 1985 MBTI Manual publication, even more research on reliability of the MBTI has been done (Ring 1998). In different meta-analyses, average overall reliabilities of .84 to .86 have been found for internal consistency and .76 for temporal stability (Ring 1998). Generally reliability is somewhat dependent on the strength of the individual preference; the stronger the preference, the higher the reliability (Ring 1998). In fact, in those respondents where their preference was strong, 92% scored identically upon retesting (Ring 1998). That number decreases to 81% with those in the medium preference category (Ring 1998).

MBTI Validity

Capraro and Capraro (2002) found that several researchers have studied the construct validity of the MBTI, correlating the scores with findings from various personality instruments and inventories. Significant correlations have been found between MBTI scores, behaviors of the constructs, and a person's self-assessment of their type (Capraro & Capraro 2002).

Carlson (1989) discussed what is called "psychological validity", meaning that the test takers and those around them often agree that their results are appropriate. In fact, in many cases, people can estimate fairly closely what their results will be, after learning about the different dimensions, before actually receiving them back (Carlson 1989).

Ring further discussed the validity of the MBTI, stating that research has been done since the publication of the last manual, including several more sophisticated tests on the convergent, divergent and predictive qualities of the MBTI (Ring 1998). There have been many exploratory and confirmatory factor analytic studies which have

produced four-factor structures almost identical to the preference scoring system's (Ring 1998). Going further, type tables have been widely used to support the MBTI's validity (Ring 1998). Type tables are a method of looking at the 16 types for multiple people at once (McCaulley, 1990). Because these tables can display type information for a number of individuals simultaneously, researchers and counselors have a graphical means of exploring data for groups (McCaulley, 1990). These provide evidence for construct validity by showing that a significantly higher percentage of certain types fall within an area of interest than could be expected by chance (Ring 1998). In correlating the MBTI results with the only other instrument that measures Jungian types, there is a significant commonality of constructs that are hit on by both (Ring 1998). There is more consistency for the EI and SN scales than TF (Ring 1998).

Criticisms

Capraro and Capraro (2002) found that critics disliked the forced-choice response format. They also believe that the test is based on the false assumption that all people can be divided into groups (Capraro & Capraro 2002). There has also been some concern over gender weighting, especially on the TF scale (Capraro & Capraro 2002). Capraro and Capraro (2002) were concerned because many of the studies they looked at did not report their own reliability and validity information for their own data. They often fell back on the idea that the MBTI is generally widely accepted without going into that on their own (Capraro & Capraro 2002).

Vacha-Haase and Thompson (1999) add to these criticisms, pointing out that the scoring of the instrument is dichotomous. Although there are underlying continuous scores produced when an individual takes the MBTI, they are assigned to either one

classification or the other with no associated strength of preference (Vacha-Haase & Thompson, 1999). Essentially, the test produces a "prediction ratio" in order to be able to classify individuals into one group or another (Vacha-Haase & Thompson, 1999). The authors assert that Jung did not assume, in his research, that people had definite preferences for one type over the other (Vacha-Haase & Thompson, 1999).

Data Collection

Participants took the MBTI Form M in the Laundry Building, a computer classroom for the First Year College. Each student was given the same directions when taking the Inventory (Appendix A). They were only to enter their name and gender in the demographic section. Participants were to select the first name of their adviser from the drop-down batch list. Participants were asked to take their time and ask any questions they had along the way. The participants were allotted as much time as necessary to complete the instrument although most took less than 30 minutes. The instruments were sent electronically at the completion of the test to the Consulting Psychologists Press. The administrative staff in the First Year College retrieved and printed full reports for each student. The main data set was sent from the Consulting Psychologists Press to the First Year College, including information on over 4000 students and their personality type, gender, and clarity scores.

The data was further modified for the purposes of this research. Both the Extraverted vs. Introverted and Judging vs. Perceiving scales were taken out of the data set. These variables were not used because prior research has not indicated that they have a relationship to success in a high technology classroom environment. Some research has looked at the EI scale in an online classroom environment; however, the current research

is not focusing on that area. Additionally, each variable's clarity index as reported by the Consulting Psychologists Press, was given on a 30-point scale. This means that if a student had a clarity score of 15 for Feeling and another student had a clarity score of 15 for Thinking, their clarity preference score would be identical. The data was adjusted to a 60-point scale so that it indicated the direction of preference towards one type or another. The same two students above would have scores of –15 and 15 respectively on the new scale. The same adjustment was done with the Sensing vs. Intuiting scale.

Data Analysis- Descriptive

Data was analyzed using the SAS (Version 9.1) Statistical Analysis Software in order to answer the research questions in this study. General descriptive data is reported including information on the number of participants, their gender, and information about their SAT scores (mean, median, standard deviation).

Regression Analyses

To answer the research questions, two multiple regression analyses were used. In each, the final semester grade in CH 101 is the dependent variable, the personality type is the independent variable and gender and SAT score are covariates. One analysis was done to gauge the predictive value of the Sensing vs. Intuiting personality type on achievement, as measured by the final semester grade in Chemistry 101, while controlling for gender and SAT score. The second measured the predictive value of the Thinking vs. Feeling personality type on achievement, as measured by the final semester grade in Chemistry 101, while controlling for gender and SAT score.

Each regression was be run with the categorical variables, Sensing or Intuiting and Thinking or Feeling, as well as with the variables' clarity index scores on the –30 to

30 scale. In doing this, the results can be compared to see if there is a difference between the categorical and continuous data. If the results of the two regression analyses have different levels of significance as shown in the parameter estimates, further investigation will need to be done in this area. Additionally, the variables were being measured not only to see their relative effect on Chemistry 101 grade but also the magnitude of that effect by using the clarity indices.

RESULTS

Sample Description

The site of this study was a large (enrollment 30,000+), coeducational, land grant university in a Southeastern capital city with a population of 276,000. During the years of 2000-2005 approximately 4697 students completed the Myers-Briggs Type Indicator through the Consulting Psychologists Press (CPP) website in the First Year College (FYC) program. A random number generator was used to select 2000 out of the group to use in this study. The list of 2000 was further narrowed to the participants that had taken and received a grade in Chemistry 101, leaving 1079 participants. The group was then restricted to those who had SAT scores, leaving 660 participants. Those original participants who were not used in the study were deleted.

In order to analyze the data, some of the variables had to be converted before proceeding. Gender is a categorical variable, either male or female. The variable was dummy-coded so that males were represented as zero and females were represented as one. Similar changes had to be made to the MBTI categorical variables of Sensing vs. Intuiting (SN) and Thinking vs. Feeling (TF). Sensing was represented with a one and Intuiting with a zero. Thinking was represented as one and Feeling as zero. The final variables that had to be adjusted slightly were those of the MBTI preference clarity indices, PREF_SN for preference on the Sensing vs. Intuiting scale and PREF_TF for preference on the Thinking vs. Feeling scale.

Originally, these variables were represented on a scale of 0 to 30. All that the variables showed was the clarity of preference on the MBTI type; they did not specify on

their own what direction that preference was in. For example, someone who had a clarity index score of 15 on Thinking would have the same number as someone with a clarity index score of 15 on Feeling. In order to delineate, all of the Intuiting and Feeling scores were multiplied by –1, therefore creating a scale of -30 to 30 for each of the new variables, preference on the Sensing vs. Intuiting scale (PREFSN) and preference on the Thinking vs. Feeling scale (PREFTF). This way, the variables could be easily used in analysis and the results would be meaningful. A description of the MBTI Clarity Index can be found in Table 4.1.

Table 4.1 Myers-Briggs Type Indicator Clarity Index Values

Preference	Numeric Value
Very Clear	25-30
Clear	15-24
Moderate	5-14
Slight	0-4

A slight majority of the sample is male, as illustrated in Table 4.2. According to University data from 2005, the current sample is representative of the overall student population that has 43.5% females (UPA 2006). More participants tested as S on the MBTI than N and more also tested as F as opposed to T, as illustrated in Table 4.3. The variables of SAT score (SAT_T), Chemistry 101 grade (CH_101), preference on the MBTI Sensing vs. Intuiting scale (PREF_SN) and preference on the MBTI Thinking vs. Feeling scale (PREF_TF) along with the new preference variables PREFSN and PREFTF are reported in Table 4.5. Most participants scored above 1000 on the SAT, only 23 or 3.5% scored below this mark. The average SAT score among participants was 1180 (out of 1600). This data is also similar to the complete University population, which has an average SAT score of 1186 (UPA 2006). This table also illustrates that Chemistry 101

grades average slightly higher than a C+ (2.33), at 2.41. Table 4.4 shows the conversion factors from a letter to numerical grade in Chemistry 101. There were students at both ends of the spectrum, 18.64% received Ds or failed the course, while 18.79% received A and A+ grades.

Table 4.2 Participants by Gender

Gender	Frequency	Percent
Male	365	55.3
Female	295	44.7

Table 4.3 Participants by MBTI Preference on the SN and TF Scales

	S	N	T	F
Frequency	380	280	262	398
Percentage	57.58	42.42	39.70	60.30

Table 4.4 Chemistry 101 Grading Scale

Letter Grade	Numeric Equivalent	Letter Grade	Numeric Equivalent
A+	4.33	C+	2.33
A	4.0	C	2.0
A-	3.67	C-	1.67
B+	3.33	D+	1.33
B	3.0	D	1.0
B-	2.67	D-	.67
		F	0

Variable Characteristics

The scores for the original preferences on the MBTI were similar to one another. Both PREF_TF and PREF_SN had minimum scores of 1 and a maximum of 30 in terms of the strength of preference when using a 30-point scale, as shown in Table 4.6. As noted earlier, however, in order to complete this research, the 30-point scale was converted to a 60-point scale to illustrate preference in either direction. The new

variables are PREFSN and PREFTF and their characteristics are also reported in Table 4.6. These variables have minimums of –30 and maximums of 30. The mean for PREFSN is 1.99; the positive value indicates it is on the S side of the spectrum. This shows that slightly more participants preferred S to N. The mean for PREFTF, however, is –3.16 which is on the negative or F side of the scale, meaning that more participants preferred F to T overall. Those results are in line with the preference raw data reported in Table 4.2.

Table 4.5 Descriptive Statistics

Variable	N	Mean	Standard Deviation	Minimum	Maximum
SAT_T	660	1179.71	107.63	830	1490
CH_101	660	2.41	1.16	0	4.33
PREF_SN	660	11.68	8.07	1	30
PREF_TF	660	11.67	7.88	1	30
PREFSN	660	1.997	14.07	-30	30
PREFTF	660	-3.16	13.73	-30	30

The range, variance and standard error of all numeric variables in this study are represented in Table 4.6. The range is the distance between the minimum and maximum values in the data. Variance represents how spread out a distribution is and is calculated by adding up the squares of the standard deviation scores and dividing by the sum of the standard deviations. The standard error normally becomes smaller the larger the sample is. It represents the standard deviation of the sampling distribution. These statistics are another way to ensure that our sample is accurate, with no outliers or other problems that would alter the results.

Table 4.6 Range, Variance and Standard Error

Variable	N	Range	Variance	Standard Error
SAT_T	660	660	11583.98	4.19
CH_101	660	4.3	1.34	.05
PREF_SN	660	29	65.15	.31
PREF_TF	660	29	62.05	.31
PREFSN	660	60	197.9	.55
PREFTF	660	60	188.5	.53

Tests for Normality

An underlying assumption of multivariate research is that the data has a normal distribution. Before moving forward with regression analyses in order to test the research questions, it is critical that normality be tested for the numerical variables involved. The Shapiro-Wilk W statistic is a function of the SAS software system's normality testing procedure. The results of this test are found in Table 4.7. It shows that all of the variables were significant at the α=.05 level with the exception of SAT_T. It had a p-value of .06 and was seen to be approaching significance. Although it didn't meet the criteria for the Shapiro-Wilk test, the SAT_T was found to be significantly normal on every other test that SAS runs for normality.

Table 4.7 Tests for Normality

Variable	N	Shapiro-Wilk W	P value
SAT_T	660	.996	.06
CH_101	660	.95	<.0001
PREF_SN	660	.94	<.0001
PREF_TF	660	.94	<.0001
PREFSN	660	.99	<.0001
PREFTF	660	.99	<.0001

To further investigate normality, it is also important to look at stem-and-leaf graphs and boxplots for the variables. These results can be seen in Figures 4.1-4.6. The

graphs show further proof that the numerical variables in this study are normally distributed.

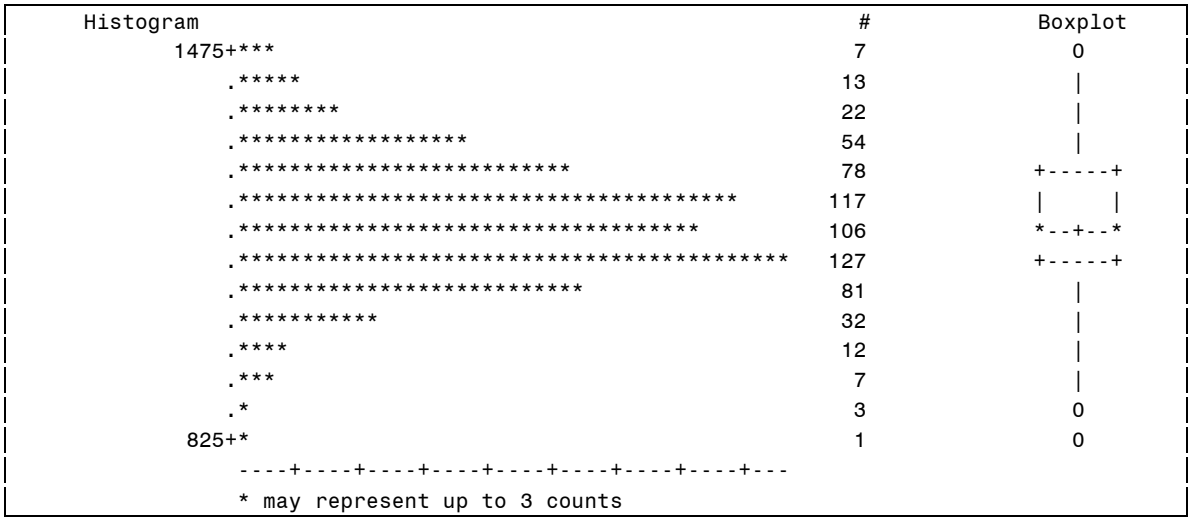

Figure 4.1 Histogram for Variable SAT Total Score (SAT_T)

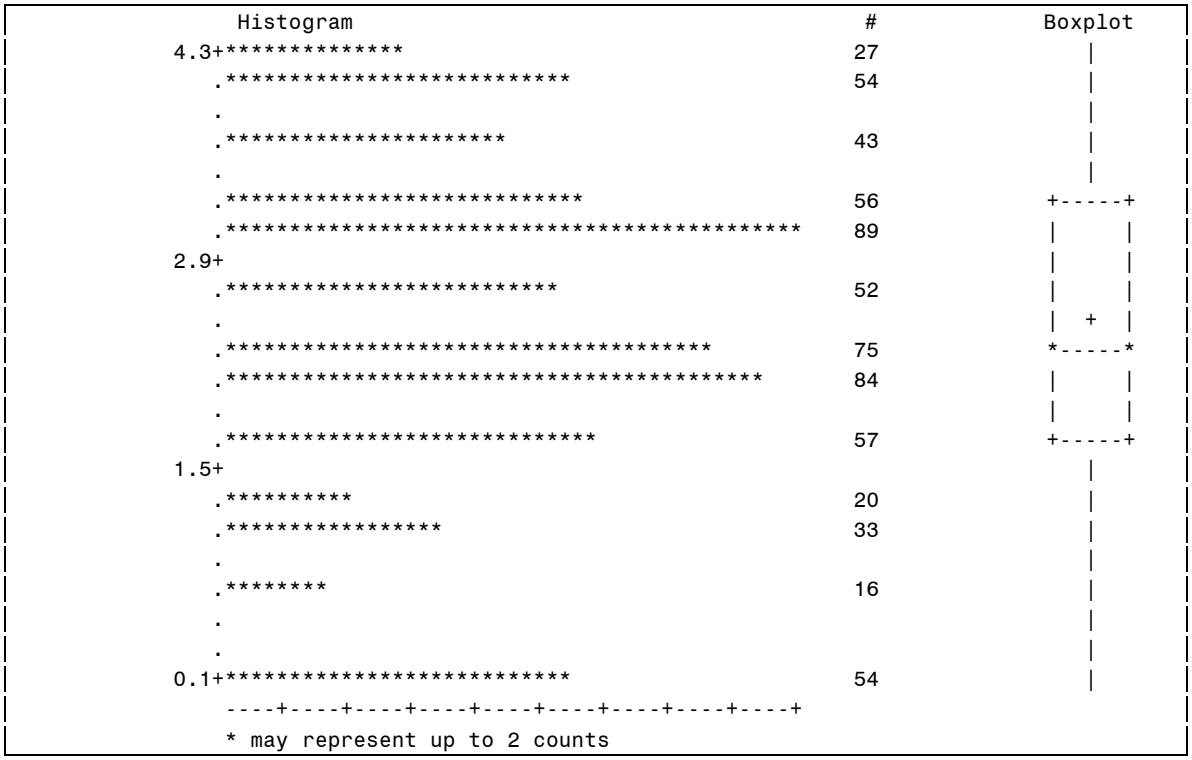

Figure 4.2 Histogram for Variable Chemistry 101 Grade (CH_101)

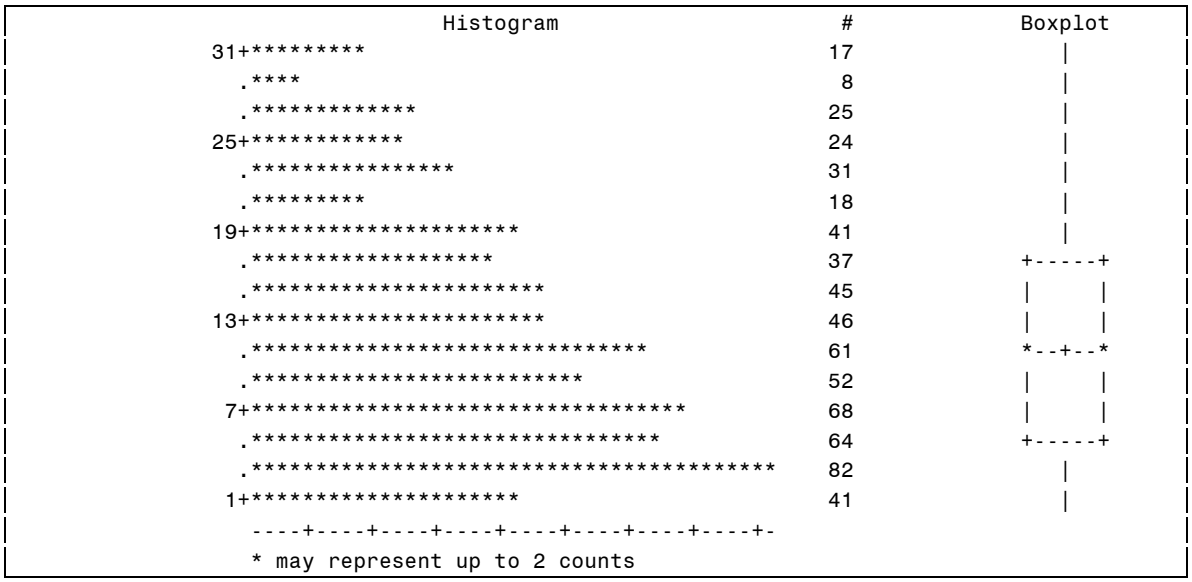

Figure 4.3 Histogram for Variable Preference on the Sensing vs. Intuiting 30 point clarity index (PREF_SN)

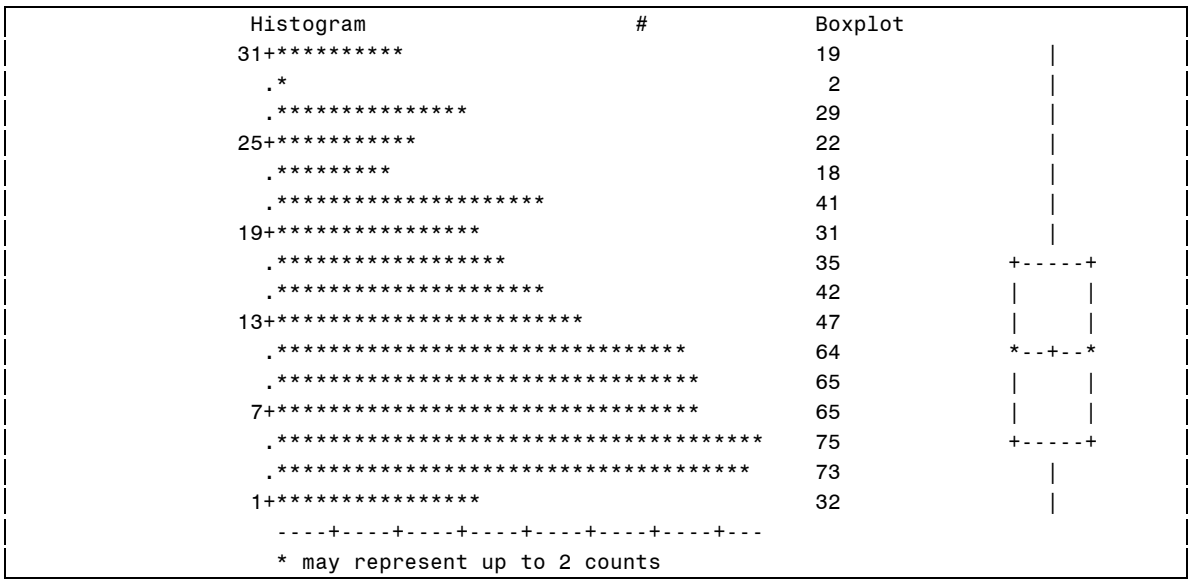

Figure 4.4 Histogram for Variable Preference on the Thinking vs. Feeling 30 point clarity index (PREF_TF)

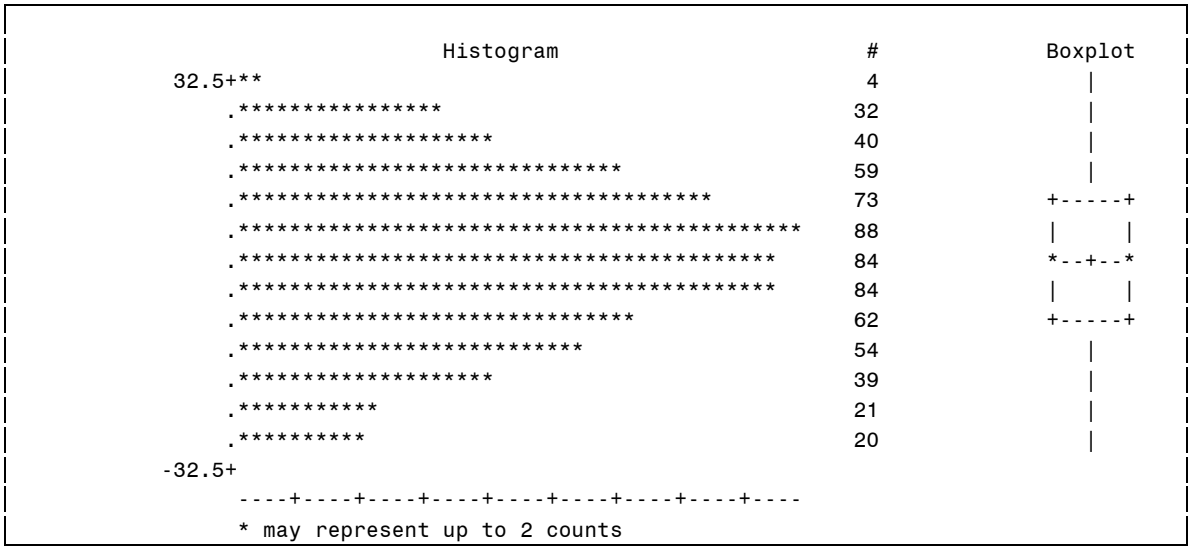

Figure 4.5 Histogram for Variable Preference on the Sensing vs. Intuiting clarity index after conversion to a 60 point scale (PREFSN)

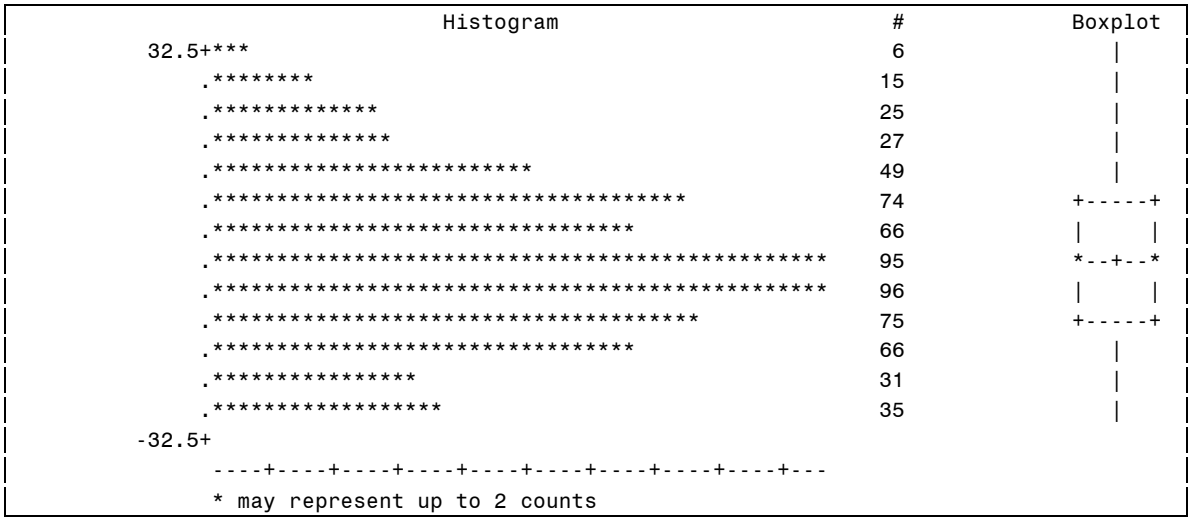

Figure 4.6 Histogram for Variable Preference on the Thinking vs. Feeling clarity index after conversion to a 60 point scale (PREFTF)

Correlation Statistics

When doing regression analyses, it is critical that the independent variables included in the model be correlated to the dependent variable. Otherwise, there is no reason to move forward with regression analyses because there is no relationship between the predictor variables, in this case gender, SAT total score, Sensing vs. Intuiting and

Thinking vs. Feeling, and the dependent variable, Chemistry 101 grade. Furthermore, the results of a regression analysis can be affected if the variables in the analysis are highly correlated with each other. This creates a problem because it is difficult to tell if results are significant because the predictor variables really are useful or if they show significance because they are so highly correlated with each other.

In this research, many of the variables were found to be significantly correlated. Because the researcher wanted the predictor variables to correlate with the dependent variable, in this case Chemistry 101, those tests were run first. Pearson Correlations were run for all of the continuous variables. In order to find correlation statistics for the categorical variables of gender, SN, and TF, ANOVAS must be used. These tests are the most appropriate when your predictor variable is categorical and your dependent variable is continuous.

As shown in table 4.8, all of the variables with the exception of PREFSN are significantly correlated with Chemistry 101 at the α=.05 level. The PREFSN variable was approaching significance with a p of .098; it was significant at the α=.10 level. Having Chemistry 101 grade and total SAT score correlated was not unexpected. The SAT measures scholastic aptitude and is usually used for college admissions processes. If a student does well on the SAT, supposedly the student will also do well in college. So the variables should, in theory, have some correlation with one another. As shown in Table 4.8, the variables have a correlation coefficient of .25, which is significant with a p < .0001. Similarly, PREFTF and TF or PREFSN and SN should correlate since they are measuring the same things in different ways.

The variables that may not have been expected to have a correlation would be GENDER with SAT_T, TF and PREFTF. However, as mentioned previously, there is a great deal of literature showing that in the general population, there is a large gender difference on the TF scale. Having that correlation exist is not that surprising. Each of these correlations is significant at the α=.05 level. They all have positive correlation coefficients. Additionally, SAT_T is correlated with SN, TF and PREFSN, PREFTF. These significant correlations could be troublesome because all of these variables are predictor variables, and having them correlate, as noted above, could contribute to a skewed result in the regression analysis. However, the correlation coefficients are significant but not large. Normally, a correlation coefficient of .8 or higher is considered to be a strong correlation and none of these variables come close to this number. If large enough, having correlation between predictor variables could lead to non-significant results in regression analyses. In this study, the coefficients and the model as a whole were all significant; therefore the correlation was not detrimental to the research.

Table 4.8 Significant Correlation Statistics for All Variables

Variable	Variable	Correlation Coefficient	Pr > r
CH_101	SAT_T	.25	<.0001
	GENDER	(F=5.01)	.026
	SN	(F=5.10)	.024
	TF	(F=9.28)	.002
	PREFTF	.15	.0002
	PREFSN	.06	.098
GENDER	SAT_T	-.12	.002
	TF	-.33	<.0001
	PREFTF	-.36	<.0001
SAT_T	SN	-.22	<.0001
	TF	.11	.006
	PREFSN	-.27	<.0001
	PREFTF	.12	.003

Research Questions and Multiple Regression Outcomes

The research questions in this study, as outlined in Chapters 1-3 are:

1) What is the predictive value of an individual's preference for Sensing vs. Intuiting on achievement in a model that controls for gender differences and SAT score?

2) What is the predictive value of an individual's preference for Thinking vs. Feeling on achievement in a model that controls for gender differences and SAT score?

To answer these research questions, regression analyses were used. Multiple regressions will illustrate whether or not an individual's preference for S or N and T or F has predictive value on grades in a high technology classroom environment. Two models were used, one with the original measure for SN or TF where the MBTI personality types are categorical, and one with the preference clarity scores, PREFSN and PREFTF. The first will henceforth be called Model 1 and the second Model 2. Both research questions 1 and 2 will be answered with the categorical variables SN and TF in Model 1. Following, both research questions will then be answered with the continuous variables PREFSN and PREFTF in Model 2.

Model 1

In the multiple regression output for Model 1, which answers both research questions 1 and 2 with the categorical variables SN and TF, the R-Square value represents the percentage of the variability explained by the model. Therefore, in this research, the regression model including SAT score, gender, preference of S or N and preference of T or F can explain 11% of the variability in Chemistry 101 grade. Table 4.8 summarizes some of the other statistics for this model. The model as a whole has a large F-value of 19.99, which leads to a significant p-value of <.0001.

Table 4.9 Regression Analysis Results for Model 1

Variable	DF	Parameter Estimate	Standard Error	t value	Pr > t	Standardized Regression Coefficient
Intercept	1	-1.59	.50	-3.17	.001	
GENDER	1	.36	.09	3.98	<.0001	.16
SAT_T	1	.003	.0004	7.32	<.0001	.28
SN	1	.30	.09	3.35	.0009	.13
TF	1	.30	.09	3.15	.0017	.12
Model 1: DF 4, Sum of Squares 96.09, Mean Square 24.02, F-Value 19.99, Pr>F <.0001 R-Square .11						

Holding gender, SAT total score and personality type on the Thinking vs. Feeling scale constant; personality type on the Sensing vs. Thinking scale has a significant effect on Chemistry 101 grade. As shown in table 4.9, the p-value is well below the α=.05 level of significance at .0009. This means that students who are Sensing have significantly higher scores in Chemistry 101 than students who are Intuiting. Similarly, holding gender, SAT total score and personality type on the Sensing vs. Intuiting scale constant; personality type on the Thinking vs. Feeling scale has a significant effect on Chemistry 101 grade. Also shown in table 4.9, the p-value is below the α=.05 level of significance at .0017. Students who are Thinking have significantly higher scores in Chemistry 101 than students who are Feeling. Interestingly, this model also shows that gender and SAT total scores have a significant effect on Chemistry 101 grade, each when holding the other variables constant. They are significant with a p-value of <.001. Females score significantly higher in Chemistry 101 than males. Students with higher SAT scores score significantly higher in Chemistry 101 than those with lower scores.

Because the variables do not have the same measurement scales, the output also gives standardized regression coefficients. This allows a comparison of relative usefulness between the predictor variables, or a ranking. In this case, the regression

coefficients, as represented in Table 4.9, show that SAT_T is the most useful predictor, followed by GENDER, SN and then TF. This means that out of the variables contained in the model, SAT total score is the most significant contributor to grade in Chemistry 101.

Although the variables SN and TF were found to each significantly affect Chemistry 101 grade, it is important to look at each further. Significance alone does not illustrate anything about the size of the variables' effect on the dependent variable. In order to do this, Cohen's D is calculated which shows the relative size of this effect. In Model 1, the SN variable has a Cohen's D of -.173 and an effect size of -.086. This means that although the results were significant, their effect size is small. The TF variable has a Cohen's D of .24 and an effect size of .12. This effect size is slightly larger and is approaching a medium, however, it is also in the small range.

Model 2

The next regression analysis, using the preference scores on the Sensing vs. Intuiting and Thinking vs. Feeling scale (Model 2), also produces significant results. Table 4.10 illustrates that Model 2 as a whole can explain 11% of the variance in Chemistry 101 grade. All of the variables were significant at the α=.05 level when holding the others constant. More specifically, the parameter estimates can illustrate how a change in the independent variable can affect the dependent variable. When holding gender, SAT total score, and preference clarity on the Thinking vs. Feeling scale constant, a one unit change in the clarity index of preference on the Sensing vs. Intuiting scale corresponds to a .008 increase in Chemistry 101 grade. This means that as a participant becomes clearer in the direction of Sensing, their Chemistry 101 grade

increases. Conversely, if an individual is clearer in the preference of Intuiting on the scale, their Chemistry 101 grade will decrease. The p-value for significance here was .02. Similar results were found when looking at preference clarity on the Thinking vs. Feeling scale while holding gender, SAT total score, and preference clarity on the Sensing vs. Intuiting scale constant. As the clarity index increases by one point in the direction of Thinking, a participant's Chemistry 101 grade increases by .01. If the individual prefers feeling and as their strength of clarity in that direction increases, their Chemistry 101 grade will decrease. The p-value for this result is significant at .0002.

Table 4.10 Regression Analysis Results for Model 2

Variable	DF	Parameter Estimate	Standard Error	t value	Pr > t	Standardized Regression Coefficient
Intercept	1	-1.22	.50	-2.43	.0152	
GENDER	1	.39	.09	4.19	<.0001	.17
SAT_T	1	.003	.0004	7.06	<.0001	.27
PREFSN	1	.008	.003	2.40	.02	.10
PREFTF	1	.01	.003	3.77	.0002	.15
Model 2: DF 4, Sum of Squares 98.08, Mean Square 24.52, F-value 20.46, Pr>F <.0001, R-Square .11						

Similar to the first regression analysis, it is useful to look at the standardized regression coefficients here due to the variables' differing units of measurement. As seen in Table 4.10, there are similar results to the first analysis. SAT_T had the highest standardized coefficient, followed by GENDER, then TF and SN.

Model Building

In order to ensure the model chosen for this study was the most appropriate model, meaning that no other combinations of the variables or the variables alone were better at explaining the variance in Chemistry 101 grade, model-building procedures were used. The methods of forward, backward, and stepwise selection use all of the available

variables to see what combination of those variables in a model best explains the variance in the dependent variable, in this case Chemistry 101 grade. Each used entry criteria of α=.15 significance for each variable and stay criteria of α=.10 significance. This means that a variable could not be entered into the model unless it had a p of greater than .15 and was subsequently dropped from the model if its p-value was less than .10 at any time. As illustrated in tables 4.11 and 4.12, the procedures clarified that the model this current study used was the most appropriate with the variables involved. Each produced a model that included all four variables used in the earlier regression analyses; gender, SAT total score, Sensing vs. Intuiting and Thinking vs. Feeling for Model 1 and gender, SAT total, preference for Sensing vs. Intuiting and preference for Thinking vs. Feeling for Model 2.

Table 4.11 Forward, Backward and Stepwise Selection Results for Model 1

Process	Model Selected
Forward	CH 101 = SAT_T GENDER SN TF
Backward	CH 101 = SAT_T GENDER SN TF
Stepwise	CH 101 = SAT_T GENDER SN TF

Table 4.12 Forward, Backward and Stepwise Selection Results for Model 2

Process	Model Selected
Forward	CH 101 = SAT_T GENDER PREFSN PREFTF
Backward	CH 101 = SAT_T GENDER PREFSN PREFTF
Stepwise	CH 101 = SAT_T GENDER PREFSN PREFTF

Uniqueness Statistics

Looking at the earlier correlation results, it is evident that the variables may have some overlap in their contributions to the variance of the entire model. In order to more accurately assess each predictor variable's contribution to the variance beyond the variance of the remaining predictor variables, a uniqueness index is calculated. Each predictor variable has a uniqueness index that can be calculated by looking at the R-square value of the entire model and comparing it to the R-square value of the reduced

model that does not include that variable. These statistics were calculated for both regression equations and can be found in Tables 4.13 and 4.14. All of the variables were found to account for a significant variance beyond the variance of the remaining predictor variables at the α=.05 level. Many of the variables were found to be even more significant, at the .01 or .001 level. These are also illustrated in Tables 4.13 and 4.14.

Table 4.13 Uniqueness Statistics for Predictor Variables in Model 1

Variable	Uniqueness Statistic	F-Value	Significance Level
SAT_T	.073	52.14	.001
GENDER	.0215	15.36	.001
SN	.0153	10.93	.001
TF	.0135	9.64	.01

Table 4.14 Uniqueness Statistics for Predictor Variables in Model 2

Variable	Uniqueness Statistic	F-Value	Significance Level
SAT_T	.0677	48.36	.001
GENDER	.0239	17.07	.001
PREFSN	.0079	5.64	.05
PREFTF	.0193	13.79	.001

Chi-Square Analyses with Gender

Because gender has been found to be a factor when talking about the MBTI, mostly with the Thinking vs. Feeling personality scale, further tests were run to compare males and females on TF and SN. Traditionally, the only MBTI scale that has a significant gender difference has been the TF scale. In this research, the same was found to be true. Table 4.15 illustrates the results of a Chi-Square test comparing males and females on the TF scale. Males far outweighed females when looking at the Thinking personality type, N=198 to N=64. Females outweighed males on the Feeling type, N=231 to N=167. A majority of females scored as Feeling (N=231) as opposed to Thinking (N=64). Males were a little more evenly distributed, N=167 Feeling and

N=198 Thinking. The Chi-Square showed that there was a significant difference with a p-value of <.0001.

Table 4.15 Chi-Square of GENDER by TF

	Thinking	Feeling
Male	N=198	N= 167
Female	N=64	N=231
Overall Population	N= 398	N=262
Chi-Square	Value 72.21, Probability <.0001	

The results of the Chi-Square analysis of gender and the SN variable were not significant, which is in line with what was expected. There were no real gender differences on each variable, and each gender did not show a significant difference between the two personality types. The results of this analysis can be seen in table 4.16.

Table 4.16 Chi-Square of GENDER by SN

	Sensing	Intuiting
Male	N= 161	N=204
Female	N=119	N=176
Overall Population	N= 280	N=380
Chi-Square	Value .95, Probability .33	

T-Test Analyses

To further confirm the relationships between the variables involved in this research, several t-tests were used to compare means and see if there were significant differences found. The results of these tests are illustrated in Table 4.17. One area of interest is gender differences on the Chemistry 101 grade. There is a significant difference found between males and females. Males had a mean Chemistry 101 grade of 2.32 and females of 2.52. This difference is significant with a t-value of –2.24 and a p-value of .03. The Cohen's D for this difference is -.17 and the effect size is .09, or small.

SAT total score was also considered, and a significant gender difference was found there as well. In the sample, males scored significantly higher on the SAT than females. The effect size was also in the small range for this difference, as illustrated in Table 4.17, however it was larger than the previous difference.

The next variable analyzed was preference on the Thinking vs. Feeling and Sensing vs. Intuiting scales using the continuous variables of PREFTF and PREFSN. For PREFTF, the t-value was highly significant at the $p<.0001$ level and an effect size that was in the small range, but approaching medium. Because the mean for females was negative, the average clarity score puts females on the Feeling (or negative) side; in contrast, the average clarity score for males places them on the Thinking (or positive) side. The PREFSN scores were also significant with a t-value of –1.93. The effect size, however, was lower, in the small range.

Finally, to once again look at the differences between the groups S and N and T and F on Chemistry 101 grades, t-tests were run for them as well. Both showed significant differences between the groups at the $\alpha=.05$ level, as illustrated in Table 4.17, with the TF difference having the larger effect size.

Table 4.17 T-Test Results Analyzing Mean Differences of Variables in the Regression Analysis

Variable	Mean	t-value	Pr > t	Cohen's D	Effect Size
Chemistry 101	Males- 2.32	-2.24	.03	-.17	.09
	Females- 2.52				
SAT Total Score	Males- 1191.1	3.05	.002	.24	.12
	Females- 1165.6				
PREFTF	Males- 1.27	9.87	<.0001	.77	.36
	Females- -8.637				
PREFSN	Males- 1.05	-1.93	.05	-.15	.08
	Females- 3.17				
Chemistry 101	S- 2.49	-2.26	.02	-.18	.09
	N – 2.29				
Chemistry 101	T- 2.58	-3.05	.002	-.24	.12
	F- 2.30				

DISCUSSION and CONCLUSIONS

Original research questions

1) *What is the predictive value of an individual's preference for Sensing vs. Intuiting on achievement in a model that controls for gender differences and SAT score?*
2) *What is the predictive value of an individual's preference for Thinking vs. Feeling on achievement in a model that controls for gender differences and SAT score?*

Significance of the Results

This research was designed to investigate the predictive ability of students' scores on the Myers-Briggs Type Indicator, specifically the Sensing vs. Intuiting and Thinking vs. Feeling scales, on student success in a high technology environment. The population that was of most interest was that of the freshman students in the First Year College at North Carolina State University. These students are undecided and hoping to gain insight and guidance into their future from their advisers and peers. North Carolina State University as a whole is known as a leader in technology innovations and is also considered a school that students choose because of its programs in engineering, textiles, and other math/science oriented majors. As North Carolina State continues to update classrooms to be increasingly high technology, offer more classes online or through other distance education mediums, and offer classes to their faculty members to assist them in making their classes more technology oriented, students will have to continue to adapt to these technological advances. The generation that is entering our schools currently, the Millennials, is known for its heavier use of technology than any coming before it. Millennial students who are not as strong in the use of technology tend to be forgotten

because they are in the minority. Faculty, advisers and other staff often assume that the students have a certain level of technological knowledge. Whereas in the past, teaching students about technology in each class or offering entire courses on the use of technology in college was common, these additions are no longer built into the curricula.

As advisers continue to work with incoming students, they maintain their search for ways to help them adapt to university life. Many programs such as the First Year College administer interest, ability, skills, values, and personality inventories to help assess where a student currently is in their decision making process. The purpose of the First Year College program is to guide the students through a developmental cycle where they learn about themselves, discover major and career opportunities, and then finally make an informed decision. These assessments are a critical part of that process, helping to guide the students toward their final choice. However, the inventories are frequently used in their traditional sense, meaning they assess what they are supposed to assess and the information given to the students specifically relates to that assessment.

For example, the Strong Interest Inventory is taken by all of the First Year College students. The advisers give each student a copy of their score report, teach them about the Holland theory associated with it, and ask them to reflect on their results. This is the only way in which these results are used, and the data is not collected from year to year. Advisers and other staff members could use these assessments much more widely, saving time and money while at the same time helping students in a broader sense. If the assessments could be used both to give students information about themselves and help advisers guide them in course selection, major options, and maybe even extracurricular activities, it would be more cost effective for the department.

This research was designed to find out whether another traditional assessment, the Myers Briggs Type Indicator (MBTI), could be used in a way other than assessing personality type. Can the students' personality types on the Sensing vs. Intuiting and Thinking vs. Feeling scales predict success in a high technology environment as well as give them information about themselves and future major/career opportunities? Currently, advisers teach students about the MBTI, hand back the students' individual results, and have them reflect on their results in a journal or paper. The reflection is guided, helping students to go through the entire MBTI report to look at information on their own type, work setting preferences, and career options. The students' individual results are often used outside of class and on their own. While some advisers may go over the MBTI in subsequent advising appointments, many do not. Some advisers do group work to illustrate the differences between the types in order to assist students in getting a clearer picture, and also to aid in the understanding of people with a different type than their own. This information is typically put in the context for example, of helping students to better work in groups in the future, or adapt to professors' different teaching styles.

The original research questions were designed to see if scores on the MBTI could be used in another way, to predict whether students of one type could be successful in the increasingly high technology classrooms over another. More specifically, it was anticipated that students who tested as Sensing over Intuiting performed better because they see things in a sequential and organized manner as opposed to thinking more globally. Students who are Sensing prefer to rely on facts that they can easily gather through the five senses while Intuitives use hunches more often. Students who were

Thinking over Feeling were expected to perform better because of their preference for logic over making decisions with their emotions. Thinkers tend to make decisions based on logic and facts while Feelers prefer a more interpersonal approach. Technology in the classroom often takes away the interpersonal aspects of a class. Frequently, professors let computers grade homework and communicate with students through email.

This study had the benefit of a large sample size, 660 students were included. The makeup of the sample is representative of the University as a whole. There are more males than females both in the study group and at the institution. In this study population, there were more students who were Sensing and Feeling than Intuitive and Thinking respectively. All of the variables included were normally distributed, allowing the results to be generalized to the larger population. Both the SN and TF clarity index scales were originally reported on a 0 to 30 scale. For purposes of this research, that scale was not useful. Students who had a 15 preference toward Thinking, for example, would have the same exact score as students who had a 15 preference toward Feeling. If the variables were used in their original format, they would not be meaningful. Both measures were converted to a –30 to 30 scale by multiplying the second personality type scores, Feeling and Intuiting respectively, by negative one. This way, someone who had a score of 15 on Thinking would keep a 15, while someone who had a 15 toward Feeling would then have a –15. In doing this, the results of this research became more meaningful and were also easy to interpret.

The results of the research proved the original hypotheses to be true. Students who were Sensing had significantly higher grades in a high technology classroom than those who were Intuiting. In fact, as a student's preference for Sensing became clearer,

as measured by the MBTI, their grade in the class increased. Students were more successful in the high technology classroom environment the better defined their preference for Sensing became. The same was true for Thinkers, with an even higher level of significance. Thinkers performed better in a high technology environment than Feelers and as the clarity toward Thinking increased, the grade also increased. The effect size for both results was in the small range, however, the differences were statistically significant. Having the effect size be smaller than average was disappointing and a good indicator that further research in this area needs to be done. However, the results were still significant at a high level and therefore produced useful information. All of these results held constant the gender and SAT total scores of the students involved.

An interesting result of the regression analyses was the difference between the model using categorical variables for the MBTI types and the model using the continuous variables. Both models had the same R^2 value; they explained 11% of the variance in Chemistry 101 grade as a whole. However, when you look at the variables individually, the parameter estimates differ. In the first model, using categorical variables, the parameter estimates for SN and TF were the same. When looking at the standardized coefficients, SN was slightly higher than TF. However, in the second model, using continuous variables, the parameter estimates were not only different from the first model, but they were different from each other. Whereas the SAT and gender estimates stayed approximately the same, the SN and TF changed from .30 each to .008 and .01 respectively. When looking at the standardized coefficients for the variables in model two, there is a different rank order than we saw in model one. In model two, preference on the TF scale contributed more than preference on the SN scale.

When the variables were looked at individually, they had a significant contribution to the overall model. Each variable was further tested to ascertain whether or not they contributed to the variance in the complete model above and beyond the contributions of the other variables. The significance that was found in the regression analyses held true here as well; each variable significantly contributed to the overall variance in the model above and beyond the contributions of the other variables. The significance of their unique contributions further solidified the significance of gender, SAT total score and the two MBTI scales as predictors of Chemistry 101 grade, a high technology classroom.

Some of the variables were further tested because of information presented in Chapters One and Two. For example, males and females were compared on the Thinking vs. Feeling scale because of the widely reported gender differences in the general population on that scale. It was important to see if those differences held true in this sample, and they did. Males were significantly more likely to be Thinking over Feeling. Females were significantly more likely to be Feeling over Thinking. Finally, males tested as Thinking significantly more than females. The same tests were run for the Sensing vs. Intuiting scale for comparison. No significant gender differences were expected here and none were found.

Additional tests were done on some of the variables to compare means. Those tests brought one of the most surprising results in this research. Females had significantly higher Chemistry 101 grades than males. This was interesting because in this institution, and in popular culture, males tend to dominate in math and science areas. To have this difference turn out to be significant in the opposite direction as expected was

surprising, and suggests that further research should be done in this area. However, SAT research has shown that the test tends to under predict for females. Males, as expected, had significantly higher SAT total scores than females. These results were in line with what was anticipated based on past research and popular culture.

The regression model as a whole, including SAT total score, gender, and scores on the preference scales, was also useful. The model accounted for a significant percentage of variance in the Chemistry 101 grade. Statistical procedures were also performed to make sure that the models that were chosen for this research were representative of the best combination of the predictor variables that was possible. These procedures confirmed that a model including all four variables was the best predictor of Chemistry 101 grade.

Implications for General Practice

The faculty and staff members in higher education institutions across the country are constantly searching for ways to relate better to their students, to make sure what they are teaching is appropriate, and to find ways to best serve the student population. The new generation on campuses in the past few years is the Millennials. This has become a "hot topic," discussed at conferences, staff meetings, and beyond. This generation carries with it characteristics that are different from the most recent generations that came before it. One of the biggest differences is the prevalence of technology in their lives. Some students have the aptitude to keep up with the technological advances of their peers, however, in a time when these advances are coming so quickly; some find it hard to keep pace. With the high prevalence of technology amongst the Millennial generation, it is easy to forget that what is common to many is not a strength of all.

One of the unique characteristics of the Millennial generation, besides their high use of technology, is their connections with their parents. These students are closer to their parents than prior ones, and vice versa. It is not unusual to have a student call their parent right before or after an advising appointment to check in or for a student to immediately walk out of a test and call home to tell them how they thought it was. Therefore, if the results of this research were going to be used to help steer students to (or away from) specific courses and/or majors, it would be helpful if the concepts could be explained to the parents. Most universities have a special part of freshman orientation that is devoted to parents, this might be an appropriate time to explain the MBTI testing and uses.

The results of this research can also help faculty, staff and current students in a variety of ways. If advisers can use this information in order to better guide their students, it not only makes the personality tests given to students more versatile and valuable, but also adds to the information they use to help their students decide what major and/or career area they want to pursue. This is a question that many students go through when entering college; more often than not, they either come thinking they want to major in a particular area and find themselves changing their mind, or come in with no idea. Either way, the more information advisers can have about their students and the more information the students know about themselves, the better the chances are that they can work together to successfully chart a course for the future that will be appropriate and successful.

Caution must be used, however, in advising students using these results. Just because a student is Sensing does not necessarily mean a student will enjoy a high

technology oriented major or will succeed in that area. There are always exceptions to the rule, but more importantly just because someone is good at something does not necessarily mean that they will enjoy doing it. In contrast, just because a student tests as Feeling does not mean they should completely avoid any high technology major or career. If they enjoy working with technology then that may be where they belong, they may just need to work a little bit harder than their counterparts.

In addition, this information will allow advisers to help students based on their personality profile. The information can be useful on a personal level. When advisers help their students to plan their courses for the following semester, this information should be taken into account. For example, based on this research, if a student is clearly Feeling and they have the choice between a section of English that includes work on laptops or in the computer classroom, and a more traditional class, the adviser could help steer the student toward the traditional class because, most likely, they will do better in that environment. Additionally, if a student has to take a class such as Chemistry 101 where all of the classes use a good deal of technology, the adviser can help the student prepare in advance by either getting them into a workshop to learn more or working with them one on one to gain more information on the technology that will be used.

In addition to advisers, the information in this study can also be helpful to faculty and administrators. Something that faculty often learn about through training or in development workshops is learning style. Although in the past the norm has been for faculty to teach in the manner they choose, it has become more common for them to teach the same topic using several different techniques in order to reach out to a more diverse group of students. The same can be applied to technology using the results of this

study. Faculty must realize that certain personality types succeed in high-technology settings more so than others. In realizing this, they can adapt their teaching style to fit all and perhaps refrain from making their entire course be technology oriented. Another option they would have would be to offer special lab or study sessions for those students who may have a harder time learning with technology, using a TA or graduate student. This way, those who may not be predisposed to learning in that environment can get extra assistance.

Administrators, using this data, can make more informed decisions about priorities and programming. At orientation or in the days leading up to the start of the semester, they may choose to offer special training workshops to help those students who are less technologically inclined adapt to the campus-specific technology. Administrators of tutoring centers might use this research to develop special training sessions for both tutors and tutees, or offer special Supplemental Instruction programs for Intuiting and Feeling students so that they are not as disadvantaged in a high technology environment.

Adding to Past Research

The Millennial Generation is a group of students who are now entering college for the first time. These students were born after 1982 and although studied in great depth in general, they are too new on college campuses to have higher education specific research completed to date. In fact, the first full class of Millennials, if on track with a four-year degree, just graduated in 2004. Any college-based research on this generation is adding good information for educators of these students. Using regression-based statistics**,** the research in this study specifically adds significant information on the Millennials as well

as unique information on the link between personality type, as measured by the MBTI, and technology, as reflected in Chemistry 101 grade.

Previous studies have either focused on the teacher or on students' comfort level with technology. There has been little, if any, research on how a student's personality type can affect their success in a higher education course that uses a large amount of technology. Similarly, there is not research that consistently shows a link between a student's learning style or personality type and their ability in using technology in the classroom. Prior research has shown that a teacher's learning style can effect their teaching methods and openness to using technology (Smith 1995; Galowich 1999; Grasha 2000; Chambers 2003). Galowich simply studied teachers' comfort levels with technology and their use of it in the classroom. Chambers' research showed that Intuitives and Thinkers were more likely to use technology in their teaching. However, the study did not look at how these individuals preferred to learn or information on the students they were teaching in this manner. Grasha's study was similar, using a scale he developed to see if personality type matched the type of instructional technology used.

The current research looks at technology in the classroom from a student's point of view. Often, in higher education, professors and students have very different styles. In the First Year College, advisers work with students to see how they can best adapt to a certain professor's teaching style if it is different than their own. Advisers spend time doing this because they are aware that these professors will most likely not change their teaching style to match their current students. Therefore, having information about students' personality types and how these types effect their learning in a high technology environment determined by the teacher and/or the institution can be extremely useful to

advisers. Students can get more useful, individualized advice from their advisers with this information.

Other research found that learning styles can potentially be altered by the use of technology (Cohen 1997; Cohen 2001). These researchers specifically focused on students in high school and how technology can change a person's learning style. Again, they did not look at the predictive ability of personality type on success in high technology environments, but focused on the environment's effect on the student. Rather than looking at the changes a high technology environment could make in an individual, the research in this current study looked at whether a student's personality type going in to a high tech environment could predict their success or failure.

Other studies have looked at the MBTI and how it accurately predicts a student's comfort level with the internet or a high-technology environment (Jones 1994; Dewar 2000; Grasha 2000; Russell 2002). Jones looked at many studies in this area and found inconsistent information regarding anxiety levels and computer use. Dewar found that Intuitives are overrepresented in those individuals using the internet to learn. He postulated that this is because the internet is easier for people who think globally. The students in the Dewar study were given in-depth workshops about the MBTI and took classes on campus before participating in an online discussion. The study focused on the students' understanding of their own personality type and the fit of that type to the online environment. The data in Dewar's study was completely reliant on the students' thoughts and opinions.

The current study was different than these previous studies because in this study the level of comfort with a high technology environment was not an issue. A student

may feel as if they are comfortable with technology but may not perform well in a high technology classroom environment. For example, students may use a program such as instant messaging in their personal lives. This is a simple, widely used program amongst college-aged students. However, these students may not have a personality type that leads to success when technology is part of their academic setting. Few, if any, studies have looked at whether a student's personality type can predict their level of success in a technology-rich environment. Those that have did not specifically study the relationship between the personality type variables and outcome in an actual class, basing results on final course grade.

The current study goes even further because no research has specifically studied this idea using regression analyses to test the personality type while controlling for other factors such as gender and intelligence (SAT score). There was a need to have more reliable and valid information about this population and their potential abilities in a high-technology classroom. This study shows that there is a significant relationship between a student's MBTI type on the Sensing vs. Intuiting and Thinking vs. Feeling scales. It provides a basis for further research in this area and to fully investigate these connections.

Validity of the Study

There are a few aspects of this study that could have affected the validity of the results. Chemistry 101 is a very difficult class at the institution. It is known as a "weeder" class; one that lets students know if they really belong in the majors that require this course. Those majors would be most of the natural sciences, engineering, and textiles. It was assumed that the class, although difficult, was equally difficult for every

student and therefore would not be a factor in the research. However, that may not be the case.

Students in the First Year College are placed into Chemistry 101 during the summer orientation. Every student enrolled in the First Year College is automatically placed in this class because it is the only science course that is transferable to every possible major they may eventually choose. For the students who come in completely undecided as to major, this is the only "safe" choice. However, any student that can clearly express to their adviser that there is no possibility they will choose a major that requires chemistry is subsequently enrolled in another, less difficult, science course. Often this process gets complicated because students at this stage in their decision-making do not want to rule out anything. They would rather keep the chemistry course and not rule out future major options when often they would be better served by switching to something easier. Orientation is a very confusing, vulnerable time for these students, which might make them reluctant to make any kind of decision about their future. Rather than deal with the stress of making that decision, they keep Chemistry 101 and vow to "work through it" the following semester.

Another issue that may impact this research is that of the First Year Course Repeat policy. At our institution, students are allowed two opportunities to repeat a course in which they did not do well. Many times, one of those is used to repeat Chemistry 101. Students can take the course again the following semester and have their initial grade erased from their GPA. This policy takes into account the difficulties of being a new student on a large college campus. There are many reasons why students don't do well in their first semester; adjustment issues, partying, homesickness among

others. These factors, along with a tough academic schedule, often contribute to lower grades during that first semester when Chemistry 101 is taken. First semester students are easily overwhelmed, leading to procrastination and/or complacency, also leading towards poor grades.

Professors' differences in grading style are also a confounding variable. For example, one of the Chemistry 101 professors is well known as being one of the toughest graders on campus. When looking at the grade distributions for professors over the past few years, no two grade exactly alike. Some professors have higher proportions of D and F grades than others, while some have more A grades.

Suggestions for Future Research

This study builds on and adds to prior research and opens many possibilities for further study. As previously mentioned, the parameter estimates and standardized regression coefficients differed both in strength and relative importance between the model using categorical personality type variables and the model using the continuous variables. This is a significant issue and one that should be further investigated. Researchers would be interested in finding out if this difference can be attributed to the greater sensitivity in the scale that ranges from –30 to 30 as opposed to the scale that codes participants into one of two categories. There could potentially be other factors involved such as the actual construct validity of the MBTI. Are these variables measuring what they are supposed to measure? Perhaps one of these MBTI scales does a better job of measuring what it is supposed to measure than the other. Could age also play a factor in this difference? In addition, the MBTI scales, set up the way they are, show the personality types as opposite ends of the same spectrum. For example, Sensing

is seen as "the opposite" of Intuiting on the MBTI scale. The types may not actually be different ends of the same continuum. Further research could analyze the variables to ascertain the validity of this argument.

Although the model chosen accounted for a significant amount of the variance in Chemistry 101 grade, there remains 89% of the variance that is unexplained. There are several factors that were not included in this research that could be explaining some of the additional variance. The other MBTI scales, Extraverted vs. Introverted and Judging vs. Perceiving were not used here because this study was building on past research. However, it is entirely possible that these other aspects of a student's personality could be contributing factors in their performance in a high technology environment. Another factor that was not specifically researched here would be the amount of preparation a student has in technology before coming to college. Some grammar schools have a significant amount of technology, therefore the students have been trained to use it and have used it on a regular basis. Other schools might not have as much, which would make their students less prepared.

At NCSU, many students have other family members who have attended the University before them. If the students have older siblings or family members that have used the systems at NCSU, they would be more likely to understand the systems we use or have more support in the event of a problem. The issue of support could be broader as well. If students have resources they know about, such as the tutoring center, online tutorials, advisers, or even a hallmate or RA, they could get help with the classroom technology more easily and quickly.

If a large enough sample were available, it would be useful to do a comparison study of one class that was taught by the same teacher in two different ways. For example, some of the classes taught at this university are taught by the same professor but one may be online and the other in a traditional classroom. That way, the two groups could be compared to see if substantial differences exist. Furthermore, research could be done using a high-technology classroom environment in a course that is not considered to be one of the most difficult on campus like Chemistry 101 is. Because of the difficulty level with Chemistry 101, many students choose to take the class over again in a subsequent semester. It might be interesting to see if these students perform better a second time around as well as to ascertain why that success or failure may occur. Some students choose to get tutoring while others seek more help with the technology used in the classroom.

A researcher might want to examine students who are later in their academic career than first-semester freshmen to see if there is a difference in the link between their level of success in a high technology environment and their personality type. Typically, an individual's personality type becomes clearer and solidifies as they mature. In doing this, they could also correlate the results with the student's chosen major. At this institution, students must declare their final major before they accumulate 60 credit hours. If a study was done with juniors and seniors, their choice of major could be included in the study design.

It would be interesting to do a longitudinal study in this area. If a student's personality type is not suited for a high-technology classroom environment, how do they continue to perform in other classroom situations? There are many students that come to

school wanting to major in engineering, science, textiles, or another high-tech degree. Do the students who don't match well with technology continue to pursue these degrees? It would be interesting to see if the students choose another degree or stay on the high tech path, and what their future successes are.

Another research study could use a survey to gather information from students on what they thought about computer use in high-technology classroom environments. This survey could assess student comfort, aptitude, or other factors associated with this technology. It might be useful to find out from students how they see technology in the classroom; what do they think of as technology? Students may not have the same perception of what classroom technology is as is defined by the institution.

Finally, a factor that was not examined here but could be an extension of this research would be a student's socioeconomic status and how it relates to their preparedness to use technology in the classroom. In this country, students' access to computers is not equal. Although many schools have computers students use as part of their education, differences exist in the number of computers and the level of technology available. A student who has always had a computer in his or her home may be more comfortable and adept at using technology than someone who did not. Including this in research would give practitioners another variable with which they can research and gather more information to help students make appropriate choices.

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APPENDICES

APPENDIX A

How to take the Myers-Briggs Type Indicator (MBTI)

Read ALL of the directions before going to the website.

1. Go to the following URL: http://online.cpp-db.com

2. For login, enter ncsufyc
   For password, enter raleigh

3. Leave the userid blank.

4. Click login.

5. Scroll to the bottom of the page, and look for the test you are to take: The Myers-Briggs Type Indicator, or MBTI.

6. Look for your instructor's name in the pop up menu—Brown
   DO NOT CLICK ON ANY OTHER ADVISER'S NAME! Choose Brown.

7. Click "take it".

You are now at the MBTI.

8. Fill in the demographic questions--only name and gender are required.
9. Click "submit."

10. Take the test--answer the questions the best you can. Do not spend too much time thinking about them. Generally your first response is the most accurate one. If you are not sure about an answer, or feel that all of the answers are true, choose the one that is true most of the time, or the one that best expresses your true preference (not what you think you ought to answer, or what you feel someone else believes is true about you).

    There are no right and wrong answers for this test.

11. When you are finished, click "done."

12. NOTE
    If you get a message saying you have not completed the test, or have not answered enough questions, click "cancel" and go back and finish the test. Answered questions will have a purple check mark.

13. You will know you have successfully completed the test when you get a message saying that it has been emailed.

14. Write down the tracking number (usually BU plus some numbers)—you must turn in this number in class week 9 to show that you have taken the MBTI.

15. Click "logout."

APPENDIX B

Exemption From Administrative Review

North Carolina State University is a land-grant university and a constituent institution of The University of North Carolina

Office of Research and Graduate Studies

NC STATE UNIVERSITY

Sponsored Programs and Regulatory Compliance
Campus Box 7514
1 Leazar Hall
Raleigh, NC 27695-7514

919.515.7200
919.515.7721 (fax)

From: Debra A. Paxton, Regulatory Compliance Administrator
North Carolina State University
Institutional Review Board

Date: October 28, 2005

Project Title: Using learning styles to predict success in a high technology environment

IRB#: 226-05-10

Dear Dr. Brown:

The research proposal named above has received administrative review and has been approved as exempt from the policy as outlined in the Code of Federal Regulations (Exemption: 46.101.b.4). Provided that the only participation of the subjects is as described in the proposal narrative, this project is exempt from further review.

NOTE:

1. This committee complies with requirements found in Title 45 part 46 of The Code of Federal Regulations.
   For NCSU projects, the Assurance Number is: FWA00003429; the IRB Number is: IRB00000330

2. Review de novo of this proposal is necessary if any significant alterations/additions are made.

Thank you.

Sincerely,

Debra Paxton
NCSU IRB