

Abstract

BOYETTE, TODD RANDALL. An In-Depth Analysis of Personality and Other Participant Characteristics in a Web-Based Course for Science Teachers. (Under the direction of John C. Park).

The purpose of this study was to analyze the role students' personality and other characteristics play in their experience and achievement in a web-based course for teachers. Participants in the study were 17 inservice teachers enrolled in Technology Tools for Science Teachers in the 2002 spring semester. "Tech Tools" is a web-based class designed to teach teachers how to use various pieces of technology such as digital cameras in the science classroom. As part of the class, students are required to attend four face-to-face sessions during the semester.

Personality data was generated by the administering of three instruments: The Simmons Personal Survey, The Sixteen Personality Factor Questionnaire (16PF), and the Rosenberg Self-Esteem Inventory. Students also completed an entrance survey at the beginning of the course. All e-mails and Instant Messages sent to the instructors as well as all posts to the class listserv were collected for both quantitative and qualitative analysis. Additional qualitative data was collected through Instant Message interviews with ten of the students conducted at the end of the course.

The Simmons measures for Assertiveness, Courage, Sociability, and Self-Esteem were strongly correlated with students' final grades. The 16PF measure for Rule-Consciousness and the students' years of teaching experience were also strongly correlated with final grades. The 16PF Global Factor Anxiety and Primary Factors Tension, Emotional Stability, and Apprehension yielded statistically significant ($p < .05$)

correlations with the quantity of emails the students sent to the instructor. The Primary Factor Privatness yielded a statistically significant ($p < .05$) negative correlation with quantity of listserv posts. The Simmons measures for Tolerance and Consideration were also negatively correlated to emails sent to the instructor. The Simmons measure for Direction was positively correlated with emails sent to the instructors.

Results from the qualitative analysis of Tech Tools indicated that students who are open and receptive to new ideas were better able to handle the rigor of the course, while students that enjoy change appreciated the content and format of the course. Self-esteem seems to impact the opinions of students regarding their experience in Tech Tools and Social Boldness seems to impact their opinions about the value of the face-to-face sessions. Other findings included how the amount of teaching experience of the students affected their perceptions of the workload involved in Tech Tools, how the requirements of North Carolina's Lateral Entry program forces students to make decisions about courses that they would not normally make, and how the class listserv was not utilized by students until they had no other alternatives for help.

**An In-Depth Analysis of Personality and Other Participant
Characteristics in a Web-Based Course for Science Teachers**

A Dissertation submitted to the Graduate Faculty, North Carolina State
University in partial fulfillment of the requirements for the degree of
Ph.D. in Science Education

By

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Dedication

This work is dedicated to my family who has supported me in so many ways throughout my graduate school career.

To my wife, Keri Matthews Boyette, who has always encouraged me to do my best and has supported me in all of my endeavors. With her help, I have been able to accomplish this project without losing perspective on what is truly important. I am definitely a more balanced person because of her.

To my children, Ashley Prentice Boyette and Colin Matthews Boyette, who gave me plenty of diversions while I was writing this dissertation. They patiently waited while daddy was writing his “book” and now wonder what the big deal is about a book that has no pictures!

To my mother, Zola Dean Boyette, who took great care of me during my frequent trips to Raleigh during this process. I never had to worry about anything but this project when I was staying at her house because she provided everything I needed.

To my brother George Luby Boyette, Jr. and my sister Kammy Boyette Ricker, who cheered me on during this process and do not hesitate telling me how proud they are of me. I am proud that they are my siblings.

Biography

Todd Randall Boyette was born in Garner, North Carolina on February 20, 1966. He graduated from Garner High School, Garner, NC in 1984. Mr. Boyette began his undergraduate studies in Chemistry at North Carolina State University, Raleigh, NC in 1984 and received a Bachelor of Arts in Chemistry and a Bachelor of Science in Science Education in 1988.

Since completing his undergraduate studies, Mr. Boyette has worked as a science teacher, as an analytical chemist, and as coordinator of an outreach program to rural schools. While in these positions Mr. Boyette pursued and received a Master of Science in Science Education from North Carolina State University, graduating in 1995.

In June, 1996, Mr. Boyette entered the informal science education field by accepting the position of Executive Director of Imagination Station Science Museum in Wilson, NC. In October, 1999 Mr. Boyette was hired as President and CEO of The Health Adventure, Inc., a hands-on health and science center in Asheville, NC. As President and CEO, Mr. Boyette is responsible for a staff of 26 and an annual budget in excess of one million dollars. He is currently working with a group of staff and volunteers to plan a major relocation and expansion that will double the size of the current Health Adventure facility.

Mr. Boyette is married to Keri Matthews Boyette, formerly of Greenville, South Carolina. Mr. and Mrs. Boyette have two children: Ashley Prentice, born on December 2, 1997, and Colin Matthews, born on August 11, 2000. The Boyettes reside in Asheville.

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I would like to thank the students in the Spring 2002 section of EMS 594I: Technology Tools for Science Teachers. The participants are extremely busy people and were still gracious enough to accommodate all of my requests during the data collection phase of this project.

I would also like to thank the Board of Directors of The Health Adventure for giving me additional leave so that I could complete this research and for supporting me in this effort. Additionally, I appreciate the self-directed nature of The Health Adventure staff that enabled me to take off the time I needed to complete this work.

Several others assisted at specific times in the process and I am grateful for their help. Dr. Mark Knecht stepped forward to order the Sixteen Personality Factor Questionnaire when I lacked the qualifications to do so, Dr. Ken Gattis conducted the regression analysis of my data and provided in-depth counsel regarding the results, and Scott Ragan hand-delivered draft copies of my dissertation to the committee to insure I met my deadlines.

Lastly, I would like to thank the members of my advisory committee. Dr. John Park provided help and much needed prodding at various times during my doctoral program and even let me borrow his laptop when mine crashed! Dr. Glenda Carter gave me fresh insights into the format of qualitative research. Dr. David Haase and Dr. Jack Wheatley have provided me support and encouragement through the many stages of my graduate school and professional life.

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Chapter One

Introduction

The Information Age is upon us and now permeates nearly every aspect of our lives. Each year more Americans go online than the year before. Currently, 62% of American households, over 63 million households, access the internet from their homes. This number is projected to increase to over 86 million households by 2006. Also in 2006, it is projected that over 210 million Americans will use the Internet either at work or at home (Jupiter Media, 2001a).

Increasing Prevalence of Distance Education

Because of this increased prevalence of internet use, it is transforming how we approach some of the educational needs of our society. Although distance education has been a part of American higher education for decades, it is playing a more significant role today. Administrators are looking at distance education as a way to address the dual challenges of increasing enrollments and shrinking budgets. For example, NC State University's enrollment is expected to increase over 20% to 36,000 students by 2010, with one out of every seven students earning degrees through distance learning (Kane, 2001). Across North Carolina, distance learning is on the rise in post secondary education. In the state's community colleges, 27% more students are taking distance learning courses in 2001/2002 than in 2000/2001. The UNC system's distance learning enrollment has increased 24% from 2000/2001 (Kane, 2001). A similar trend is seen on the national level. In fact, a report by The International Data Cooperation (IDC) estimated that 2.2 million college students will be enrolled in distance education courses

by 2002, an increase from approximately 710,000 in 1998 (Council for Higher Education Accreditation, 1999).

Some of the critics of distance learning have cited the lack of student-student and student-teacher interaction as obstacles to effective teaching and learning. However, newer communications methods such as Instant Messaging, chat rooms, audio and video streaming can promote greater levels of interaction. Instant Messaging allows the user to communicate via email in a real-time conversation. Business use of Instant Messaging and Chat applications has increased 110% from 2000 to 2001, while personal use of Instant Messaging and Chat has increased 48% during the same time period with over 50 million users (Jupiter Media, 2001b).

Audio and video streaming allows users to see images and hear sounds through their computers real-time. Until recently, these forms of electronic communication have not been very accessible to home users because of the speed of dial-up connections. This is changing now because of the availability of high-speed broadband connections for U.S. households. Currently, one in six home online users (10 million households) are connected through broadband (cable modem, DSL, etc) technology. This number is expected to grow to 40% (35 million households) by 2006 (Jupiter Media, 2001a). It is obvious that the changing technology industry and the increasing accessibility of internet communications to the general public will spur further development of distance learning programs, especially internet-based courses. Therefore, the need is great for research in the area of distance education, and particularly internet-based distance education, so we can better understand the dynamics of this emerging field.

Distance Education in Teacher Preparation

One area that Distance Education might make a tremendous impact is through teacher preparation. There will be an incredible need for teachers in the U.S. over the next decade. Student enrollments, expected to reach well over 54 million by 2009, will be the highest in history and will require an additional 800,000 teachers. Combined with an expected increase in teacher retirements, districts may actually need to hire as many as 2.7 million teachers over the next decade (Husser, 1999). Historically, low-income districts have the largest problems with teacher shortages when there is an inadequate teacher supply. In addition, these low-income districts are also least likely to have a university nearby to train preservice, inservice, and lateral entry teachers. With increasing availability of internet access and communications methods offering better ways to communicate electronically, web-based teacher education can play a major role in equipping new teachers in low-income and outlying areas.

Distance Education can also enhance the professional development of inservice teachers. A 1999 report from the United States Department of Education presents survey results that indicate many teachers in the U.S. feel unprepared to face the challenges of teaching (Lewis, et al, 1999). One of the main areas that teachers feel inadequately prepared is using technology in the classroom. Only 20% of the survey respondents felt they could effectively use technology as a teaching tool (Lewis, et al, 1999)). Areas of teaching that are perceived as weak by teachers can be addressed and strengthened by professional development opportunities such as inservice classes, workshops, and collaboration with other professionals. Once again, teachers in isolated geographical areas are at a disadvantage in terms of opportunities for professional development. Web-

based teacher education, especially involving the area of technology in the classroom, can provide opportunities for teachers to develop new skills regardless of where they are located.

Online opportunities in the area of teacher professional development have grown significantly over the last several years and will continue to grow in importance. The use of technology in the classroom is becoming increasingly important and is included in long range plans for public education. Two of the goals listed by the *Goals 2000, Educate America Act of 1994* were “to infuse technology and technology planning into all educational programs and training functions carried out within the school systems at the state and local level” and “promote awareness of the potential of technology for the improvement of teaching and learning”.

For goals such as these to be attained, the teacher has to play a central role in the implementation of technology in the classroom. According to Brand (1998), the lack of teacher training is one of the major barriers to the integration of technology into today’s classroom. For the same reasons that web-based classes meet the unique needs of nontraditional students, web-based professional development can meet the needs of practicing teachers. As professional development becomes increasingly important for teachers to remain up-to-date with teaching skills and effective pedagogy, online learning is a critical component of professional development plans. Jalonga (1991) described the most effective teachers as active continual learners who are more insightful about their students’ needs because they themselves are learners. Also, as mentioned earlier, the incredible need for additional teachers over the next decade will force nontraditional approaches to professional development.

Online professional development benefits teachers by giving them hands-on experience with a practical use of technology. Nelson-Nisan (1999) noted that teachers view themselves more positively when they successfully complete online professional development. Their progress through an online program affects the way they view themselves as professionals. As the teachers become more confident in the use of the technology, they tend to view themselves as professional educators.

EMS 594I

Under this backdrop, NC State University developed EMS 594I: Technology Tools for Science Teachers. “Tech Tools” is a web-based graduate level course designed to promote the use of instructional technology in the teaching and learning of science. EMS 594I is the result of NC State’s attempt to develop an effective graphics-intensive website to teach teachers how to use technology to teach science. The course is primarily web-based, but students are required to attend four in-person class sessions during the course of the semester.

The goals of Tech Tools include:

1. Enabling inservice teachers enrolled in the course to learn how to use educational technology in the science classroom
2. Providing the teachers with skills in using the technology in their classrooms.

To attain these goals, the Tech Tools course is built around an extensive website which serves as the main method of delivering instruction. In addition to the website, students are provided access to a dedicated listserv, access to the instructors and the rest

of the class through instant messaging (IM) and email, virtual office hours to converse with the instructors through IM, and monthly face-to-face class sessions for personal interaction with the instructors and other students.

The technology tools the students learn to use include instant messaging, the listserv, digital cameras, website design software, microcomputer-based lab equipment, calculator-based lab equipment, and data analysis software. To optimize the learning opportunities in the course, the instructors provided each student with a laptop computer and all of the equipment necessary to complete the course. The only prerequisites for Tech Tools are:

1. Access to an Internet connection.
2. The ability to navigate the World Wide Web.
3. Access to email and the ability to send and receive email messages.
4. Approximately 9 hours per week to devote to learning the course material and completing the assignments.

The course syllabus is located on the course website and directs the students to the web-based instructional units and the assignments. Each unit includes pre- and post-tests to measure the students' knowledge gains. Students submit assignments by uploading them onto a private server, sending them to the instructors as email attachments, posting to the listserv, or presenting during a face-to-face session.

The face-to-face sessions are three hours long and meet one Saturday each month in January, February, March, and April. They are designed to give students opportunities to interact personally with the instructors and with their classmates. Most of the time during these sessions is dedicated to instruction, although some time during each session

is dedicated to student questions. In addition, during the spring 2002 section of Technology Tools for Science Teachers, time was allotted in the first two face-to-face sessions to collect data for research on the course itself.

Harmon and Jones (1999) suggest five levels of use of the Web common in schools, colleges, and corporations. These levels represent a continuum from basic occasional use to advanced continual use. The table below defines and summarizes each of the levels.

Table 1-1. Levels of Web Use

Level of Web Use	Description
Level 0: No Web Use	The default level. Implies no web use at all.
Level 1: Informational	Providing relatively stable information to the student typically consisting of instructor placed items such as the syllabus, course schedules, and contact information. This information is easily created by the instructor, requires little or no daily maintenance, and takes up minimal space and bandwidth.
Level 2: Supplemental	Provides course content information for the learner. May consist of instructor placed course notes and other handouts. For example, a PowerPoint presentation saved as an HTML document and placed on the Web for students to review.
Level 3: Essential	The student cannot be a productive member of the class without regular web access to the course. At this level the student obtains most, if not all of the written course content information from the web.
Level 4: Communal	Classes meet both face-to-face and online. Course content may be provided in an online environment or in a traditional classroom environment. Ideally, students generate much of the course content themselves.
Level 5: Immersive	All of the course content and course interactions occur online. A sophisticated, constructivist virtual learning community.

Based on the above descriptions, EMS 594I is designed as a Level Four web-based course.

Purpose of the Study

The purpose of this study was to explore the relationship between student personality traits, their achievement, their perceptions, and behaviors in the Technology Tools for Science Teachers course. In addition, the nuances of the Tech Tools course were also explored. Both qualitative and quantitative research methods were employed in this project to investigate fully these areas of interest.

Tech Tools was offered for the first time during the Spring Semester 2000 as an experimental approach to delivering skill-based instruction to inservice teachers via the web. Therefore, it is important to the course developers to conduct research on the impact, effectiveness, and other issues of interest related to the Tech Tools course specifically and to web-based education in general. In the spring of 2001, Flynn (2001) conducted a quantitative research project to explore relationships between personality traits and measures of success in the Tech Tools course. Flynn's research indicates that several measurable personality traits correlate with how well students perform in Tech Tools, including a negative correlation between self-esteem and student achievement.

Flynn used the Simmons Personal Survey and the Myers-Briggs Type Indicator to identify personality characteristics of the students in the spring 2001 Tech Tools course. She also chose and used several measures of success (pre/post test gain scores, communications with instructors, etc.) and correlated these with the students' scores on the personality instruments.

There are several reasons why Flynn's initial findings require further study. They are listed below:

1. One of the instruments used by Flynn, the Simmons Personal Survey, is a personal inventory used by many businesses for employee job placement and has no documentation supporting its use as a tool in academic research. There is also no research published in an academic journal that cites the Simmons Survey or lists any of its test statistics.
2. The study conducted by Flynn involved a small group of subjects ($n = 11$) and utilized only quantitative data, therefore producing a fairly shallow pool of data.
3. Although the study involved a small amount of data, the results generated by Flynn's research are extremely interesting and should be explored further. Her finding that students' self-esteem is negatively correlated with their success measures is contrary to the vast majority of published research on the relationship between academic achievement and self-esteem.

This research project is designed to look more deeply at some of the questions generated by Flynn's initial research and to also explore other questions regarding the Tech Tools course. The specific questions driving this research project are listed below.

Research Questions

1. Is there a distinctive personality profile of the students enrolled in the spring 2002 section of Technology Tools for Science Teachers? (Chapter Five)
2. What is the relationship between student personality traits and their achievement in the Tech Tools course? (Chapter Five)

3. Can a useful model be created that can predict a student's achievement in Tech Tools based upon their scores on personality inventories? (Chapter Five)
4. How do students rate of electronic communication within the framework of Tech Tools relate to their achievement in the course? (Chapter Five)
5. Is there a relationship between students' personality and how often they communicate electronically in Tech Tools? (Chapter Five)
6. Is there a relationship between students' personality or other characteristics and the nature and content of their electronic communication? (Chapter Four)
7. Are their patterns in the nature and content of the electronic communications within Tech Tools that hint at the culture of the course? (Chapter Six)

Chapter Two

Review of the Related Literature

History of Distance Education

Distance education as a delivery mode of education has been around for a very long time. Shortly after mail began to run, institutions began sending print-based information to students living in areas away from the institution's campus. These print-based correspondence courses are the oldest form of distance education and are still in use today. The largest provider of these courses today is the U.S. government through its military and non-military home study institutes. Universities have also provided extensive correspondence study and through the years researchers have conducted research studies on its effectiveness. In a very early study measuring the comparative performance of extension students, Crump (1928) administered a series of examinations at the conclusion of both traditional and correspondence courses and determined that there were no statistically significant differences between the performances of traditional versus correspondence students. In another study, Dysinger (1957) investigated the study habits and progress of students enrolled in a correspondence introductory psychology course. Dysinger's data indicated that the 41 correspondence students studied more and earned higher final grades than 167 of their classmates enrolled in the same course offered through traditional means. He concluded that the results from this study showed that the correspondence course was at least equivalent to traditional instruction. Other studies have found similar results when comparing correspondence courses to resident instruction.

Television emerged as a distance learning medium in the 1950's, but like correspondence courses, broadcast TV and closed circuit TV lacked the important feature of interactivity between student and teacher. A limited amount of interactivity was introduced in the early 1970's when the Air Force began using "Teleteach" telephones to provide limited-duration audio instruction to distance learners. This expanded in the late 1970's when the Teleteach courses included an electronic blackboard that can transmit written material through telephone lines for display on a TV monitor. It also included another set of phone lines to transmit verbal information. This new system was called Teleteach Expanded Delivery System (TEDS.)

Video teleconferencing is another form of television-based distance education that became prevalent in the late 1980's and early 1990's. It involves TV and audio hookups between a local classroom and distant sites. Typically, lead teachers conduct classes and/or workshops from the local classroom, while facilitators are located at each remote site to coordinate all of the logistical aspects at the site. (Reeves and Oliver, 1996, and Barry and Runyon, 1995.) Research and evaluation studies have indicated that in many video teleconferencing classes, interactivity among the students, instructors, and content is limited and higher-order cognition is not supported. Successful teleconference classes promote interactivity by creating opportunities for collaboration, motivation, contextual engagement, personal autonomy, and generative learning (Reeves and Oliver, 1996).

Computer-based delivery systems became prevalent in the 1990's. Asynchronous Computer Conferencing involves computers networked to a server that stores information entered by the sender and asynchronously transmits the information to the recipients

whenever they contact the server (i.e. interoffice email). Computer Mediated Communication, another form of computer-based delivery, includes:

1. Computer conferencing through email and bulletin boards.
2. Informatics which is the use of on-line resources.
3. Computer Assisted Instruction.

The most recent addition to computer-based distance education is the use of the World Wide Web for instruction. These web-based classes allow students to access a web site and retrieve text, audio, and video presentations at any time. Students and teachers can communicate through email, chat sessions, Instant Messaging, audio and video streaming, electronic bulletin boards, and by phone. Web-based classes vary tremendously, ranging from simple web sites that contain only the course syllabus and text to complex setups that provide live interaction through the use of video and audio streaming.

Harmon and Jones (1999) suggest five levels of educational use of the Web common in schools, colleges, and corporations. These levels represent a continuum from basic occasional use to advanced continual use. Table 2-1 defines and summarizes each of the levels.

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The World Wide Web has become a driving force in educational technology and subsequently, web-based education has created an entirely new level of interest and momentum for distance education. Schools, colleges and universities, and businesses are attempting to offer more of their instruction and training on the web and through other distance education delivery methods (Kane, 2001). Yet while there has been research conducted on distance education, it is currently not keeping pace with the expansion of the distance education delivery methods themselves (Hill, 2000).

A review of the literature containing research studies on distance education shows the kinds of research that has been conducted on distance education, its effectiveness, and

its impact on both students and instructors. Included below is a summary of distance education research categorized by the type of study conducted.

Research in Distance Education

Noncomparative Studies on Distance Education

Numerous studies have explored the nuances of different forms of distance education. These noncomparative studies provide information about distance education without regard to how it compares to more traditional means of instruction. For example, in a study analyzing the impact of a videoconference project involving math education to parents in eleven western US states, Lanich (1996) conducted a naturalistic inquiry by collecting data over a six month period by using field notes, journal entries and interviews of participants. The project targeted parents of K-3 children and was designed to give them activities to use at home to teach math to their children. Lanich found that participating parents developed a greater understanding of math concepts and developed a better relationship with their respective schools. However, the teachers involved experienced a high level of stress from during the project because they lacked the training necessary to successfully use the distance education.

Instructor attitudes about distance education can impact its effectiveness and hinder its success. Some teachers believe that the lack of personal interaction in distance education formats will impact student attitudes and therefore hinder learning (Barker and Patrick, 1989). In an attempt to explore the one aspect of student attitudes in a distance education class, Silvernail and Johnson (1992) looked at how Interactive Televised Instruction (ITI) impacted student evaluations of their instructors. From their research,

Silvernail and Johnson discovered that students evaluated the instructor separately from the instructional method and therefore the ITI had no effect on the evaluations. It also appeared from their data that there might be some relationship between students' perceptions of instructional television, their overall perception of the course, and their level of satisfaction with the amount of student involvement in the course

In another study exploring student perceptions within a distance learning environment, Stenhoff, et al. (2001) used an online survey to investigate student impressions of student-teacher and student-technology interactions in web-based undergraduate and graduate courses in special education. The web-based classes used an Internet-delivered interactive teleconferencing system to provide means for synchronous audio and video communication among students and teachers. Survey results indicated that the instructors with the most experience with distance learning received higher ratings on all of the student survey questions regarding student-teacher interactions than their less experienced colleagues. Students of the more experienced teachers also accessed the website more often and generally felt that the technology was more useful than did students of the less experienced teachers. Stenhoff, et al. proposed that the level of experience teachers have with distance education impacts their students' experiences and perceptions of the class and the perceived effectiveness of the distance learning methods.

A recurring theme in the literature is student and teacher perceptions of an increased amount of time needed to take and teach distance education courses. In a study of faculty members involved in developing and teaching distance education courses in the field of Library and Informational Science, Small (1999) used questionnaires, focus

groups, and structured interviews of the faculty and discovered that they believe distance teaching requires more time, ongoing training, and technical support than does traditional instruction. Small also collected data from part-time Library and Informational Science students through interviews, focus groups, and questionnaires. As opposed to the responses from faculty, the resident students often find it more difficult than their distance education peers to balance academic responsibilities with their personal and work lives.

Carr (2000) conducted a reflective action research study while teaching a videoconference version of a basic instructional design course at the same time as teaching a traditional version of the same course. Results indicate that distance education experts will have to engage faculty with their concerns in more substantive ways than what has been done in the past for distance education to gain in popularity among faculty. The study asserts that distance education is not motivating for traditional faculty members because of increased time demands, lack of traditional rhythm, lack of personal contact with students, and less evident interest among distant learners in the areas that faculty value.

In another study, Gifford (1998) conducted research to determine the perceptions of graduate students regarding the time they spent in taking a course via the Internet. The graduate students completed a course in research on curriculum and instruction solely on the web and through email. They were responsible for both individual and group assignments which were completed through the web site and/or email. Results from a survey after the completion of the course indicated that the majority of students felt that more time was required for the web-based class than if the course had been offered in the

traditional classroom. Gifford did not address whether this perception was related to the content in the class or use of the technology. Survey results also indicated that the students felt that self-discipline and self-motivation were necessary qualities of students if they were to be successful in a web-based class. Gifford suggested that course content needs to be evaluated thoroughly before establishing distance education classes.

Harmon and Jones (2000) conducted a qualitative analysis on an intensive graduate level course in Web-based instruction which was also delivered via the Web. Harmon and Jones collected data through interviews, chat logs, and bulletin board interactions and discovered themes of the data as it relates to web-based instruction. The amount of time needed to complete assignments in this class was an issue in this class also as they discovered that it became a huge obstacle for many students. Students that fell behind in the material of the class quickly became disengaged and would not participate in the class. In other findings, Harmon and Jones discovered that students preferred asynchronous interactions over synchronous interaction and that weekly chat sessions were critical in developing a sense of community among the participants.

Boling and Robinson (1999) evaluated how lecture-based distance education (videoconference) could best be supplemented with learning activities. They allowed groups of college students to engage in one of three post-videoconference-lecture activities - individual study, cooperative learning, or interactive multimedia. The students were then tested on knowledge of the lecture material and were asked how much they enjoyed the post-lecture activity. Results indicated that although the interactive multimedia group enjoyed the learning activity more than the cooperative learning and individual study groups, the cooperative learning group learned the most. Martens and

Valcke (1995) explored the impact of Embedded Support Devices. These devices are elaborations of the basic content of the course (ex. Questions with feedback, advance organizers, and study guidelines) intended to support student learning in distance education contexts. Results support the positive impact of embedded support devices in written materials.

Chung, Chung, and Severence (1999) examined how support tools (i.e., prompts that support students to use self-explanation and self-monitoring strategies, prompts to encourage summarization, etc.) impact the knowledge building processes in a web-based virtual university engineering course. They found that these support tools as well as the group interaction in the web-based class enhances student engagement in knowledge building and increases student performance in integrating concepts. Chung, Chung, and Severence recommend the use of prompts in any web-based course design.

The practice of distance education is not limited to formal education, as businesses and the military are utilizing it to train employees at multiple sites. One study looked at the impact of teleassistance, a form of distance help involving telephone and computer-based assistance, on low-skilled employees of a small business in France. Vivet et al. (1993) found that this form of teaching provided a good solution for small businesses in the areas of new skills and training. It also is an extremely cost effective way to train personnel. In a study of costs savings generated by distance learning strategies in the U.S. military, Barry and Runyon (1995) found that this form of training had saved the U.S. Navy over \$7 million in travel costs and per diem expenses and an additional \$4.3 million in training costs over the previous five year period. Distance learning strategies had saved the U.S. Air Force \$5 million and 30 man-years in travel

time over a two year period. In the same article, Barry and Runyon reviewed the literature on distance learning studies and found that more recent distance education technologies such as audiographics, computer-mediated communications, and video teleconferences had added a level of interactivity that made distance training as effective as face-to-face instruction. They conclude that these factors, combined with the incredible cost savings, will allow distance training to supplant traditional resident training courses as the primary means of training personnel in the U.S. military.

Impact of Distance Education vs. Traditional Instruction

Numerous studies have attempted to compare the impact and effectiveness of distance education courses to similar courses offered by traditional means. These studies have yielded mixed results.

In a comparative study of the effectiveness of computer-mediated delivery on pre-service teacher education, Hacker and Sova (1998) distributed courseware designed to develop lesson planning skills to four separate groups of students. The first group was taught on-campus by a traditional lecture and seminar, the second group was taught on-campus via traditional lecture plus additional work with the supervising teacher, and the third and fourth groups were taught in the same contexts as groups one and two, respectively, but courseware delivery was via the Internet. Student achievement gains, as measured by pre- and post-tests, were significantly higher (15% between groups one and three, 36% between groups two and four) for Internet-mediated delivery compared to traditional instruction. Hacker and Sova suggest that the greater efficacy of Internet-mediated instruction in this study is related to the opportunities for self-paced work and

access to advice from peers, tutors and experts on demand via the Internet. Hesser, Hogan, and Mizell (1992) conducted an intensive 3-year longitudinal study to track the effectiveness of Nova University's videoconference "cluster" class in their Child and Youth Studies program. They discovered positive attitudes among students involved in the videoconference classes and more frequent communication between students, faculty, and staff members in the video classes than in the site-based classes.

In a study of graduate-level social work students, Freddolino and Sutherland (2000) used a modified version of the Adult Classroom Environment Scale (ACES) to quantify student perceptions of their classroom environments. The researchers administered the ACES at the end of each course from 1994 to 1998. Data was collected from a total of 13 graduate level courses during this time. The data compiled during this time span indicated no difference in students' perceptions of the learning environment between one on-campus and two videoconference sites. Freddolino and Sutherland conclude that graduate-level social work education can be provided effectively to students who do not live in close proximity to a university campus through distance education methods.

In a similar type of study, Spooner and his colleagues (1999) compared student perceptions and outcomes of an on-campus special education class to the same class offered as a videoconference class. End-of-course student evaluations were examined and Spooner et al. found no difference between on-campus students off-campus distance education students, including course rating, instructor ratings, and rating of level and quality of communications. They also found no differences between the two groups in student outcomes.

In a comparison of nursing students who chose to take a traditional research course with those who chose to take the course on the web, Leasure, Davis, and Thievon (2000) found no differences in learning outcomes of the two groups. They did find that students chose the traditional class for reasons such as increased interaction, immediate feedback, and decreased potential for procrastination. Students in the web-based class chose it for cost, convenience, and flexibility. Leasure, Davis, and Thievon also discovered that the students in the web-based class suggested that self-directed, self-paced students were most suited for web-based courses.

White (1999) took a group of 40 college students enrolled in a Communication Technology and Change Class and divided them into one traditional class section (24 students) and one online class section (16 students). White then conducted a case study to compare student performance in the traditional vs. the online course. Although the results indicated that in all cases the classroom section performed slightly better than the online section, in no case were the differences significant. White concluded from the case study findings that web-based instruction is as effective as classroom instruction as far as grades are concerned, but students in web-based courses are at a disadvantage if classroom discussion is important to learning. It is important to note that the only type of communication offered through the online course was the class listserv. Synchronous communication methods such as chat sessions and Instant Messaging were not available to the students.

Although most research on distance education is for post-secondary students, some research has been conducted on distance education methods within high school settings. In one study comparing web-based instruction with the traditional high school

classroom, Parker (1999) set up a simulated intranet learning environment within a school and randomly selected students to study a modified ecology curriculum through either the intranet environment or through traditional instruction. She then used the Watson-Glasser Critical Thinking Appraisal on 9th and 10th grade biology students to establish that there were no significant differences among the intranet-based group and traditional group with problem-solving ability in science. In the same study, students used software to construct concept maps of the material learned to determine level of metacognitive reflection among the students. Parker found that there was a significant improvement in metacognitive reflection among the intranet-based group as compared to the traditional one. According to Parker, increasing the amount of metacognitive reflection can improve learning. She also suggests that this type of instruction could be used in science classrooms to create equal opportunities for learning for both genders.

Not all of the comparative research results on distance education are positive, however. In a different study of graduate-level social work students, Thyer and colleagues (1998) replicated an earlier study by collecting course evaluation data from 57 students at the conclusion of two courses that combined equal amounts of live and televised instruction. They found that these students significantly favored live instruction over televised distance learning and that delivery method explained approximately 19% of the variance in student ratings of instructional quality. Thyer et al. conclude that it is very important to conduct the necessary research on distance education methods prior to “experimenting” with Masters of Social Work students’ professional education.

Culture of Distance Education

After reviewing the research, it is clear that interaction between students and between teachers and students is different within a distance education context as opposed to the traditional classroom setting. Flottemesch (2000) performed a literature review regarding interaction in distance education settings and found that proper techniques had to be employed by teachers to incorporate interaction among distance education students. She went on to state that the quality of the distance education was dependent upon the interaction and participation of the students and teachers had to make this a priority in instruction.

In a qualitative study exploring non-verbal communication during face-to-face tutoring and videotutoring, Nichol and Watson (2000) videotaped both the student and tutor during each kind tutoring session. They analyzed the tapes for non-verbal communication by using a research-based rubric. They discovered that the interaction of participants mediated through the TV monitor was significantly different from face-to-face communication in relation to the two-dimensional image on the screen and the “viewing frame” effect of the monitor. Their findings suggest that the two-dimensionality and the viewing frame of the video monitor emphasized both positive and negative elements in interpersonal communication and they concluded that videotutoring could potentially be a more effective form of tutoring than face-to-face interaction.

McHenry and Bozik (1995) studied interaction in a college videoconference class by recording observations and conducting individual and group interviews with the students. They discovered that technology in the classroom was a factor in the nature and frequency of student/student and student/teacher interaction. They also found that

college students adapt well to technological change and view it positively. The majority of students responded to the technology favorably. McHenry and Bozik also noted that teaching a videoconference class requires skill and flexibility by the teacher.

Westbrook (1999) studied the attitudes of graduate students enrolled in their first Web-based class and found that the students perceived a high degree of student-to-teacher and student-to-student interaction as well as high levels of satisfaction with the course. Swartz and Biggs (1999) analyzed a three-hour (48 contact hours) undergraduate videoconference course and noted that independence of movement, talk, and turn-taking was evident in the class and required strong teaching and classroom management skills to conduct the class successfully. They also noted modification of ordinary class behavior of students and the instructor. Swartz and Biggs also raise interesting questions about the separation of time and space that is inherent in distance education and whether or not this may be problematic. They conclude that an important question that should be addressed in future research is the question of the meaning and importance of being physically present in an educational setting.

Success in Online Education

Swan, et al. (2000) reviewed the literature and conducted an empirical study in an attempt to determine factors of success for online learning. Their literature revealed that students taking online courses tend to be older, more motivated, and have a more serious attitude than traditional students. They also found that the most successful online courses are well structured, user-friendly, and give students opportunities to interact often with their classmates and their instructors. Swan and colleagues then tested their findings by

surveying 3800 students enrolled in SUNY's Learning Network, the online learning system for the entire SUNY system. The results from the surveys supported their review findings: structure and ease of use in course design, high interaction among students and instructors, and nontraditional student demographics are common factors that contribute to success in web-based courses. Swan et al. suggest in their conclusions that questions regarding student characteristics for success in online courses deserve further investigation.

Harrison and Bergen (2000) looked at design strategies for online courses and came up with several general suggestions. They state that successful websites for online classes should have a course outline for students, weekly learning modules, activities that foster a community of learners (Instant Messaging, Chat Sessions, face-to-face interactions, etc) and required assignments. Harrison and Bergen also state that faculty training and preparation are crucial to success regardless of course design. Hiltz (1998) agreed that building a community of learners was important to online education and reviewed several studies involving collaborative learning in web-based courses. Hiltz reported that online learning was as effective as traditional classroom instruction only if students were given ample opportunity to work collaboratively in small groups. However, Hiltz also found that students were significantly less satisfied with the asynchronous learning experience of web-based education, both in terms of the group interaction process and the quality of the group discussions.

Martinez (1999) researched ways to insure successful online learning by attempting to determine if learning orientation and learning environment impacted how students interacted on a web-based class for adults. Students were given the Learning

Orientation Questionnaire to classify them into one of three learning orientations – intentional learners, conforming learners, and performing learners. The students were then randomly assigned to different web-based learning environments to determine the relationship between learning orientation and learning environment. Martinez discovered that each learning orientation required different environments for maximum success. Intentional learners thrived in sophisticated discovery learning situations, performing learners did best in non-risk interactive settings, and conforming learners were most successful in structured, non-risk settings. Martinez suggests that web-course designers include opportunities for students to engage in all of the learning environments to reach students from each of the learning orientations.

Several other studies have attempted to identify characteristics of learners who are most likely to be successful in online classes. Web-based instruction is inherently self-paced which allows learners to think through possible answers to questions prior to completing assignments. Therefore, self-regulation seems to be a key characteristic for success. Bandura (1977) defined self-regulation as the ability to control our own behavior by:

1. Self-observation, by observing and monitoring our behavior
2. Judgment, by comparing what we see with a standard
3. Self-response, by responding in positive or negative ways based on (1) and (2).

Learners who do not have the ability to self-regulate or self-direct may have trouble with the self-paced nature of web-based learning. In fact, Palloff and Pratt (1999) identified a learner's ability to self-direct and self-regulate as predictors of success in

online education. Hargis (2000) discovered similar results in a study of post-secondary science and engineering majors taking web-based chemistry courses. She administered the Motivated Strategies for Learning Questionnaire to one hundred forty-five students in a pre- and post-assessment study design and discovered that self-regulation was a primary trait with students who were successful in the web-based classes. Hargis suggests that since most online learners choose this medium in which to learn, they are typically highly motivated and self disciplined. In a paper addressing questions about how institutions of higher learning can successfully meet the educational needs of distance learners, Gibson (1998) further described online learners as task-oriented and focused and suggests that course designers consider these characteristics when designing web-based courses.

Limitations of Past Research in Distance Education

Nearly twenty years ago, Weisner (1983) reviewed the literature and concluded that a “broad theoretical framework” that can be applied to distance education was needed. A review of more current literature seems to indicate that we have not made much progress in this area over the past twenty years. In 1999, an Institute for Higher Education Policy Study sponsored by the American Federation of Teachers and the National Education Association conducted a comprehensive review of the research on distance education including web-based learning. The review found that the bulk of these writings suggest that the learning outcomes of students using technology at a distance are similar to the learning outcomes of students who participate in conventional classroom instruction. However, the review also concluded that “there is a relative paucity of true,

original research dedicated to explaining or predicting phenomena related to distance learning.”

Merisotis and Phipps (1999) examined distance education research and found shortcomings and gaps such as:

1. Research focusing primarily on student outcomes for individual courses rather than entire academic programs.
2. Research not taking into account differences (age, gender, motivation, learning styles, etc) among students.
3. Research focusing on impact of individual technologies rather than multiple technologies.
4. Lack of a theoretical framework which would allow others to replicate research.

Merisotis and Phipps concluded that technology cannot replace the human factor in learning, and it is not nearly as important as other factors such as learning tasks, learner characteristics, student motivation and the instructor.

Farber (1998) argues that measurable competence, though a central component of education, is not in itself an adequate indicator of educational effectiveness. In a review of 248 studies comparing distance education and traditional instruction, Farber concludes that these studies fail to go beyond measurable competence, fail to support the newer technologies involved in distance education, and do not support any transfer of post-secondary education from the classroom to the screen.

Lockee, Burton, and Cross (1999) criticize media comparison studies as inappropriate research designs for measuring the effectiveness of distance education.

They state that comparing achievement between groups of students involved in distance education with students involved with on-campus classes will statistically, “almost guarantee” that distance learners will perform as well as campus-based learners. Lockee, Burton, and Cross suggest aptitude-treatment interaction studies, longitudinal studies, and development studies as effective alternatives to media comparisons to evaluate distance education.

Benefits of Web-Based Education

As mentioned previously, web-based education is growing rapidly in higher education. Colleges and universities are looking at the Internet as a means to educate more students while at the same time dealing with dwindling budgets and available classroom space. The literature also reflects many benefits to students of web-based education.

Boone and Anderson (1995) suggests that a major benefit of web-based education is its ability to provide learners who are remote geographically or who are under time constraints the same opportunities as learners who are not hindered by similar constraints. Huntley and Mather (1999) also agree with this position. In addition Gibson (1998) discovered that learners who are interested in innovative ways of learning or have had a negative past experience with traditional education are deeply satisfied with and successful in web-based coursework. Nelson-Nisan (1999), in a study of teachers using web-based education for professional development, found no significant difference in achievement in a comparison of a traditional classroom learner and the web-based learner, but there was a significant difference in level of satisfaction. The web-based

learners possessed higher levels of satisfaction with the educational process than the learners in a traditional classroom. Chute, Thompson, and Hancock (1999) speculate that one of the reasons for this high level of satisfaction may be the level of control the learner has on what is learned and the pace at which the content is delivered.

Web-based education seems to be most positively embraced by non-traditional students. Since non-traditional students tend to be older with different responsibilities (such as family and full-time jobs) than their traditional student classmates, the flexibility offered by the Web appears to be a great benefit. Grill (1999) described the typical American distance learner as one who is 25 – 50 years of age, taking courses to learn new subjects and skills or to update old ones, and experienced in participating in education. Hudson (2000) surveyed adult students, all over the age of 25, about the benefits of web-based courses and heard five major benefits articulated:

1. The ease of communicating online makes it possible for students to feel as close or closer to online classmates than they ever felt to classmates in traditional classes.
2. Web-based courses give students opportunities to search the Web and master computer skills that are essential in today's world.
3. The Web enables students to reach other students and their instructors at times other than normal classroom hours making it easier for students to share information and offer support.
4. The flexibility of Web-based courses allows adult learners to balance their educational pursuits with their job and family responsibilities, thus

allowing people with limited time the opportunity to further their education.

5. Web-based courses allow students to develop self-sufficiency and engage in independent thinking.

Web-Based Training and Professional Development

For many of the same reasons that it has grown in higher education, (reduced costs, worldwide accessibility, and improved technological capabilities) Web-based education is beginning to find its way into the area of training and professional development. In fact, McGee (1999) estimates that technology assisted training via the Internet will represent half of all training methods by the year 2002.

Business training represents a large portion of the online training that exists today. Companies large and small are beginning to view classroom seminars as expensive and obsolete. Travel concerns and expenses, prompted by the terrorist attacks of 9/11, have bolstered the case for online training even more. U.S. companies spent \$4.2 billion on web-based training in 2001 and are expected to increase usage 50% per year to nearly \$15 billion by 2004 (Hickey, 2002).

In light of the current and expected growth in online training, the developers of training systems are interested in effective delivery methods. Therefore research in this expanding field is becoming increasingly necessary. Preliminary evidence indicates that employees are open to this kind of training. In a recent survey of 5,000 employees at Fortune 500 companies, nearly half reported that they would be excited if told they would

be taught something online and 19% said they preferred this type of learning over any other method (Hickey, 2002).

Web-based professional development for teachers is also growing, but little research has been conducted in this area. In a study examining vocational education teachers' knowledge about and experiences of online learning, Schofield et al. (2001) collected data from teachers through a survey, structured interviews, online research events, and two face-to-face workshops. The data indicates that those teachers who are considered leading edge online practitioners are actually experimenting with their teaching instead of recreating their traditional methods. Schofield et al. conclude that using online technologies in the classroom requires the construction of new and complex practices, thus leading to further training.

Flynn (2001) explored the relationship between personality and success in a web-based training course for inservice teachers. She administered the Simmons Emotional Intelligence Survey and the Myers-Briggs Type Indicator to 11 students and correlated their scores on these measures with pre-defined indicators of success. Flynn found that two personality traits as measured by Simmons were strongly related to the measures of success. Most notably is a negative correlation between the Simmons measure for self-esteem and two measures for success: Number of on-time assignments and number of emails the students sent to the instructors. The other Simmons measure that yielded a strong correlation to measures of success is direction. Flynn's data shows a significant positive relationship between direction and the students' gain scores on pre- and post-instruction assessments. None of the Myers-Briggs variables produced significant relationships with measures of success.

In her study, Flynn concludes that her finding of a negative relationship between self-esteem and success is interesting but not contrary to previous research (Flynn, 2001). Flynn also suggests that the small sample size (11) used in the study makes it difficult to make any broad generalizations about the whole population of online students in relation to personality characteristics and academic success and that additional research needs to be conducted in this area.

Personality and Academic Achievement

There has been a tremendous amount of research conducted on the relationship personality plays in academic achievement. For example, in a study exploring the relationship between personality type and achievement in college biology, Tharp (1993) administered the Myers-Briggs Type Indicator (MBTI) to 146 students in a biology class at a large state university and compared the results with the students' total numeric grade from the four exams given during the semester. Tharp selected personality types based on previous findings that had indicated certain types had some influence on academic achievement. He found that introverts were the highest achievers while perceiving types were the lowest. Among the type combinations the introverted-judging types had the highest achievement and the extroverted-perceiving types were the lowest. Tharp reports that these results are in close agreement with previous research and concludes that large course sections at large universities favor students that can work alone, concentrate well, and likes to live in a planned, orderly way (IJ type). He suggests that the high attrition rate of college freshmen at large universities may be the result of these personality types and that learning environments need to consider the needs of other types of students.

In a study designed to determine the interaction effects of selected personality characteristics and classroom climate on achievement, Haukoos and Penick (1987) randomly selected biology classes and set up classroom climates determined by the directness or indirectness of the teaching that occurred in the class. Student achievement was measured at the conclusion of the course through the Science Process Inventory. Personalities were measured by Edwards Personal Preference Schedule (EPPS). They found that students who scored high on Heterosexuality as measured by the EPPS made greater achievements in the discovery-based climate, whereas students who scored high on Autonomy as measured by the EPPS made greater achievements in the non-discovery climate. Further analysis revealed a negative interaction between need for autonomy and need for science-process achievement. Haukoos and Penick conclude that educators consider spending more time focusing on creating successful classroom climates and what constitutes their existence.

Hill (1999) conducted a study to identify the personality characteristics of high achieving remedial students and to discover how personality characteristics relate to academic performance among high achieving remedial and non-remedial college students. He administered the MBTI to remedial and non-remedial honor students and then looked for patterns of personality within these groups of students. Hill found that the high achieving remedial students, as a group, exhibited a significantly different mode of perception than high achieving non-remedial students. He also discovered that high achieving remedial students tend to be more extroverted, more feeling, and more judging.

Biner and his colleagues (1995) cite, as a motivation for their study, a lack of research into the role personality plays in student success in distance education courses.

In their large scale field study, they attempted to determine if personality traits of college students in televised classes differed from the traits of students enrolled in traditional classes. They also attempted to identify specific personality traits that can predict successful performance in televised classes.

Biner et al. administered the Sixteen Personality Factor Questionnaire to university students enrolled in 18 different televised courses and also to those enrolled in the same courses taught through traditional means. Among the primary factors, they found that the telecourse students were more abstract in their thinking, more emotionally stable, more disciplined and controlled, and less trusting than their counterparts in traditional classes. Among the global factors, Biner and his colleagues found that, relative to traditional students, telecourse students were more passive and conforming.

The research group calculated correlation coefficients between the personality factors and the students' final grades in the telecourses and traditional courses. For the primary factors, they found that the telecourse students who achieved higher grades tended to be more self-sufficient than group-oriented and less compulsive. Among the traditional students, higher grades were associated with greater emotional stability, seriousness, shyness, imaginativeness, and experimentation. One of the more interesting results found by Biner and colleagues was the finding of a significant relationship between grades and scores on the expedient/rule-consciousness factor for both telecourse and traditional courses. In this case, the direction of the relationship differed as a function of the group. Higher grades were associated with higher levels of expedience for the telecourse students whereas higher grades were associated with greater rule-consciousness for the traditional students.

Correlations drawn between grades and global factors also yielded interesting results between the two groups of students. Among the traditional students, higher grades were associated with higher levels of introversion and emotionality and lower levels of anxiety. As with the traditional students, the more introverted telecourse students performed better in their classes than their more extraverted classmates. There was no significant relationship between grades and emotionality or levels of anxiety among the traditional students. However, as was discovered with the primary factor expedient/rule-consciousness, a divergence of relationships among the two groups appears between student grade and the global factor Control. In this case, the telecourse students with better grades scored lower on control while the traditional students with higher grades scored higher on control. Biner et al. reference these results while recommending to distance educators to implement a personality testing program to identify potential low-performing students and provide them the necessary support they need to insure success in online classes.

Self-Esteem and Academic Achievement

According to the findings from numerous research studies on the subject over the past twenty-five years, self-esteem seems directly correlated with academic achievement at least to a moderate degree (Wiggins et al., 1994). In a study of levels of self-concept held by high achieving and low achieving students, Bloom (1977) administered a self-concept instrument to students in the highest fifth and the lowest fifth of their classes in the first through eighth grades. The results showed that both high and low achieving students had similar levels of self-concept in grades one and two, but they became more

distinct in their self concepts in each subsequent grade until they were extremely different in their views of themselves by grade eight. Further investigation into this area revealed that academic disparities increased between the high achievers and low achievers if low self-esteem was also present (Bloom, 1977). According to Bloom's research, correlations between self-concept and academic achievement range from 0.23 in late elementary school to 0.50 in seventh and eighth grades (Bloom, 1977).

In a study into the effect television viewing has on earned grades, locus of control, and self esteem, Wiggins (1987) administered questionnaires regarding time spent watching television to 490 students in grades four to twelve. These same students were also given instruments designed to measure self-esteem and locus of control. Grades averages were computed for the students and each of the variables correlated with one another. The results indicated that self-esteem was the only variable significantly correlated with grade (Wiggins, 1987). In another study, Wiggins et al. (1994) confirmed the earlier results by reproducing a similar correlation with an even larger population of students. They also showed a significant correlation between self-esteem and scores on standardized achievement tests. Other studies have found similar results regarding the relationship between academic achievement and self-esteem (Simon and Simon, 1975; Rubin, 1978; Thomas-Brantley, 1988; Liu, Kaplan, and Risser, 1992; Daniel and King, 1995)

Although there is a tremendous amount of research supporting the idea that self-esteem is positively correlated with achievement, many researchers debate the causal relationship between the two. In his review of five research studies, Holly (1987) suggests that self-esteem is not a cause of academic success, but rather an effect. In a

longitudinal study, Ross and Broh (2000) investigated the effects of academic achievement of students in the eighth grade on their self-esteem and the sense of personal control when they were in the tenth grade. Ross and Broh also looked at the effect these students' self-esteem and control in the tenth grade had on their academic achievement when they were seniors. The researchers found that sense of personal control affects subsequent academic achievement but self-esteem does not. Ross and Broh did find that earlier academic achievement increased self-esteem.

Chapter Three

Methodology

Introduction

The focus of this study is to explore the relationship between personality traits of students and their achievement and behavior in a web-based professional development course for science teachers. The goals of this project are as follows:

1. Is there a distinctive personality profile of the students enrolled in the spring 2002 section of Technology Tools for Science Teachers? (Chapter Five)
2. What is the relationship between student personality traits and their achievement in the Tech Tools course? (Chapter Five)
3. Can a useful model be created that can predict a student's achievement in Tech Tools based upon their scores on personality inventories? (Chapter Five)
4. How do students rate of electronic communication within the framework of Tech Tools relate to their achievement in the course? (Chapter Five)
5. Is there a relationship between students' personality and how often they communicate electronically in Tech Tools? (Chapter Five)
6. Is there a relationship between students' personality or other characteristics and the nature and content of their electronic communication? (Chapter Four)
7. Are their patterns in the nature and content of the electronic communications within Tech Tools that hint at the culture of the course? (Chapter Six)

Participants

The participants in this study were the 17 students enrolled in Technology Tools for Science Teachers (Tech Tools) offered through NC State University for the spring semester of 2002. Sixteen of the students were inservice science teachers from high schools and middle schools in North Carolina. Each of these students was a “lateral entry” teacher, a program in North Carolina that allows people with undergraduate degrees in a content area to receive a temporary license for public school teaching until they are able to complete all the requirements for initial licensure from an institution of higher education. The other student in the class was teaching physics labs at NC State while attempting to fulfill the requirements for an initial teaching license. At NC State University, the science education lateral entry students are required to take the Tech Tools course as part of their technology requirement.

These students were instructed predominately via the web through the Tech Tools web site. They also submitted most assignments and communicated with the instructors mainly through electronic means. Because of this, the face-to-face sessions were used extensively to collect data from the students for this project.

Data Collection

Data for this project was collected from a variety of sources. Through standardized personality instruments, instruments uniquely designed for Tech Tools, observations of student communication during the course, interviews of students, and the final grades earned by the students. Below is a description of these sources of data.

Entrance Survey

The Entrance Survey is a 17-item questionnaire that was specifically developed for this course by the instructors and the researcher. It was administered during the first face-to-face session at the beginning of the Tech Tools course. The first section of the survey allows the students to rank themselves on 12 separate technology skills: Using email, using a Listserv, using Instant Messaging, navigating the web, using a digital camera, using a scanner, using image manipulation software, creating web pages, using calculator-based laboratories, using microcomputer-based laboratories, creating digital videos, and creating panoramas and object movies. The students used a 6-point scale to rank their skill level for each of these skills, where 1 = Expert and 6 = Novice.

The second section is made up of five free-response questions designed to collect background information about the student. Questions about the students' professional background prior to teaching, prior experience with distance education and expectations for Tech Tools are included.

The Simmons Emotional Intelligence Survey

The Simmons Emotional Intelligence Survey is a measure of emotionally-based characteristics and was developed by John Simmons after he studied his own and others' research on these characteristics as predictors of success. The survey contains a list of 360 adjectives from which each participant selects. In part I, the participant selects any 60 of the 360 adjectives listed that the participant would use to describe himself. In part II, the participant selects any 60 of the 360 adjectives that the participant believes others would use to describe him. For this study, the survey was administered online during the

first face-to-face session and scored by a certified testing center. The results of the surveys are returned in the form of scores ranging from 1.0 to 10.0 on 13 different scales. Table 3-1 shows the emotional characteristics associated with the 13 scales, and the traits related to low scores and high scores. In addition to each score, a brief description is provided of the individual based upon where the person falls in the range of scores.

Table 3-1. Simmons' 13 Emotion Ranges

Emotional Characteristic	Low Score Trait	High Score Trait
Energy	Slow paced	Fast paced
Stress	Relaxed	Stressed
Optimism	Fault finding	Positive
Self-esteem	Humble	Self-assured
Commitment to work	Leisurely	Hard working
Attention to detail	Spontaneous	Careful
Desire for change	Routine	Changing
Courage	Cautious	Courageous
Direction	Hesitant	Decisive
Assertiveness	Compliant	Assertive
Tolerance	Intolerant	Tolerant
Consideration for others	Self-willed	Considerate
Sociability	Reserved	Sociable

The Simmons Survey has been used mainly in business settings to predict job performance of employees. Simmons and Simmons (1997) report on several internal studies conducted with their clients to assert the validity of the Simmons survey as a predictor of success. In one study, they report that the survey was used with a fast food franchise and produced a correlation of 0.86 with the job performance of restaurant managers, as measured by the company's semiannual performance review. They also report finding a correlation of 0.68 with job performance of hospital nurses at Methodist Hospitals, as measured by the Methodist Hospitals Performance Appraisal. Most impressively, Simmons and Simmons report that the Simmons Survey correlated a perfect 1.00 with the job performance of a Temporary Service company's sales force, as measured by the company's President's Club Ranking.

Although these test statistics seem impressive, the fact that the results come from internal studies conducted by the test developers themselves creates possible concerns about the credibility of the results. In their reporting of the results, Simmons and Simmons fail to mention the methodology they employed in the studies. In addition, other than Flynn's research (2001), a review of the literature found no other references to the Simmons Survey in any academic research article. The fact that the Simmons Survey has rarely been used in academic settings necessitates the use of other instruments more widely utilized in personality research.

Rosenberg Self-Esteem Inventory

The Rosenberg Self-Esteem Inventory (RSE) was also administered to the students during the first face-to-face session as an attachment to the Entrance Survey.

Developed in 1965 by Morris Rosenberg, the RSE is a 10-item scale designed to measure self-esteem using self-acceptance and self-worth statements. It is one of the most popular and well-utilized measures of self-esteem and is generally considered the standard against which other measures of self-esteem are compared.

Although Rosenberg (1965) used the Guttman scoring method to obtain self-esteem scores, other researchers have preferred to sum the subjects' responses for all ten statements. Wallace (1988) proposes using a four-point Likert scale for each of the ten items. According to Wallace, using this scoring system is advantageous because it is simple to score and produces a wider range of scores and subsequently, greater discrimination among individuals. In an analysis of 18 research studies that used the Likert scoring system, Wallace calculated that the average internal consistency of the Inventory using this scoring method was 0.80 and the average test/retest stability = 0.74.

The Rosenberg Self Esteem Inventory was selected for this study because of its significance in self-esteem research and the amount of documentation available regarding the reliability and validity of the measure. Since the research by Flynn (2001) indicates a strong negative correlation between success and self-esteem as measured by the Simmons Survey, the Rosenberg Self Esteem Inventory serves as an excellent standard to confirm the self-esteem measures of the Simmons Survey.

The Sixteen Personality Factor Questionnaire

Developed in 1955 by Raymond Cattell, The Sixteen Personality Factor Questionnaire (16PF) is a widely used personality assessment instrument with well-documented psychometric properties (Cattell, Eber, and Tatsouka, 1970) and is the

second most cited personality inventory behind only the Minnesota Multiphasic Psychological Inventory (Schuerger, 1992). The 16PF is unique among personality instruments in that it samples a broad base of questions about normal personality style. In creating the 16PF, Cattell took a collection of all known adjectives describing human behavior and created a smaller list through content analysis. This list was used to collecting ratings data from large groups of subjects which Cattell later factor-analyzed to yield 16 factors of personality. These became the primary factors of the 16PF. No other researcher has constructed a questionnaire by this method of systematically sampling the entire realm of personality descriptors and then reducing them to a small number of primary traits. This method contrasts with the method of writing items to a particular theory, as with the Myers-Briggs Type Indicator (Myers et al..., 1998).

Because so many researchers have used the 16PF in their research through the years, a large amount of data exists to assess the credibility of the data it generates. For example, in a meta-analysis of 106 research articles, Schuerger, Zarella and Hotz (1989) discovered that the average internal consistency of the 16PF = 0.74 and the average test/retest stability was 0.75 over six years.

The 16PF contains 185 multiple choice items distributed across sixteen bipolar factor scales. In addition to the primary scales, the 16PF contains a set of five scales that combine related primary scales into Global Factors of personality. Factor names and associated personality characteristics for the 16 primary factors and the five global factors are outlined in Tables 3-2 and 3-3 respectively. Raw scores are converted to standardized-ten (STEN) scores normed for age, race and gender. The 16PF was administered to the entire class three weeks into the Tech Tools course during the second

face-to-face session. For this study, the 16PF data was scored by the Institute for Personality and Ability Testing (IPAT). In addition to the Primary Factor and Global Factor scores, IPAT provided a detailed personality profile for each of the students.

Table 3-2. Low and High Score Characteristics for Primary Factors of 16PF

Factor	Low Score Characteristics	High Score Characteristics
Warmth (Factor A)	Reserved, Impersonal, Distant	Warm, Outgoing, Attentive to Others
Reasoning (Factor B)	Concrete	Abstract
Emotional Stability (Factor C)	Reactive, Emotionally Changeable	Emotionally Stable, Adaptive, Mature
Dominance (Factor E)	Deferential, Cooperative, Avoids Conflict	Dominant, Forceful, Assertive
Liveliness (Factor F)	Serious, Restrained, Careful	Lively, Animated, Spontaneous
Rule-Consciousness (Factor G)	Expedient, Nonconforming	Rule-Conscious, Dutiful
Social Boldness (Factor H)	Shy, Threat-Sensitive, Timid	Socially Bold, Venturesome, Thick-Skinned
Sensitivity (Factor I)	Utilitarian, Objective, Unsentimental	Sensitive, Aesthetic, Sentimental
Vigilance (Factor L)	Trusting, Unsuspecting, Accepting	Vigilant, Suspicious, Skeptical, Wary
Abstractedness (Factor M)	Grounded, Practical, Solution-Oriented	Abstracted, Imaginative, Idea-Oriented
Privateness (Factor N)	Forthright, Genuine, Artless	Private, Discreet, Non-Disclosing
Apprehension (Factor O)	Self-Assured, Unworried, Complacent	Apprehensive, Self-Doubting, Worried
Openness to Change (Factor Q1)	Traditional, Attached to the Familiar	Open to Change, Experimenting
Self-Reliance (Factor Q2)	Group-Oriented, Affiliative	Self-Reliant, Solitary, Individualistic
Perfectionism (Factor Q3)	Tolerates Disorder, Unexacting, Flexible	Perfectionistic, Organized, Self-Disciplined
Tension (Factor Q4)	Relaxed, Placid, Patient	Tense, High Energy, Impatient, Driven

Table 3-3. Low and High Score Characteristics for Global Factors of 16PF

Factor	Low Score Characteristics	High Score Characteristics
Extraversion	Introverted, Socially Inhibited	Extraverted, Socially Participating
Anxiety	Low Anxiety, Unperturbed	High Anxiety, Perturbable
Tough-Mindedness	Receptive, Open-Minded, Intuitive	Tough-Minded, Resolute, Unempathic
Independence	Accommodating, Agreeable, Selfless	Independent, Persuasive, Willful
Self-Control	Unrestrained, Follows Urges	Self-Controlled

Although the MBTI is more frequently used in education research, the 16PF is cited more often in research articles overall. In addition, the method of developing the 16PF from an exhaustive list of adjectives used for behavior seems to parallel the Simmons Survey's use of adjectives. These two factors, the large amount of citations on the 16PF and their subsequent validity data as well as the unique method of developing the 16PF, were the primary reasons for selecting the 16PF as the additional personality instrument used in the study. Nevertheless, Table 3-4 shows the correlations between the MBTI Types and the 16PF primary factors and 16PF global factors respectively (Russell and Karol, 2002).

Electronic Communications

Since much of the communication in Tech Tools is based upon electronic communications technology, measuring frequency and monitoring content of this correspondence provides another source of data that can be used to explore the role of personality and learning in the class. For this study, the instructors saved all Instant Message conversations and email exchanges in which they engaged the students. In addition, all posts to the course listserv were saved. All of the communication data was compiled for data analysis.

Instant Message Interviews

Ten students were selected for interviews during the last three weeks of the Tech Tools course. The students were selected to represent a cross section of personality types based on their scores from the 16PF, the Simmons instrument, and the Rosenberg Self-Esteem Inventory. The researcher attempted to select students with opposing scores on certain personality traits (i.e. Extraversion vs. Introversion, High vs. Low Self-Esteem, Traditional vs. Openness to Change, etc.). Each of the students selected agreed to participate in the interview.

The interviews were conducted as 30-45 minute Instant Message sessions between the subject and the researcher. The Instant Message format was chosen for several reasons:

- The Instant Message format allowed interviews to take place outside of normal business hours. The lateral entry teachers enrolled in Tech Tools are working full-time during the day and many had other school and/or family responsibilities in the evenings. The flexibility of IM allowed very busy students an opportunity to participate in the interviews.
- The Instant Message format allowed students from remote geographical areas to participate as easily as students who live closer to campus. IM interviews are convenient to these students for the same reasons web-based education is convenient.

Table 3-4. Correlations of 16PF with Myers-Briggs Type Indicator

	16 PF Primary Factor Scale															
MBTI Type	A	B	C	E	F	G	H	I	L	M	N	O	Q1	Q2	Q3	Q4
Extraversion	0.41	-0.09	0.36	0.31	0.48	-0.17	0.65	-0.10	-0.22	-0.15	-0.40	-0.32	0.06	-0.49	-0.01	-0.12
Introversion	-0.36	0.08	-0.23	-0.23	-0.51	0.17	-0.52	0.13	0.13	0.06	0.37	0.19	-0.19	0.42	0.02	0.08
Sensing	-0.06	-0.18	-0.12	-0.22	-0.06	0.20	-0.16	-0.17	0.05	-0.41	0.18	0.04	-0.59	0.06	0.25	-0.12
Intuitive	-0.03	0.27	0.09	0.19	-0.06	-0.20	0.19	0.28	-0.16	0.41	-0.14	0.00	0.54	-0.03	-0.23	0.03
Thinking	-0.32	0.10	0.09	0.21	-0.03	-0.01	0.17	-0.19	0.20	-0.04	0.27	-0.33	-0.07	0.08	0.13	0.15
Feeling	0.24	-0.12	-0.09	-0.20	0.09	0.01	-0.08	0.28	-0.12	0.08	-0.23	0.27	0.00	-0.08	-0.11	-0.03
Judging	-0.15	-0.03	-0.10	0.01	-0.22	0.25	-0.09	0.18	0.12	-0.25	0.19	0.18	-0.29	0.20	0.57	0.01
Perceptive	-0.03	0.02	0.01	0.04	0.11	-0.37	0.06	-0.13	-0.03	0.31	-0.18	-0.09	0.21	0.06	-0.53	0.10
	16PF Global Factor Scale															
MBTI Type	Extraversion			Anxiety			Tough-Mindedness			Independence			Self-Control			
Extraversion		0.68			-0.38			-0.03			0.39			-0.13		
Introversion		-0.61			0.23			0.08			-0.35			0.17		
Sensing		-0.16			0.04			0.56			-0.36			0.38		
Intuitive		0.08			-0.08			-0.56			0.32			-0.35		
Thinking		-0.18			-0.05			0.24			0.22			0.08		
Feeling		0.19			0.09			-0.26			-0.19			-0.10		
Judging		-0.26			0.15			0.17			-0.09			0.54		
Perceptive		0.09			-0.01			-0.12			0.11			-0.57		

Yellow highlights indicate $p < 0.01$

- The transcripts for Instant Message interviews were easily recorded and printed to eliminate errors caused by transcribing interviews from field notes or audio recordings.

Although the interviews included many of the same questions for all subjects, the structure of the interview allowed enough flexibility for the researcher to ask more questions if necessary to further explore specific issues.

Final Grade

The students in Tech Tools earned grades based upon the timeliness and quality of the assignments they completed for the course. The instructors awarded a specific number of points for each assignment. The assignment scores were then summed at the conclusion of the semester to provide a numerical grade as a measure of their level of achievement in Tech Tools. The instructors provided this final grade data to the researcher for comparative analysis with the other variables.

Data Analysis

Because of the small number of students in the Tech Tools course, data analysis included both qualitative and quantitative methods to adequately investigate the relationship between personality and performance in the course.

Qualitative Data Analysis

For the qualitative portion of this investigation, ten students were selected for Instant Message interviews that were selected to represent a cross section of personality

types based on their scores from the various personality instruments. This group of students served as the population participating in the qualitative portion of this research project. All of this written information (Entrance Surveys, interview data, emails and IMs with the instructors, and the listserv posts) from these ten students was analyzed extensively using standard qualitative analysis methods. The objective was to determine possible patterns in their electronic communications. As often as possible the qualitative data was analyzed using the students' personality traits as points of comparison. As can be expected, there were several educationally significant patterns discovered during the qualitative analysis that had no obvious relationship with personality. These patterns were recorded and compiled as additional findings.

Quantitative Data Analysis

The quantitative data was compiled and analyzed in an assortment of ways. The class averages for all of the global and primary factors of the 16PF were compared to national norms made available by the authors of the 16PF. A significance test was calculated for the differences between the class and national averages for each of the factors to show whether or not the Tech Tools students varied from the national averages. This profiling of the Tech Tools class was not conducted for the RSE or the Simmons Survey because no national norm data was found in the literature.

Years of teaching experience from the Entrance Survey as well as the scores from the 16PF, Rosenberg, and Simmons Survey were compared to student final grade by calculating Pearson correlation coefficients. In addition this data was also compared to tallies of all of the monitored communication (Instant Messages with the instructors,

emails to the instructors, posts to the course listserv, and the sum total of all of the aforementioned electronic communications) by calculating Pearson correlation coefficients. Significance tests were performed for these correlations to determine level of statistical significance. It was determined that correlations above 0.48 were statistically significant at the $p < 0.05$ level for a sample size of 17 subjects.

At the conclusion of the Tech Tools course less than nine points separated the grades for 16 of the 17 students. Since this affected the size of the correlations calculated for final grade, it was decided that any correlation with final grade that had a value of at least 0.30 would be highlighted as educationally significant.

To determine the level of inter-correlation present, Pearson correlations were also calculated among the variables of all four instruments used in this study. The data for inter-correlation was then used to provide a greater context to analyze and report the results.

A final step in the data analysis of this project involved conducting a regression analysis of all of the variables with final grade as the dependent variable. Separate regressions were run for the Simmons Survey and the 16PF due to the level of inter-correlation between variables of these two instruments. The regression analysis produced equations that can be used to predict final grade based on the students' scores on the independent variables: Either the traits measured by the Simmons, 16PF, Rosenberg, or Entrance Survey, and/or the amount of electronic communication in which the students engaged during the course. Using the prediction equations, predicted grade was then plotted against actual grade for each of the students in Tech Tools.

All of the statistical analysis of the data, except for the regression analysis, was accomplished using Microsoft Excel for Windows. The regression analysis was conducted by Dr. Ken Gattis of the NCSU Tutorial Center. He used SAS statistical analysis software accessed through the NCSU mainframe computer system.

Chapter Four

A Qualitative Study Into Personality Traits and Their Impact on Electronic Interactions in a Web-based Course for Science Teachers

Introduction

Research in Distance Education

Nearly twenty years ago, Weisner (1983) reviewed the literature and concluded that a “broad theoretical framework” that can be applied to distance education was needed. A review of more current literature seems to indicate that we have not made much progress in this area over the past twenty years. In 1999, an Institute for Higher Education Policy Study sponsored by the American Federation of Teachers and the National Education Association (Merisotis and Phipps, 1999) conducted a comprehensive review of the research on distance education including web-based learning. The review found that the bulk of the writings suggest that the learning outcomes of students using technology at a distance are similar to the learning outcomes of students who participate in conventional classroom instruction. However, the review also concluded that there is a relative paucity of true, original research dedicated to explaining or predicting phenomena related to distance learning.

Merisotis and Phipps (1999) examined distance education research and found shortcomings and gaps such as:

1. Research focusing primarily on student outcomes for individual courses rather than entire academic programs.

2. Research not taking into account differences (age, gender, motivation, learning styles, etc) among students.
3. Research focusing on impact of individual technologies rather than multiple technologies.
4. Lack of a theoretical framework which would allow others to replicate research.

Merisotis and Phipps concluded that technology cannot replace the human factor in learning, and it is not nearly as important as other factors such as learning tasks, learner characteristics, student motivation and the instructor.

Farber (1998) argues that measurable competence, though a central component of education, is not in itself an adequate indicator of educational effectiveness. In a review of 248 studies comparing distance education and traditional instruction, Farber concludes that these studies fail to go beyond measurable competence, fail to support the newer technologies involved in distance education, and do not support any transfer of post-secondary education from the classroom to the screen.

Lockee, Burton, and Cross (1999) criticize media comparison studies as inappropriate research designs for measuring the effectiveness of distance education. They state that comparing achievement between groups of students involved in distance education with students involved with on-campus classes will statistically, “almost guarantee” that distance learners will perform as well as campus-based learners. Lockee, Burton, and Cross suggest aptitude-treatment interaction studies, longitudinal studies, and development studies as effective alternatives to media comparisons to evaluate distance education.

Some researchers have employed qualitative methods to study the dynamics of distance education. In a study to identify qualitative factors that affect learning in a web-based university course, Sujo de Montes and Gonzales (2000) used a variety of methods to collect data. These methods included an open-ended questionnaire given to participating students at the middle and end of the semester, electronic journals kept by the participating students, and in-depth interviews with four of the participants at the end of the semester.

In a study of web-based undergraduate and graduate courses in special education, Stenhoff, et al. (2001) used an online survey to investigate student impressions of student-teacher and student-technology interactions. The web-based classes used an Internet-delivered interactive teleconferencing system to provide means for synchronous audio and video communication among students and teachers. Survey results indicated that the instructors with the most experience with distance learning received higher ratings on all of the student survey questions regarding student-teacher interactions than their less experienced colleagues. Students of the more experienced teachers also accessed the website more often and generally felt that the technology was more useful than did students of the less experienced teachers. Stenhoff et al. proposed that the level of experience teachers have with distance education impacts their students' experiences and perceptions of the class and the perceived effectiveness of the distance learning methods.

Gifford (1998) conducted a study to determine the perceptions of graduate students regarding the time they spent in taking a course via the Internet. The graduate students completed a course in research on curriculum and instruction solely on the web

and through email. They were responsible for both individual and group assignments which were completed through the web site and/or email. Results from a survey after the completion of the course indicated that the majority of students felt that more time was required for the web-based class than if the course had been offered in the traditional classroom. Gifford did not address whether this perception was related to the content in the class or use of the technology. Survey results also indicated that the students felt that self-discipline and self-motivation were necessary qualities of students if they were to be successful in a web-based class. Gifford suggested that course content needs to be evaluated thoroughly before establishing distance education classes.

Harmon and Jones (2000) conducted a qualitative analysis on an intensive graduate level course in Web-based instruction that was also delivered via the Web. Harmon and Jones collected data through interviews, chat logs, and bulletin board interactions and discovered themes of the data as it relates to web-based instruction. Harmon and Jones found that students preferred asynchronous interactions over synchronous interaction, but that weekly chat sessions were critical in developing a sense of community. Harmon and Jones also discovered that the amount of time the class required was a huge obstacle for many students. Students that fell behind in the material of the class quickly became disengaged and would not participate in the class.

Several other studies have attempted to identify characteristics of learners who are most likely to be successful in online classes. Web-based instruction is inherently self-paced which allows learners to think through possible answers to questions prior to completing assignments. Therefore, self-regulation seems to be a key characteristic for success. Bandura (1977) defined self-regulation as the ability to control one's own

behavior by self-observation, judgment, and self-response. Learners who do not have the ability to self-regulate or self-direct may have trouble with the self-paced nature of web-based learning. In fact, Palloff and Pratt (1999) identified a learner's ability to self-direct and self-regulate as predictors of success in online education. Hargis (2000) discovered similar results in a study of post-secondary science and engineering majors taking web-based chemistry courses. Since most online learners choose this medium in which to learn, they are typically highly motivated and self disciplined. Gibson (1998) further described online learners as task-oriented and focused.

The literature also reflects many benefits to students of web-based education. Boone and Anderson (1995) suggests that a major benefit of web-based education is its ability to provide learners who are remote geographically or who are under time constraints the same opportunities as learners who are not hindered by similar constraints. Huntley and Mather (1999) also agree with this position. In addition Gibson (1998) discovered that learners who are interested in innovative ways of learning or have had a negative past experience with traditional education are deeply satisfied with and successful in web-based coursework. Nelson-Nisan (1999), in a study of teachers using web-based education for professional development, found no significant difference in achievement in a comparison of a traditional classroom learner and the web-based learner, but there was a significant difference in level of satisfaction. The web-based learners possessed higher levels of satisfaction with the educational process than the learners in a traditional classroom. Chute, Thompson, and Hancock (1999) speculate that one of the reasons for this high level of satisfaction may be the level of control the learner has on what is learned and the pace at which the content is delivered.

Web-based education seems to be most positively embraced by non-traditional students. Since non-traditional students tend to be older with different responsibilities (such as family and full-time jobs) than their traditional student classmates, the flexibility offered by the Web appears to be a great benefit. Grill (1999) described the typical American distance learner as one who is 25 – 50 years of age, taking courses to learn new subjects and skills or to update old ones, and experienced in participating in education. Hudson (2000) surveyed adult students, all over the age of 25, about the benefits of web-based courses and heard five major benefits articulated.

1. The ease of communicating online makes it possible for students to feel as close or closer to online classmates than they ever felt to classmates in traditional classes.
2. Web-based courses give students opportunities to search the Web and master computer skills that are essential in today's world.
3. The Web enables students to reach other students and their instructors at times other than normal classroom hours making it easier for students to share information and offer support.
4. The flexibility of Web-based courses allows adult learners to balance their educational pursuits with their job and family responsibilities, thus allowing people with limited time the opportunity to further their education.
5. Web-based courses allow students to develop self-sufficiency and engage in independent thinking.

Technology Tools for Science Teachers

Under this backdrop, NC State University developed EMS 594I: Technology Tools for Science Teaching (Tech Tools) – a web-based graduate level course designed to promote the use of instructional technology in the teaching and learning of science. EMS 594I is the result of NC State’s attempt to develop an effective web-based course to teach teachers how to use technology to teach science. Tech Tools utilizes an extensive website which serves as the main method of delivering instruction. In addition to the website, students are provided access to a dedicated listserv, access to the instructors and the rest of the class through instant messaging (IM) and email, virtual office hours to converse with the instructors through IM, and monthly face-to-face class sessions for personal interaction with the instructors and other students.

The technology tools the students learn to use include instant messaging, the listserv, digital cameras, website design software, microcomputer-based lab equipment, calculator-based lab equipment, and data analysis software. To optimize the learning opportunities in the course, the instructors provided each student with a laptop computer and all of the equipment necessary to complete the course. The course syllabus is located on the course website and directs the students to the web-based instructional units and the assignments. Each unit includes pre- and post-tests to measure the students’ knowledge gains. Students submit assignments by uploading them onto a private server, sending them to the instructors as email attachments, posting to the listserv, or presenting during a face-to-face session.

Since EMS 594I was offered for the first time during the Spring Semester 2000, it is important to the course developers to conduct research on its impact and effectiveness.

In the spring of 2001, Flynn (2001) conducted a quantitative research project to explore relationships between personality traits and measures of success in the Tech Tools course. Flynn's research indicates that several measurable personality traits correlate with how well students perform in Tech Tools, with a negative correlation present between self-esteem and student achievement. This article describes a qualitative research project conducted in the spring of 2002 designed to explore more deeply the relationship between student personality traits, their perceptions, and behaviors in Technology Tools for Science Teachers.

Technology Tools for Science Teachers is designed as a post-baccalaureate course for inservice teachers and is required for all Lateral Entry teachers seeking a science teaching certificate from NC State. The requirements of the Lateral Entry program insure that these students are nontraditional, have time constraints, and for the most part are similar to the profile of the American distance learner as described by Grill.

Flynn (2001) conducted research on the Tech Tools course during the spring semester of 2001 and studied potential relationships between student personality traits and achievement in the course. Flynn administered the Simmons Emotional Intelligence Survey and the Myers-Briggs Personality Type Indicator to the students, then attempted to correlate student scores on these instruments with measures of success in the class such as gain scores on pre- and post-tests, the number of on-time assignments, and communications with the instructor. Data from the study indicates a strong negative correlation between self-esteem as measured by the Simmons instrument and each of the measures of success. The data also shows a positive correlation between the Simmons measure for Direction and the measures of success. However, the sample size for Flynn's

study was small (only 11 students) and Flynn herself concludes that more research is needed to explore indicators of success in web-based education.

Methodology

Participants

The participants in this study were selected from the 17 students enrolled in Technology Tools for Science Teachers (Tech Tools) for the spring semester of 2002. All of the students included were inservice science teachers and 16 of the 17 students were “lateral entry” teachers, a program in North Carolina that allows people with undergraduate degrees in a content area to receive temporary licensure for public school teaching until they are able to complete all the requirements for initial licensure from an institution of higher education. At NC State University, the science education lateral entry students are required to take the Tech Tools course as part of their program requirement.

Three instruments designed to measure various personality traits were administered to each of the seventeen Tech Tools students: The Sixteen Personality Factor Questionnaire, The Simmons Emotional Intelligence Survey, and the Rosenberg Self Esteem Inventory. Ten students were selected to participate in the qualitative analysis of the course and represented a diverse array of personality types. Because of the results from the earlier work of Flynn (2001), several of the students were selected for this project based upon their self-esteem scores.

Personality Assessment Instruments

The Simmons Emotional Intelligence Survey is a measure of emotionally based characteristics and was developed by John Simmons after he studied his own and others' research on these characteristics as predictors of success. The survey contains a list of 360 adjectives from which each participant selects. In part I, the participant selects any 60 of the 360 adjectives listed that the participant would use to describe himself. In part II, the participant selects any 60 of the 360 adjectives that the participant believes others would use to describe him. For this study, the survey was administered online during the first face-to-face session and scored by a certified testing center. The results of the surveys are returned in the form of scores ranging from 1.0 to 10.0 on 13 different scales. Table 4-1 shows the emotional characteristics associated with the 13 scales, and the traits related to low scores and high scores. In addition to each score, a brief description is provided of the individual based upon where the person falls in the range of scores.

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Assertiveness	Compliant	Assertive
Tolerance	Intolerant	Tolerant
Consideration for others	Self-willed	Considerate
Sociability	Reserved	Sociable

One of the most popular and well-utilized measures of self-esteem is the Rosenberg Self-Esteem Inventory (1965). The Rosenberg inventory was originally developed to measure adolescents' global feelings of self-worth or self-acceptance, and is generally considered the standard against which other measures of self-esteem are compared. In use nearly 40 years, it includes 10 items that are scored using a four-point response ranging from strongly disagree to strongly agree. Extensive and acceptable reliability (internal consistency and test/retest) information exists for the Rosenberg Self-Esteem Inventory. Wallace (1988) conducted a review of the literature citing Rosenberg and calculated that the average internal consistency of the Inventory was 0.80 and the average test/retest stability = 0.74

The Rosenberg Self Esteem Inventory was selected for this study because of its significance in self-esteem research and the amount of documentation available regarding the reliability and validity of the measure. Since the research by Flynn (2001) indicates a strong negative correlation between success and self-esteem as measured by the Simmons Survey, the Rosenberg Self Esteem Inventory serves as an excellent standard to confirm the self-esteem measures of the Simmons Survey.

The Sixteen Personality Factor Questionnaire (16PF) is a widely used personality assessment instrument with well-documented psychometric properties (Cattell, Eber, and Tatsouka, 1970) and is the second most cited personality inventory behind only the Minnesota Multiphasic Psychological Inventory (Schuerger, 1992). In addition, in a meta-analysis of 106 research articles, Schuerger, Zarella and Hotz (1989) discovered that the average internal consistency of the 16PF = 0.74 and the average test/retest stability was 0.75 over six years.

The 16PF contains 185 multiple choice items distributed across sixteen bipolar factor scales. In addition to the primary scales, the 16PF contains a set of five scales that combine related primary scales into Global Factors of personality. Factor names and associated personality characteristics for the 16 primary factors and the five global factors are outlined in Tables 4-2 and 4-3 respectively. Raw scores are converted to standardized-ten (STEN) scores normed for age, race and gender. The 16PF was administered to the entire class three weeks into the Tech Tools course during the second face-to-face session. For this study, the 16PF data was scored by the Institute for Personality and Ability Testing (IPAT). In addition to the Primary Factor and Global Factor scores, IPAT provided a detailed personality profile for each of the students.

Table 4-2. Low and High Score Characteristics for Primary Factors of 16PF

Factor	Low Score Characteristics	High Score Characteristics
Warmth	Reserved, Impersonal, Distant	Warm, Outgoing, Attentive to Others
Reasoning	Concrete	Abstract
Emotional Stability	Reactive, Emotionally Changeable	Emotionally Stable, Adaptive, Mature
Dominance	Deferential, Cooperative, Avoids Conflict	Dominant, Forceful, Assertive
Liveliness	Serious, Restrained, Careful	Lively, Animated, Spontaneous
Rule-Consciousness	Expedient, Nonconforming	Rule-Conscious, Dutiful
Social Boldness	Shy, Threat-Sensitive, Timid	Socially Bold, Venturesome, Thick-Skinned
Sensitivity	Utilitarian, Objective, Unsentimental	Sensitive, Aesthetic, Sentimental
Vigilance	Trusting, Unsuspecting, Accepting	Vigilant, Suspicious, Skeptical, Wary
Abstractedness	Grounded, Practical, Solution-Oriented	Abstracted, Imaginative, Idea-Oriented
Privateness	Forthright, Genuine, Artless	Private, Discreet, Non-Disclosing
Apprehension	Self-Assured, Unworried, Complacent	Apprehensive, Self-Doubting, Worried
Openness to Change	Traditional, Attached to the Familiar	Open to Change, Experimenting
Self-Reliance	Group-Oriented, Affiliative	Self-Reliant, Solitary, Individualistic
Perfectionism	Tolerates Disorder, Unexacting, Flexible	Perfectionistic, Organized, Self-Disciplined
Tension	Relaxed, Placid, Patient	Tense, High Energy, Impatient, Driven

Table 4-3. Low and High Score Characteristics for Global Factors of 16PF

Factor	Low Score Characteristics	High Score Characteristics
Extraversion	Introverted, Socially Inhibited	Extraverted, Socially Participating
Anxiety	Low Anxiety, Unperturbed	High Anxiety, Perturbable
Tough-Mindedness	Receptive, Open-Minded, Intuitive	Tough-Minded, Resolute, Unempathic
Independence	Accommodating, Agreeable, Selfless	Independent, Persuasive, Willful
Self-Control	Unrestrained, Follows Urges	Self-Controlled, Inhibits Urges

Data Collection

Extensive qualitative data was collected throughout the duration of the Tech Tools course. Each IM session and email exchange with the instructors was saved, as well as all posts to the Tech Tools listserv. In addition, the researcher selected ten students for IM interviews during the last three weeks of the course. The students were selected to represent a cross section of personality types based on their scores from the 16PF, the Simmons instrument, and the Rosenberg Self-Esteem Inventory. The researcher attempted to select students with opposing scores on certain personality types (i.e. Extraversion vs. Introversion, High vs. Low Self-Esteem, Traditional vs. Openness to Change, etc.). The interview data, the emails and IMs with the instructors, and the listserv posts of these ten students were analyzed extensively to determine possible patterns in their electronic communications. The qualitative data was analyzed using the students' personality traits as points of comparison. Table 4-4, 4-5, and 4-6 show the ten students' (pseudonyms) scores on the three personality measures. Scores for the other students, average scores for the entire class, and median scores for the entire class are also included.

Table 4-4 Student Scores on 16PF Global Factors

Name	16PF Global Factors				
	Extraversion	Anxiety	Tough-Mindedness	Independence	Self Control
Susan	4.0	6.0	6.0	7.0	8.0
George	6.0	3.0	8.0	5.0	6.0
Matthew	7.0	2.0	3.0	6.0	3.0
Melissa	1.0	5.0	10.0	1.0	9.0
Cathy	4.0	6.0	6.0	4.0	6.0
Morgan	8.0	8.0	3.0	7.0	3.0
Maralee	8.0	10.0	6.0	9.0	6.0
Raquel	8.0	6.0	7.0	6.0	7.0
Craig	6.0	6.0	5.0	6.0	4.0
Martha	7.0	5.0	6.0	4.0	5.0
Student 11	4.0	6.0	5.0	6.0	6.0
Student 12	6.0	3.0	3.0	8.0	6.0
Student 13	5.0	3.0	6.0	7.0	6.0
Student 14	4.0	7.0	7.0	5.0	8.0
Student 15	6.0	5.0	3.0	6.0	6.0
Student 16	7.0	6.0	5.0	6.0	5.0
Student 17	8.0	6.0	7.0	5.0	7.0
class avg	3.47	3.35	3.53	3.24	3.35
class median	6.50	6.00	6.00	6.00	6.00

Table 4-5 Student Scores on 16PF Primary Factors

Name	16PF Primary Factors															
	Warmth	Reasoning	Emotional Stability	Dominance	Liveliness	Consciousness	Rule Boldness	Social Boldness	Sensitivity	Vigilance	Abstracted	Privateness	Apprehension	Openness to Change	Self-Reliance	Perfectionism
Susan	4	4	5	6	4	8	7	5	8	5	7	5	6	7	7	6
George	5	6	6	5	4	6	7	3	4	6	5	3	3	5	7	3
Matthew	5	6	7	5	6	3	6	5	1	8	2	4	9	6	3	4
Melissa	2	6	6	2	3	9	2	2	5	2	9	5	2	9	8	5
Cathy	6	6	5	6	2	6	2	5	3	6	5	7	5	7	5	7
Morgan	7	9	4	5	9	4	6	5	8	9	5	8	8	4	5	6
Maralee	6	6	1	9	8	6	9	6	8	6	2	9	4	6	9	9
Raquel	8	6	5	5	6	7	7	3	6	4	3	6	5	4	6	6
Craig	6	7	6	5	4	6	6	5	9	8	5	6	5	5	3	4
Martha	7	6	8	2	7	4	6	7	6	2	5	6	5	5	3	5
Student 11	4	5	5	6	5	5	5	5	7	6	7	7	7	6	7	4
Student 12	7	8	8	6	4	7	9	6	4	7	6	4	9	6	5	4
Student 13	4	5	8	6	7	7	6	4	6	6	7	3	7	5	6	3
Student 14	4	9	3	5	3	6	5	5	5	4	4	7	5	7	9	5
Student 15	7	9	5	5	7	6	4	7	4	5	7	5	9	4	6	6
Student 16	6	7	6	5	8	6	8	5	5	4	5	6	7	5	4	6
Student 17	6	6	5	5	6	7	7	4	5	5	2	6	5	3	7	5
average	5.53	6.53	5.47	5.18	5.47	6.06	6.00	4.82	5.53	5.47	5.06	5.71	5.94	5.53	5.88	5.18
median	6.00	6.00	5.00	5.00	6.00	6.00	6.00	5.00	5.00	6.00	5.00	6.00	5.00	5.00	6.00	5.00

Table 4-6. Student Scores on Simmons Personal Survey and Rosenberg Self-Esteem Inventory

	Simmons Personal Survey EQ Profile													RSE
	Energy	Stress	Optimism	Self-Esteem	Work	Detail	Change	Courage	Direction	Assertive	Tolerance	Considerate	Sociable	
Susan	5.0	6.2	2.1	8.1	2.0	1.4	8.0	6.0	3.0	7.8	4.1	3.1	7.0	37.0
George	5.2	3.8	3.8	7.0	4.5	4.0	7.0	3.5	4.0	6.0	5.8	3.8	6.3	40.0
Melissa	4.7	3.6	4.5	2.5	5.6	5.3	8.0	4.5	3.5	5.3	7.6	4.5	3.5	31.0
Cathy	6.2	5.1	2.5	2.5	4.5	3.8	6.2	6.8	6.2	7.3	2.6	2.2	4.0	30.0
Morgan	5.0	4.7	4.5	8.5	3.8	2.3	7.3	3.0	3.7	5.3	7.0	4.7	8.2	32.0
Maralee	5.0	5.6	0.7	8.5	3.1	5.6	5.0	8.0	6.0	8.4	2.6	2.4	7.6	31.0
Raquel	7.6	4.2	4.5	2.0	4.7	4.0	6.8	7.3	6.5	7.0	3.8	2.8	4.5	29.0
Matthew	5.3	4.9	4.2	8.8	4.0	5.6	7.0	2.3	3.0	3.5	8.3	5.2	7.3	33.0
Craig	4.6	5.0	3.8	8.3	3.4	3.4	8.0	2.3	3.2	4.0	7.1	4.2	5.0	36.5
Martha	4.8	4.5	4.5	8.3	3.1	3.1	6.8	3.5	3.5	4.0	8.1	5.0	8.0	37.0
11	5.0	4.7	6.0	9.0	6.0	4.6	6.5	1.5	4.3	3.2	7.6	5.5	8.6	35.0
12	6.0	4.9	2.6	6.0	2.6	1.7	6.5	6.5	3.2	7.1	4.8	2.8	4.0	35.0
13	6.0	4.5	6.0	0.1	7.7	6.7	5.0	7.6	7.5	7.1	5.4	4.2	3.5	40.0
14	4.8	4.0	2.5	7.3	4.7	5.3	6.8	4.5	4.0	6.5	3.8	3.4	7.3	36.0
15	5.3	3.7	3.5	6.5	4.0	3.4	7.3	6.0	3.7	6.3	5.1	3.7	4.5	36.0
16	5.0	4.3	3.4	7.3	4.2	4.3	7.3	3.0	3.5	5.6	7.1	5.0	8.0	35.0
17	6.0	4.2	5.3	8.1	6.3	6.5	6.8	6.8	7.5	6.3	2.8	3.5	5.0	35.0
Average	5.38	4.58	3.79	6.40	4.36	4.18	6.84	4.89	4.49	5.92	5.51	3.88	6.02	34.62
Median	5.00	4.50	3.80	7.30	4.20	4.00	6.80	4.50	3.70	6.30	5.40	3.80	6.30	35.00

The following is a summary of the themes found in the semester-long qualitative analysis of the Tech Tools course.

Student Personality Traits and Electronic Interactions

Expression of Concerns and Stresses of the Course

Many of the students in the spring 2002 Tech Tools course were first year lateral entry teachers. Usually these teachers have entered the teaching profession from other fields and have little, if any, prior experience leading a classroom. Combining this with post-baccalaureate education requirements and a new course format with Tech Tools can create a large amount of stress during the semester. An analysis of the comments made throughout the semester indicates that several students were not bashful about discussing the amount of stress they were feeling. Craig, a first year biology teacher, told Dr. Washington (one of two instructors in Tech Tools) during the first week of class that he was “more than a little nervous about all of this technology”. Maralee, a first year teacher at a private school, sent the following comment by email to Dr. Washington during the first week of class:

I am really worried about this class because it seems scary that we have to depend on the computers so much and our ability to connect. Maybe I'm being just like my students at the beginning of the semester, overwhelmed and stressed. The main thing that concerns me is that there seems to be so many different locations of things we are supposed to do, listserv, web assign, email, imagine etc.

This feeling of being overwhelmed and stressed stayed with Maralee throughout the semester. She refers to her stress level in several communications with the instructor. It appears that the level of stress she experiences in this class even leads her into a moral dilemma. During the end-of-year interview, she confesses that she broke the class rule

regarding individual work during the most stressful times: “All I’m saying is that unless people are completely virtuous it is hard to enforce that people don’t get help.” This is an especially interesting statement considering that the 16PF indicates that Maralee is slightly more rule-conscious (Rule-Consciousness = 6.0) than the average person.

Maralee’s decision to cheat is an extreme example of decisions that are forced by the stress of balancing work and study and certainly is not isolated to her alone. The students in the Tech Tools course had to constantly make decisions about time management. After a frustrating time trying to upload an assignment to a crashing server, Martha, in exasperation, informs the instructors: “I have given all I have this week and teaching is going to have to come first for awhile. I am stressing myself out over this class!”

Expressions of concern about the level of stress caused by Tech Tools were not limited to first year teachers, however. Cathy, a chemistry teacher with 4 years of experience, discusses the time requirements with one of the instructors during the first week of school: “My problem is which 9 hours do I allot? Do I have to do 3 hours a day, 5 hours one day 4 the next, or is it a task that can be completed over a week? I feel like I’m walking blindly through a maze.”

Comments about the stress caused by Tech Tools were scattered throughout the communications of several students. An in-depth look at the individuals making the comments showed no apparent similarities in personality or background. The students expressing how stressed they were by the course had varied levels of experience and diverse personality traits. A deeper look at a contrary viewpoint, however, does yield some interesting insights.

Morgen has been enrolled in the lateral entry program for four years. She teaches biology at the high school and college level and faces a 90-minute commute whenever she has to visit NC State's campus. A single parent of a teenage son with two jobs and enrolled in a school 90 minutes from home, Morgen has numerous reasons to feel stressed about Tech Tools. During the interview, however, Morgen states that Tech Tools "taught me a great deal more than I expected without an undue amount of stress and work. Not that I didn't have to work to keep up, it just seemed to flow easily." Morgen is the only student in the class that made such a statement about stress. Her life seems more complicated than most, yet, unlike many of her classmates, she seems unfazed by the rigor of the course or the web-based format. She has no more experience than some others in the class who felt stressed, so level of experience probably is not a factor.

A look at Morgen's personality profile shows only one characteristic that distinguishes her from the students who were stressed. Tough-Mindedness is one of the five global factors measured by the 16PF and measures an individual's flexibility and openness to new ideas. Low scorers on this factor are open and flexible while high scorers are generally inflexible. Morgen's Tough-Mindedness was measured as the lowest in the class (Tough-Mindedness = 3.0), which may explain her ability to meet the challenges of the innovative learning unique to Tech Tools. The 16PF describes Morgen as a receptive person, valuing "breadth and variety of experience, including openness to different ideas, people, or situations." Interestingly enough, the three other students in the class that had similar 16PF scores for Tough-Mindedness also never expressed to the instructors, the listserv or on the interview that the Tech Tools course was causing undue

stress. Could it be that openness and receptivity as defined and measured by the 16PF serve as a predictor of how a student handles the rigor and uniqueness of a web-based class such as Tech Tools? The qualitative data seem to indicate this.

Self-Esteem and Opinions of the Tech Tools Course

As mentioned earlier, quantitative data in the pilot study of the Tech Tools course indicated a negative correlation between self-esteem and achievement. Analysis of the quantitative data in the current study also indicates a negative (yet somewhat smaller) correlation between the two variables. Because of this seemingly counterintuitive relationship between self-esteem and achievement in Tech Tools, the impact of self-esteem on student perceptions of the course was explored.

An analysis of the comments made online throughout the semester seems to show a relationship between the students' level of self-esteem and their commentary on the Tech Tools course. Positive comments were generally stated by students with high self-esteem as measured by the Simmons and the Rosenberg instruments, while negative comments were generally stated by students with low self-esteem. Susan, a third year teacher with relatively high self-esteem (Self-Esteem = 8.1 on the Simmons scale, 37 on the RSE), described the Tech Tools course as including "the things that teachers need to learn in the world of technology. I feel the format was thought through carefully. It puts a lot of responsibility on each student but we are BIG kids now and should be able to discipline ourselves." George, another teacher with high self-esteem (SE = 7.0 Simmons, 40 RSE), evaluated Tech tools as "a great course because I learned so much on how to create options of using technology in my classroom." He also told one of the instructors

via IM that he thinks the concept of Tech Tools is “great” because it “can allow more time for the student and instructor”. Craig (SE = 8.3 Simmons, 37 RSE), a rookie teacher, states that he is “overall happy with the course and impressed with the professors and support structure”. He also adds that the course “has broadened my capabilities with technology and challenged me to think about new ways to integrate technology in the classroom.”

Contrast the statements above with statements from students with low self-esteem. Cathy (SE = 2.5 Simmons, 30 RSE), the fourth year chemistry teacher, seemed perturbed that administering personality instruments was part of the course syllabus. She asked one of the instructors during the first week of class, “Why are we taking this test (the Simmons) to begin with? I’m just curious. I signed up for a technology course, not a psychology course.” Three weeks later she tells the same instructor: “If we could spend less time taking personality tests it would be a great class.” Asked to give an assessment of the course overall, she said that the Tech Tools course “needs some fine tuning” and that she was “very frustrated by some of the policies and lessons”. One of the policies that frustrated Cathy throughout the semester was her not knowing how much time assignments would require. In an email to one of the instructors during the first week of class, Cathy asks

How can I do that (manage time) if I don’t know what to expect of the assignments? I don’t know how much time to allot to each task, but I do know how much time it takes to grade 66 labs, 50 Honors Chem tests, and 16 AP Chem tests...Needless to say, that particular detail is a little frustrating already, I’m hoping it gets better as I get used to online classes.

Melissa, a third year teacher who also has low self-esteem as measured by the Simmons and Rosenberg (SE = 2.5 Simmons, 31 RSE) instruments, was frustrated by

what she perceived was the impracticality of the course content. She stated that she “learned a lot in the course, but a lot of it isn’t practical in the classroom... There is no way that we would be able to get the majority of the equipment that we learned about and used in class.” No one else in the class discussed this as an issue.

There are two exceptions (of seven students stating opinions) to the apparent correlation between self-esteem and opinion of the Tech Tools course. Morgen, the receptive teacher mentioned earlier, had extremely positive things to say about Tech Tools, but the Rosenberg Inventory and the Simmons test yielded conflicting measures of self esteem (SE = 8.5 Simmons, 32 RSE). It is difficult to classify Morgen’s comments because of the conflicting data regarding her self-esteem.

The other exception involves Martha. According to the Simmons and Rosenberg instruments Martha has high self-esteem (SE = 8.3 Simmons, 37 RSE), yet she does respond negatively when asked to give an overall opinion of the course. She states that “there were a few assignments at the beginning of the course that I could have debated were just busy work... I found little interest or justification in reading some of the articles that we read and had to do reviews of.” As mentioned earlier, however, Martha is a first year teacher who was quite stressed by the workload and format of Tech Tools. The fact that she questions the purpose of some of the assignments is not too surprising.

It is interesting that the qualitative data indicates that students with high self-esteem view the Tech Tools course differently from students who have low self-esteem. Students who expressed opinions about the course, whether they were positive or negative, were varied on all other measured factors and no other connections could be made. It is not clear what role, if any, positive and negative opinions play in the negative

correlation between self-esteem and achievement in the Tech Tools course. However, a study of the data seems to indicate that these relationships do exist.

Positive Features of the Tech Tools Course

During the interviews each of the students was given an opportunity to discuss positive aspects of the Tech Tools course. The responses fell into three categories and students within each category have some similarities in personality traits and behavior during the course.

Susan, George, Melissa, Raquel, and Matthew listed skills and equipment they learned during the semester as the most positive features of the course. Matthew stated that “I learned things I probably would have never explored. For instance - the software to make web pages - I feel competent to use it now. That is something that I wouldn’t have chosen to undertake at this time.” Raquel reported: “I’ve really enjoyed using all the ‘toys’. I’m glad I’ve learned how to do a web page and become familiar with the Macintosh computer. I feel more computer literate.” She also gave high marks to equipment and software the students learned to use during the course: “The Lab Pro is great. I would love to be able to do labs with it and use the Logger Pro to view the data. I’m sure one day all teachers will have to have a web page, so I’m glad I learned to do that as well”.

Interestingly, each of the students who responded that the strength of Tech Tools was what was learned in the class – skills, software, and equipment – scored highly for Change on the Simmons test. According to the Simmons, each of these students enjoy change and “want to create, improve, or change things; want new ideas; new activity”.

Apparently, the new skills and equipment these students learned to use for their classrooms met an important personal need to avoid routine and traditional ways of doing things.

Four students, Morgen, Martha, Melissa (she mentioned equipment also) and Craig identified the format of the class as a positive aspect of Tech Tools. Morgen has taken several other distance education classes prior to enrolling in Tech Tools and had this to say about the course:

This class has been designed the best of all of them as far as material and information presentation. The webpage for the course is so well thought out. I also liked the communication between the instructors via email and IM.

Morgen was not alone in her praise of the design of the course. Craig stated that “the course has a very nicely organized format” and that “the sections on the internet have a level of detail and clarity in the information that I find exemplary”. Likewise, Martha stated: “I really thought the way they put it together was fantastic. Not that I have a lot of experience with internet courses but I was honestly surprised at the organization they have”.

Just like the students who identified the content of Tech Tools as a strength, the students who stated that the format of Tech Tools was a strength also scored highly for Change according to the Simmons. Taking a course in an innovative way apparently filled a personal need to do things differently.

The two remaining students were not as enthusiastic as the others in discussing strengths of Tech Tools. Maralee complimented the course grudgingly: “I feel like the only piece of technology I can really say I’ve learned is the digital camera and web page creating basics.” When Cathy was asked if there were any strengths to the course, she

replied “I didn’t have to go to class every Monday!” Cathy also said, “I learned what I won’t be buying for my classroom, or if I do, I’ve learned how to make the directions better!” The latter comment is apparently referring to her belief that either the equipment was not useful to her class or the instructions provided by the website were not very clear. This comment is in stark contrast to the very positive comments the other students gave regarding the website and/or the equipment.

Although their scores fell in the moderate range for Change as measured by the Simmons instrument, Maralee (Change = 4.0) and Cathy (Change = 5.0) did score lower than the rest of their classmates on this trait. They also have very low scores for Optimism (Optimism = 0.7 and 2.5 respectively, 1st and 3rd lowest scores), Tolerance (Tolerance = 2.6 and 2.6, lowest two scores), and Consideration (Consideration = 2.4 and 2.2, lowest two scores). Apparently one or more of these traits contribute to the difficulty these students encounter when trying to discuss positive aspects of Tech Tools.

Value of Face-to-Face Sessions

One of the unique features of the Tech Tools web-based course is the monthly face-to-face sessions. The instructors used these 3-hour classes on Saturdays to introduce and demonstrate new topics, answer questions, and allow time for administering the research instruments used in this study. Student opinions regarding the face-to-face sessions varied. Some enjoyed the face-to-face classes to the extent that they would have liked more of them. Susan reported: “I like face-to-face classes and would have not minded going twice as often on Saturdays...I like to meet my teachers and my peers within the class”. According to Raquel, the face-to-face sessions were more than just

time to meet peers and instructors: “I wish we had more of them. It’s time consuming to flip back and forth all the time to find answers. I’m a need-to-hear-it type person.”

Martha expressed even stronger feelings about the Saturday sessions: “I think it was a mistake to take a tech tools class via the internet. I know that sounds funny but I need hands-on instruction. I got so much more out of classes on Saturdays than I did with three weeks by myself”.

For Matthew, face-to-face instruction is so important that he does not plan on taking any more distance learning courses after the Tech Tools class. He explains why:

Several reasons – I don’t manage myself that well, and I think face-to-face would keep me paced better. Also, I feel that face-to-face would expose me to more. With the web format, I found myself skimming for immediately needed info...I also like the face-to-face medium better. It is more personable. I bore easily with a computer if no one is there.

Matthew also points out the importance of personal interaction in the face-to-face sessions. This seems to be an important aspect of the Saturday sessions. In fact, every student that stated that they enjoyed the Saturday sessions rated well above average on Social Boldness as measured by the 16PF. According to the 16PF, high scorers tend to initiate social contacts and are not shy in the face of new social settings. Although this trait contributes to the global factor Extraversion, one does not have to be an extrovert to score high on Social Boldness. This is the case with Susan, an introvert who scored highly on Social Boldness (Social Boldness = 7.0).

Rating high on the Social Boldness scale of the 16PF does not guarantee that students prefer more face-to-face sessions or even value them. Morgen and Maralee are good examples of this. Morgen scored above average on Social Boldness (Social Boldness = 6.0) but believes she could “have done the course fine with half the face-to-

face classes”. Maralee also scored highly on Social Boldness (Social Boldness = 9.0) but stated that she “really found the face-to-face meetings in this class useless”. Maralee’s criticism, however, was prompted by the content of the sessions, not the sessions themselves: “This time could be used for ‘round table’ discussions, properly lead of course to avoid digressions or for sharing experiences”. For Maralee, it seems that interacting with others is an important aspect of learning. Therefore, her dissatisfaction with the Tech Tools Saturday sessions should not be interpreted as a statement against personal interaction with web-based learning. Likewise, it is possible that Morgen’s opinion about the number of classes has more to do with content and function than personal interaction.

Hands-On Learning and the Tech Tools Course

When discussing the Tech Tools course during the interviews, several students mentioned the concept of hands-on learning through web-based instruction that prompted the development of the Tech Tools course. Martha stated that she was a hands-on learner and that the Saturday sessions were more effective for her because “if there was a problem with the instructions the instructors were there to get around it. They knew all the tricks which makes it so much less frustrating”. Cathy stated that she would consider taking another course with a similar format, “but not with a content that is so hands-on. I’m signed up to take a Psychology class online this fall.” Cathy went on to say that classes involving hands-on learning need to be taught in more traditional ways or with more direction than provided by Tech Tools.

Morgen has a completely different opinion about hands-on instruction via the internet: “This course’s material lends itself well to this type of format...Because by using this technology in our own learning processes, we have constructed what student perceptions and struggles might occur in implementing this into our own teaching”. As mentioned earlier, Morgen’s score on the 16PF (Tough-Mindedness = 3.0) indicates that she is open to new experiences. Cathy and Martha (Tough-Mindedness = 6.0) lean toward more tough-mindedness and greater inflexibility. Morgen also rates more highly on Independence (Independence = 7.0) than either Cathy or Martha (Independence = 4.0). It would seem from this data that Tough-Mindedness and Independence are both factors that impact whether a student can thrive in hands-on instruction through a web-based class. One student’s responses, however, may not support this idea.

Like Morgen, Matthew is a receptive person as measured by the 16PF (Tough-Mindedness = 3.0) and is somewhat independent (Independence = 6.0). Unlike Morgen, however, he does not think web-based education works for all of the content in Tech Tools: “For parts of this course, the web format was great – reading articles, responding to them, etc. But the technical aspects were long and dull. The web format is good for sharing ideas, but not for a text, in my opinion”. Matthew continues by explaining what he means by technical aspects: “ I am referring more to the spreadsheet directions that included ‘go to Microsoft’s page for more info’. That is a lot of stuff to sort through. Also, camera features became long to keep focus”. Although Tough-Mindedness and Independence may play a role in a student’s experience in a hands-on web-based class, Matthew’s comments seem to indicate that some other factors play a role also.

Similarities of Students Asking Technical Questions

Content in the Tech Tools course consists of types of technology with which many adults are familiar (email, web sites) and some that is less commonly used (i.e. Instant Messaging, digital camera, listserv, etc.). Therefore questions from students about certain technical aspects of the technology are a natural part of the course. Most of the questions asked resulted from the students' lack of experience in using these applications. For instance, early in the semester Susan asked one of the instructors if her listserv messages would come through her email. Several students had specific questions about communicating with Instant Messaging, with Craig asking if sending an IM message would go to every student on his Buddy List and Raquel asking how to set up a chat session through IM. Question topics were varied and usually sent to the instructors via email, although some students asked these kinds of questions as IM conversations during virtual office hours. An in-depth look at the students asking these kinds of questions, however, shows some similarities.

Of the ten students whose communications were analyzed, four (Morgen, Susan, Craig, and Maralee) asked questions prompted by their lack of understanding of the technology. All of the students have above average anxiety as measured by the 16PF, all have high self-esteem as measured by the Simmons, and all generally communicated more often to the instructors and through the listserv than their classmates. None of these similarities should be too surprising. It appears that these students who are anxious will communicate more readily when they have questions and that their high self esteem enables this.

Interestingly, however, each of these students have higher-than-average levels of Independence by the 16PF. According to the 16PF, these students are often suspicious of interference from others. It seems counterintuitive that these kinds of students were the ones asking questions about things they did not understand.

Suggestions for Improving Tech Tools

During the interview, each of the students was asked for ways to improve the Tech Tools course. The responses fell into three categories: (1) Reducing the workload, (2) Changing the assignments, and (3) Other suggestions. Not surprisingly, two of the students who complained about the excessive workload of Tech Tools also suggested reducing the workload as a way to improve the course. According to Maralee, it would be better if Tech Tools spent more time on fewer topics:

I think there is too much quantity and not enough quality in terms of what is covered...I feel like I got a nibble of lots of things, Jill of all trades, master of none. I don't feel confident enough about most of the things to actually use them in the classroom. It would be better to focus on a few things and learn them well than to come away still not knowing anything enough to implement in the classroom.

Martha believes that the problem lies in the length of the course. Tech Tools began nearly three weeks after the start of the Spring semester, and according to Martha, the course was too condensed by losing those three weeks:

Personally I think that there are too many assignments in one week. So, if we were to have more weeks then they could be spread out and we would have possibly one more Saturday to help us answer questions. That would help me but only if they stayed with the same course load.

Martha and Maralee also think that the course could be improved by adding opportunities for the class to learn from each other through group discussions. When

describing her opinions about some of the assignments, Martha said that she “would have rather been given a topic and discussed it online with members of the class or something along those lines”. As first-year teachers, both Martha and Maralee feel that they can benefit from the opinions of other teachers. In addition, both are rated as extroverts and scored high on Sociability (Sociability = 8.0 and 7.6 respectively) on the Simmons instrument which most certainly contributes to these students’ needs for group interaction.

Other suggestions involved changing how the work was assigned. Assignments were made through the web site and were only accessible for five days before they were due. Several students felt like Melissa:

It would’ve been nice if they had listed all of the assignments from one class meeting to the next. Sometimes you end up with a busy week at school or something may happen and you get behind and it is hard to complete the assignments once they were posted. If they were posted from one class to the next class, you could work at your own pace to complete the assignments.

Other students suggested making all of the assignments available at the beginning of the course so they could work at their own pace. Matthew suggested “reversing the skill activities and doing the lab interfaces first”. In his opinion, this would have given the students more time to experiment and use the equipment in their classrooms.

Craig suggested improvements on the format of the course. He stated that “the professors are not always available, and I think it would be good for them to have phone office hours.” Craig also believes that the University should provide free internet service to the students taking online courses such as Tech Tools.

Other than the two first-year teachers suggesting to reduce the workload as a way to improve the course, apparently none of the other students suggesting improvements

share similar traits. From the personality measures used in the study, it appears that no distinctive personality traits affect students' opinions on how to improve the Tech Tools course.

Opinions About Web-Based Learning

During the course of the interview, several students expressed their opinions about web-based education. Cathy believes it needs to be improved: "I think web-based education still has a long way to go. Unless you get to know your classmates and discuss ideas, you're really just learning on your own". Martha believes she would take another web-based course, but only if the subject content was something with which she was familiar to insure that she "would not need much help".

Conversely, Melissa believes that web-based education is a wonderful option for students like her: "I like not having to go to class because of everything we have going on as a lateral entry teacher. It makes it easier to complete the required classes that we need to get our certification". George agrees: "I think it is great, even though it is a lot of work it allows you to work it into your life".

Once again, comparing the students' responses with their personality traits yielded no obvious relationship between the two. It appears from the qualitative analysis that the students' opinions about web-based education, how it fits into their education, and how it fits into education in general vary greatly regardless of personality type.

Conclusions

Impact of Personality on Students' Experience in Tech Tools

There are several areas where it appears that the students' personality traits play a role on how they experienced the Technology Tools for Science Teachers course. One of the most interesting is the apparent connection between Morgen's ability to handle the rigor of the course and her low score on Tough-Mindedness as measured by the 16PF. As mentioned earlier, a low score on Tough-Mindedness indicates a person's flexibility and openness to new ideas and experiences. A student's openness and desire to experience new things should be a valuable asset in an innovative learning format such as Tech Tools. This is certainly the case with Morgen, who seemed to take the unique learning environment in stride and had nothing but extremely positive things to say about her experience in the class. From this research it is clear that Tough-Mindedness as measured by the 16PF plays a role in how much stress a student experiences in Tech Tools.

A personality trait similar to the 16PF's Tough-Mindedness is "Change" as measured by the Simmons instrument. Persons scoring high on change are open to new activities and "want to create, improve or change things". As the results indicate, students who scored highly on Change enjoyed the new equipment they learned to use in Tech Tools and/or the unique format of the course itself. A main purpose of Tech Tools is exposing inservice teachers to state-of-the-art technology they can use in their classrooms. Therefore, most of the students taking Tech Tools have never used any of the equipment prior to taking the course. Likewise, the format of Tech Tools is unique in

post graduate education, so it is logical that Simmons measure for Change can be an indicator of how much a student will enjoy the content and/or format of the web-based Tech Tools course.

Based on the results of Flynn's research (2001) on the Tech Tools course, self-esteem was identified prior to this study as an area of exploration. It was hoped that more information would be discovered about the role self-esteem plays in web-based courses such as Tech Tools. Although there are some patterns in the opinions about the course expressed by the students and their self-esteem, the qualitative data does not provide additional insights into why students with low self-esteem perform better in this course than students with lower self-esteem. The results show that students with high self-esteem generally expressed positive opinions about Tech Tools while students with low self-esteem expressed negative opinions. It is not surprising that students with negative opinions about themselves also possess negative opinions of a course such as Tech Tools. What is surprising, and still unclear, is why these students perform better in the class than students who view themselves more positively.

As mentioned earlier, the format for Tech Tools includes both web-based learning and face-to-face sessions. The face-to-face sessions are intended to allow students to personally interact with one another and with the instructors. One would assume that extraverted students would value these sessions more than introverts primarily because of the personal interaction involved. The results are not quite so clear-cut. There were no distinctions in student opinions about face-to-face sessions and their scores on the 16PF Global Factor Extraversion. However, the Primary Factor Social Boldness does seem to play a role with some students with several who are socially bold expressing positive

opinions about the face-to-face sessions. Two other students, Morgen and Maralee, are socially bold but do not feel the face-to-face sessions are valuable. Maralee specifically criticized the content of the sessions instead of the sessions in general. Obviously, content of the face-to-face sessions is a major factor in whether or not students value this aspect of the course. However, from the results of this study, it appears that students who score highly on Social Boldness are more likely to value the face-to-face sessions than students who do not. Face-to-face sessions should assist the socially bold by providing social interaction, but the content of these sessions must be substantive.

This study confirms that personality plays a role in student experience in the Tech Tools course. The instruments used to identify each student's personality traits are well-documented and determined as valid by researchers in the field of personality research. Therefore the conclusions drawn above are valid and applicable to the Tech Tools course. Several areas showed no clear relationship between specific personality traits and their opinions, responses, and experiences in Tech Tools. It is likely that multiple personality traits play a role in many of these areas. It is also possible that other personality traits contribute to the relationships already determined from this study.

Suggestions for Further Research

The results discovered and conclusions drawn by this study highlight several areas for additional research. More research is needed to explore the impact of personality on student performance and experience in web-based education. Specifically, Tough-Mindedness and Self-Esteem are two traits that seemed to show an impact on student experience and perceptions of Tech Tools. An in-depth study is needed to

explore the relationship of the 16 PF Global Factor Tough-Mindedness and a student's ability to handle innovative learning methods such as web-based education. More study is also needed to further explore the impact of self esteem on students and their experience in web-based courses since this trait appears in several themes of this study. In addition, a more detailed analysis is needed to explore how several personality traits work together or counteract one another to impact students in web-based courses.

It appears that creating a community of learners is an ongoing challenge for designers of distance learning courses. Researching the value of community in traditional learning would be an important addition to the body of knowledge in education. Exploring ways community can be effectively reproduced in web-based education is another important research area.

Could the results of this study also apply to traditional classroom instruction? A study employing similar methodology in a traditional course covering similar topics would yield additional information on the role personality plays in formal education. It could also be possible to compare results from traditional classrooms to results from this study or a replicated study of a web-based course.

Since Tech Tools attempts to provide skills for inservice teachers to use in their respective classrooms, another area of study could include analyzing web-based courses that emphasizes readings and reflections instead of teaching participants how to use particular pieces of equipment. It would be interesting to see if results were similar to this study.

Alternative licensure programs such as the Lateral Entry Teacher program will gain in prominence as the teacher shortage increases during the next decade. Therefore it

is important to conduct research on these programs and to explore ways to insure that this method of creating teachers is as effective as possible. One of the interesting findings in this study was the impact of teaching experience on the stress level of students.

Exploring this relationship is another area for further research.

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Chapter Five

Exploring Relationships Between Participant Characteristics, Communication and Achievement in a Web-Based Course for Science Teachers

Introduction

The rate of technology use by the general public has grown tremendously over the past decade. Each year more Americans go online than the year before. Currently, 62% of American households, over 63 million households, access the Internet from their homes. This number is projected to increase to over 86 million households by 2006. Also in 2006, it is projected that over 210 million Americans will use the Internet either at work or at home (Jupiter Media, 2001a).

This increased prevalence of Internet use is transforming how we approach some of the educational needs of our society. Although distance education has been a part of American higher education for decades, it is playing a more significant role today. Administrators are looking at distance education as a way to address the dual challenges of increasing enrollments and shrinking budgets. For example, NC State University's enrollment is expected to increase over 20% to 36,000 students by 2010, with one out of every seven students earning degrees through distance learning (Kane, 2001). Across North Carolina, distance learning is on the rise in post secondary education. In the state's community colleges, 27% more students took distance learning courses in 2001/2002 than in 2000/2001. The University of North Carolina system's distance learning enrollment has increased 24% from 2000/2001 (Kane, 2001). A similar trend is seen on the national level. In fact, a report by The International Data Cooperation (IDC)

estimated that 2.2 million college students will be enrolled in distance education courses in 2002, an increase from approximately 710,000 in 1998 (Council for Higher Education Accreditation, 1999).

Some of the critics of distance learning have cited the lack of student-student and student-teacher interaction as obstacles to effective teaching and learning. However, newer communications methods such as Instant Messaging, chat rooms, audio and video streaming can promote greater levels of interaction. Instant Messaging allows the user to communicate via email in a real-time conversation. Business use of Instant Messaging and Chat applications has increased 110% from 2000 to 2001, while personal use of Instant Messaging and Chat has increased 48% during the same time period with over 50 million users (Jupiter Media, 2001b).

Audio and video streaming allows users to see images and hear sounds through their computers real-time. Until recently, these forms of electronic communication have not been very accessible to home users because of the speed of dial-up connections. This is changing now because of the availability of high-speed broadband connections for U.S. households. Currently, one in six home online users (10 million households) are connected through broadband (cable modem, DSL, etc) technology. This number is expected to grow to 40% (35 million households) by 2006 (Jupiter Media, 2001a). It is obvious that the changing technology industry and the increasing accessibility of internet communications to the general public will spur further development of distance learning programs, especially Internet-based courses. Therefore, the need is great for research in the area of distance education, and particularly Internet-based distance education, so we can better understand the dynamics of this emerging field.

Technology Tools for Science Teachers

Under this backdrop, NC State University developed EMS 594I: Technology Tools for Science Teaching (Tech Tools) – a web-based graduate level course designed to promote the use of instructional technology in the teaching and learning of science. EMS 594I is the result of NC State’s attempt to develop an effective graphics-intensive website to teach teachers how to use technology to teach science. The course is primarily web-based, but students are required to attend four face-to-face class sessions during the course of the semester.

The goals of Tech Tools include:

1. Enabling inservice teachers enrolled in the course to learn how to use educational technology in the science classroom
2. Providing the teachers with skills in using the technology in their classrooms.

To attain these goals, the Tech Tools course is built around an extensive website which serves as the main method of delivering instruction. In addition to the website, students are provided access to a dedicated listserv, access to the instructors and the rest of the class through instant messaging (IM) and email, virtual office hours to converse with the instructors through IM, and monthly face-to-face class sessions for personal interaction with the instructors and other students.

The technology tools include instant messaging, the listserv, digital cameras, website design software, microcomputer-based lab equipment, calculator-based lab equipment, and data analysis software. To optimize the learning opportunities in the

course, the instructors provided each student with a laptop computer and all of the equipment necessary to complete the course. The only prerequisites for Tech Tools are:

1. Access to an Internet connection.
2. The ability to navigate the World Wide Web.
3. Access to email and the ability to send and receive email messages.
4. Approximately 9 hours per week to devote to learning the course material and completing the assignments.

The course syllabus is located on the course website and directs the students to the web-based instructional units and the assignments. Each unit includes pre- and post-tests to measure the students' knowledge gains. Students submit assignments by uploading them onto a private server, sending them to the instructors as email attachments, posting to the listserv, or presenting during a face-to-face session.

Offered for the first time during the Spring Semester 2000, it is important to the course developers to conduct research on the impact and effectiveness of EMS 594I. In the spring of 2001, Flynn (2001) conducted a research project to explore relationships between personality traits and measures of success in the Tech Tools course. Flynn's research indicates that several measurable personality traits correlate with how well students perform in Tech Tools, including a negative correlation between self-esteem and student achievement. This article describes a quantitative research project conducted in the spring of 2002 designed to explore more deeply the relationship between student personality traits and their performance in Technology Tools for Science Teachers.

Research in Web-Based Education

Nearly twenty years ago, Weisner (1983) reviewed the literature and concluded that a “broad theoretical framework” that can be applied to distance education was needed. A review of more current literature seems to indicate that we have not made much progress in this area over the past twenty years. In 1999, an Institute for Higher Education Policy Study sponsored by the American Federation of Teachers and the National Education Association conducted a comprehensive review of the research on distance education including web-based learning. The vast majority of these writings suggest that the learning outcomes of students using technology at a distance are similar to the learning outcomes of students who participate in conventional classroom instruction. However, the review also concluded that “there is a relative paucity of true, original research dedicated to explaining or predicting phenomena related to distance learning.”

Merisotis and Phipps (1999) examined distance education research and found shortcomings and gaps such as:

1. research focusing primarily on student outcomes for individual courses rather than entire academic programs.
2. research not taking into account differences (age, gender, motivation, learning styles, etc) among students.
3. research focusing on impact of individual technologies rather than multiple technologies.
4. lack of a theoretical framework which would allow others to replicate research.

Merisotis and Phipps concluded that technology cannot replace the human factor in learning, and it is not nearly as important as other factors such as learning tasks, learner characteristics, student motivation and the instructor.

Culture and Success in Distance Education

After reviewing the research, it is clear that interaction between students and between teachers and students is different within a distance education context as opposed to the traditional classroom setting. Flottemesch (2000) performed a literature review regarding interaction in distance education settings and found that proper techniques had to be employed by teachers to incorporate interaction among distance education students. She went on to state that the quality of the distance education was dependent upon the interaction and participation of the students and that teachers had to make this a priority in instruction.

Swan, et al (2000) reviewed the literature in an attempt to determine factors of success for online learning. Their efforts revealed that three common factors have been constantly shown to significantly influence success of online courses. These factors are: consistency in course design, contact with course instructors, and active discussion with other students and with the instructor.

Harrison and Bergen (2000) looked at design strategies for online courses and came up with several general suggestions. They state that successful websites for online classes should have a course outline for students, weekly learning modules, activities that foster a community of learners (Instant Messaging, Chat Sessions, face-to-face interactions, etc) and required assignments. Harrison and Bergen also state that faculty

training and preparation are crucial to success regardless of course design. Hiltz (1998) agreed that building a community of learners was important to online education and reviewed several studies involving collaborative learning in web-based courses. Hiltz reported that online learning was as effective as traditional classroom instruction only if students were given ample opportunity to work collaboratively in small groups.

Several other studies have attempted to identify characteristics of learners who are most likely to be successful in online classes. Web-based instruction is inherently self-paced which allows learners to think through possible answers to questions prior to completing assignments. Therefore, self-regulation seems to be a key characteristic for success. Bandura (1977) defined self-regulation as the ability to control our own behavior by self-observation, judgment, and self-response. Learners who do not have the ability to self-regulate or self-direct may have trouble with the self-paced nature of web-based learning. In fact, Palloff and Pratt (1999) identified a learner's ability to self-direct and self-regulate as predictors of success in online education. Hargis (2000) discovered similar results in a study of post-secondary science and engineering majors taking web-based chemistry courses. Since most online learners choose this medium in which to learn, they are typically highly motivated and self disciplined. Gibson (1998) further described online learners as task-oriented and focused.

The literature also reflects many benefits to students of web-based education. Boone and Anderson (1995) suggests that a major benefit of web-based education is its ability to provide learners who are geographically remote or who are under time constraints the same opportunities as learners who are not hindered by similar constraints. Huntley and Mather (1999) also agree with this position. In addition Gibson (1998)

discovered that learners who are interested in innovative ways of learning or have had a negative past experience with traditional education are deeply satisfied with and successful in web-based coursework. Nelson-Nisan (1999), in a study of teachers using web-based education for professional development, found no significant difference in achievement in a comparison of a traditional classroom learner and the web-based learner, but there was a significant difference in level of satisfaction. The web-based learners possessed higher levels of satisfaction with the educational process than the learners in a traditional classroom. Chute, Thompson, and Hancock (1999) speculate that one of the reasons for this high level of satisfaction may be the level of control the learner has on what is learned and the pace at which the content is delivered.

Web-based education seems to be most positively embraced by non-traditional students. Since non-traditional students tend to be older with different responsibilities (such as family and full-time jobs) than their traditional student classmates, the flexibility offered by the Web appears to be a great benefit. Grill (1999) described the typical American distance learner as one who is 25 – 50 years of age, taking courses to learn new subjects and skills or to update old ones, and experienced in participating in education. Hudson (2000) surveyed adult students, all over the age of 25, about the benefits of web-based courses and heard five major benefits articulated:

1. The ease of communicating online makes it possible for students to feel as close or closer to online classmates than they ever felt to classmates in traditional classes.
2. Web-based courses give students opportunities to search the Web and master computer skills that are essential in today's world.

3. The Web enables students to reach other students and their instructors at times other than normal classroom hours making it easier for students to share information and offer support.
4. The flexibility of Web-based courses allows adult learners to balance their educational pursuits with their job and family responsibilities, thus allowing people with limited time the opportunity to further their education.
5. Web-based courses allow students to develop self-sufficiency and engage in independent thinking.

Technology Tools for Science Teachers is designed as a post-baccalaureate course for inservice teachers and is required for all alternative licensure teachers seeking an initial North Carolina science teaching certificate. The students taking the course are nontraditional, have time constraints, and for the most part are similar to the profile of the American distance learner as described by Grill.

Flynn (2001) conducted research on the Tech Tools course during the spring semester of 2001 and studied potential relationships between student personality traits and achievement in the course. Flynn administered the Simmons Emotional Intelligence Survey and the Myers-Briggs Personality Type Indicator to the students, then investigated correlations of student scores on these instruments with measures of success in the class such as gain scores on pre- and post-tests, the number of on-time assignments, and communications with the instructor. Data from the study indicates a strong negative correlation between self-esteem as measured by the Simmons instrument and each of the measures of success. Those with lower self-esteem were more successful

in the course than those students who scored higher on the Simmons measure for Self Esteem. The data also shows a positive correlation between the Simmons measure for Direction and the measures of success. Those students who scored higher on Direction were also more successful as defined by Flynn. However, the sample size for Flynn's study was small (only 11 students) and Flynn herself concludes that more research is needed to explore indicators of success in web-based education.

Methodology

Participants

The participants in this study were the 17 students enrolled in Technology Tools for Science Teachers (Tech Tools) for the spring semester of 2002. Sixteen of the seventeen students were "lateral entry" science teachers, an alternative licensure program in North Carolina that allows people with undergraduate degrees in a content area to receive temporary licensure for public school teaching until they complete all the requirements for initial licensure from an institution of higher education. At NC State University, the science education lateral entry students are required to take the Tech Tools course as part of their program requirement.

Three instruments designed to measure various personality traits were administered to each of the Tech Tools students: The Sixteen Personality Factor Questionnaire, The Simmons Emotional Intelligence Survey, and the Rosenberg Self Esteem Inventory.

Personality Assessment Instruments

The Simmons Emotional Intelligence Survey is a measure of emotionally based characteristics and was developed by John Simmons after he studied his own and others' research on these characteristics as predictors of success. The survey contains a list of 360 adjectives from which each participant selects. In part I, the participant selects any 60 of the 360 adjectives listed that the participant would use to describe himself. In part II, the participant selects any 60 of the 360 adjectives that the participant believes others would use to describe him. For this study, the survey was administered online during the first face-to-face session and scored by a certified testing center. The results of the surveys are returned in the form of scores ranging from 1.0 to 10.0 on 13 different scales. Table 5-1 shows the emotional characteristics associated with the 13 scales, and the traits related to low scores and high scores. In addition to each score, a brief description is provided of the individual based upon where the person falls in the range of scores.

Table 5-1. Simmons' 13 Emotion Ranges

Emotional Characteristic	Low Score Trait	High Score Trait
Energy	Slow paced	Fast paced
Stress	Relaxed	Stressed
Optimism	Fault finding	Positive
Self-esteem	Humble	Self-assured
Commitment to work	Leisurely	Hard working
Attention to detail	Spontaneous	Careful
Desire for change	Routine	Changing
Courage	Cautious	Courageous
Direction	Hesitant	Decisive
Assertiveness	Compliant	Assertive
Tolerance	Intolerant	Tolerant
Consideration for others	Self-willed	Considerate
Sociability	Reserved	Sociable

One of the most popular and well-utilized measures of self-esteem is the Rosenberg Self-Esteem Inventory (1965). The Rosenberg inventory was originally developed to measure adolescents' global feelings of self-worth or self-acceptance, and is generally considered the standard against which other measures of self-esteem are compared. In use nearly 40 years, it includes 10 items that are scored using a four-point response ranging from strongly disagree to strongly agree. Extensive and acceptable reliability (internal consistency and test/retest) information exists for the Rosenberg Self-Esteem Inventory. Wallace (1988) conducted a review of the literature citing Rosenberg and calculated that the average internal consistency of the Inventory was 0.80 and the average test/retest stability was 0.74

The Rosenberg Self Esteem Inventory was selected for this study because of its significance in self-esteem research and the amount of documentation available regarding the reliability and validity of the measure. Since the research by Flynn (2001) indicates a strong negative correlation between success and self-esteem as measured by the Simmons Survey, the Rosenberg Self Esteem Inventory serves as an excellent standard to confirm the self-esteem measures of the Simmons Survey. It was also administered during the first face-to-face session.

The Sixteen Personality Factor Questionnaire (16PF) is a widely used personality assessment instrument with well-documented psychometric properties (Cattell, Eber, and Tatsouka, 1970) and is the second most cited personality inventory behind only the Minnesota Multiphasic Psychological Inventory (Schuerger, 1992). In addition, in a meta-analysis of 106 research articles, Schuerger, Zarella and Hotz (1989) discovered that the average internal consistency of the 16PF was 0.74 and the average test/retest stability was 0.75 over six years.

The 16PF contains 185 multiple choice items distributed across sixteen bipolar factor scales. In addition to the primary scales, the 16PF contains a set of five scales that combine related primary scales into Global Factors of personality. Factor names and associated personality characteristics for the 16 primary factors and the five global factors are outlined in Tables 5-2 and 5-3 respectively. Raw scores are converted to standardized-ten (STEN) scores normed for age, race and gender. The 16PF was administered to the entire class three weeks into the Tech Tools course during the second face-to-face session. For this study, the 16PF data was scored by the Institute for

Personality and Ability Testing (IPAT). In addition to the Primary Factor and Global Factor scores, IPAT provided a detailed personality profile for each of the students.

Table 5-2. Low and High Score Characteristics for Primary Factors of 16PF

Factor	Low Score Characteristics	High Score Characteristics
Warmth	Reserved, Impersonal, Distant	Warm, Outgoing, Attentive to Others
Reasoning	Concrete	Abstract
Emotional Stability	Reactive, Emotionally Changeable	Emotionally Stable, Adaptive, Mature
Dominance	Deferential, Cooperative, Avoids Conflict	Dominant, Forceful, Assertive
Liveliness	Serious, Restrained, Careful	Lively, Animated, Spontaneous
Rule-Consciousness	Expedient, Nonconforming	Rule-Conscious, Dutiful
Social Boldness	Shy, Threat-Sensitive, Timid	Socially Bold, Venturesome, Thick-Skinned
Sensitivity	Utilitarian, Objective, Unsentimental	Sensitive, Aesthetic, Sentimental
Vigilance	Trusting, Unsuspecting, Accepting	Vigilant, Suspicious, Skeptical, Wary
Abstractedness	Grounded, Practical, Solution-Oriented	Abstracted, Imaginative, Idea-Oriented
Privateness	Forthright, Genuine, Artless	Private, Discreet, Non-Disclosing
Apprehension	Self-Assured, Unworried, Complacent	Apprehensive, Self-Doubting, Worried
Openness to Change	Traditional, Attached to the Familiar	Open to Change, Experimenting
Self-Reliance	Group-Oriented, Affiliative	Self-Reliant, Solitary, Individualistic
Perfectionism	Tolerates Disorder, Unexacting, Flexible	Perfectionistic, Organized, Self-Disciplined
Tension	Relaxed, Placid, Patient	Tense, High Energy, Impatient, Driven

Table 5-3. Low and High Score Characteristics for Global Factors of 16PF

Factor	Low Score Characteristics	High Score Characteristics
Extraversion	Introverted, Socially Inhibited	Extraverted, Socially Participating
Anxiety	Low Anxiety, Unperturbed	High Anxiety, Perturbable
Tough-Mindedness	Receptive, Open-Minded, Intuitive	Tough-Minded, Resolute, Unempathic
Independence	Accommodating, Agreeable, Selfless	Independent, Persuasive, Willful
Self-Control	Unrestrained, Follows Urges	Self-Controlled, Inhibits Urges

Data Collection

Data was collected throughout the duration of the Tech Tools course. Each IM session and email exchange with the instructors was saved and tallied, as well as all posts to the Tech Tools listserv. In addition, a preliminary questionnaire was administered to the students during the first face-to-face session. The questionnaire asked the students to provide information about their teaching experience and allowed them to assess their own skill levels for using various technologies. The results from the three personality measures, student self-report data from the preliminary questionnaire, and the students' final grade in the Tech Tools course make up the entire collection of data for this research project. Table 5-4, 5-5, 5-6, and 5-7 display the data collected. 16PF and Simmons scores are based a ten-point scale while the RSE scores are based on a forty-point scale. Years of teaching experience was determined by the participants' responses from the preliminary questionnaire. Technology Skill Level was determined by the participants' responses on a Likert scale regarding their level of understanding of specific technologies.

Table 5-4. Student Scores on 16 PF Global Factors, Years Experience, and Technology Skill Level (TSL).

	16PF Global Factors					Yrs Exp	TSL
	Extraversion	Anxiety	Tough-Mindedness	Independence	Self Control		
Student 1	4.0	6.0	6.0	7.0	8.0	3	59
Student 2	6.0	3.0	8.0	5.0	6.0	6	55
Student 3	7.0	2.0	3.0	6.0	3.0	2	61
Student 4	1.0	5.0	10.0	1.0	9.0	3	61
Student 5	4.0	6.0	6.0	4.0	6.0	4	47
Student 6	8.0	8.0	3.0	7.0	3.0	4	46
Student 7	8.0	10.0	6.0	9.0	6.0	1	49
Student 8	8.0	6.0	7.0	6.0	7.0	1	64
Student 9	6.0	6.0	5.0	6.0	4.0	1	47
Student 10	7.0	5.0	6.0	4.0	5.0	1	61
Student 11	4.0	6.0	5.0	6.0	6.0	0	42
Student 12	6.0	3.0	3.0	8.0	6.0	2	31
Student 13	5.0	3.0	6.0	7.0	6.0	4	28
Student 14	4.0	7.0	7.0	5.0	8.0	1	45
Student 15	6.0	5.0	3.0	6.0	6.0	2	51
Student 16	7.0	6.0	5.0	6.0	5.0	1	44
Student 17	8.0	6.0	7.0	5.0	7.0	1	48
Average	5.82	5.47	5.65	5.76	5.94	2.18	49.35

Table 5-5. Student Scores on 16 PF Primary Factors

	16 PF Primary Factors															
	Warmth	Reasoning	Emotional Stability	Dominance	Liveliness	Rule Conscious	Social Boldness	Sensitivity	Vigilance	Abstracted	Privateness	Apprehension	Openness to Change	Self-Reliance	Perfectionism	Tension
Student 1	4	4	5	6	4	8	7	5	8	5	7	5	6	7	7	6
Student 2	5	6	6	5	4	6	7	3	4	6	5	3	3	5	7	3
Student 3	5	6	7	5	6	3	6	5	1	8	2	4	9	6	3	4
Student 4	2	6	6	2	3	9	2	2	5	2	9	5	2	9	8	5
Student 5	6	6	5	6	2	6	2	5	3	6	5	7	5	7	5	7
Student 6	7	9	4	5	9	4	6	5	8	9	5	8	8	4	5	6
Student 7	6	6	1	9	8	6	9	6	8	6	2	9	4	6	9	9
Student 8	8	6	5	5	6	7	7	3	6	4	3	6	5	4	6	6
Student 9	6	7	6	5	4	6	6	5	9	8	5	6	5	5	3	4
Student 10	7	6	8	2	7	4	6	7	6	2	5	6	5	5	3	5
Student 11	4	5	5	6	5	5	5	5	7	6	7	7	7	6	7	4
Student 12	7	8	8	6	4	7	9	6	4	7	6	4	9	6	5	4
Student 13	4	5	8	6	7	7	6	4	6	6	7	3	7	5	6	3
Student 14	4	9	3	5	3	6	5	5	5	4	4	7	5	7	9	5
Student 15	7	9	5	5	7	6	4	7	4	5	7	5	9	4	6	6
Student 16	6	7	6	5	8	6	8	5	5	4	5	6	7	5	4	6
Student 17	6	6	5	5	6	7	7	4	5	5	2	6	5	3	7	5
Average	5.53	6.53	5.47	5.18	5.47	6.06	6.00	4.82	5.53	5.47	5.06	5.71	5.94	5.53	5.88	5.18

Table 5-6. Student Scores on Simmons Personal Survey and Rosenberg Self-Esteem Inventory (RSE)

	Simmons Personal Survey EQ Profile													RSE
	Energy	Stress	Optimism	Self-Esteem	Work	Detail	Change	Courage	Direction	Assertive	Tolerance	Considerate	Sociable	
Student 1	5.0	6.2	2.1	8.1	2.0	1.4	8.0	6.0	3.0	7.8	4.1	3.1	7.0	37.0
Student 2	5.2	3.8	3.8	7.0	4.5	4.0	7.0	3.5	4.0	6.0	5.8	3.8	6.3	40.0
Student 4	4.7	3.6	4.5	2.5	5.6	5.3	8.0	4.5	3.5	5.3	7.6	4.5	3.5	31.0
Student 5	6.2	5.1	2.5	2.5	4.5	3.8	6.2	6.8	6.2	7.3	2.6	2.2	4.0	30.0
Student 6	5.0	4.7	4.5	8.5	3.8	2.3	7.3	3.0	3.7	5.3	7.0	4.7	8.2	32.0
Student 7	5.0	5.6	0.7	8.5	3.1	5.6	5.0	8.0	6.0	8.4	2.6	2.4	7.6	31.0
Student 8	7.6	4.2	4.5	2.0	4.7	4.0	6.8	7.3	6.5	7.0	3.8	2.8	4.5	29.0
Student 3	5.3	4.9	4.2	8.8	4.0	5.6	7.0	2.3	3.0	3.5	8.3	5.2	7.3	33.0
Student 9	4.6	5.0	3.8	8.3	3.4	3.4	8.0	2.3	3.2	4.0	7.1	4.2	5.0	36.5
Student 10	4.8	4.5	4.5	8.3	3.1	3.1	6.8	3.5	3.5	4.0	8.1	5.0	8.0	37.0
Student 11	5.0	4.7	6.0	9.0	6.0	4.6	6.5	1.5	4.3	3.2	7.6	5.5	8.6	35.0
Student 12	6.0	4.9	2.6	6.0	2.6	1.7	6.5	6.5	3.2	7.1	4.8	2.8	4.0	35.0
Student 13	6.0	4.5	6.0	0.1	7.7	6.7	5.0	7.6	7.5	7.1	5.4	4.2	3.5	40.0
Student 14	4.8	4.0	2.5	7.3	4.7	5.3	6.8	4.5	4.0	6.5	3.8	3.4	7.3	36.0
Student 15	5.3	3.7	3.5	6.5	4.0	3.4	7.3	6.0	3.7	6.3	5.1	3.7	4.5	36.0
Student 16	5.0	4.3	3.4	7.3	4.2	4.3	7.3	3.0	3.5	5.6	7.1	5.0	8.0	35.0
Student 17	6.0	4.2	5.3	8.1	6.3	6.5	6.8	6.8	7.5	6.3	2.8	3.5	5.0	35.0
Class Avg.	5.38	4.58	3.79	6.40	4.36	4.18	6.84	4.89	4.49	5.92	5.51	3.88	6.02	34.62

Table 5-7. Students' Final Grade and Electronic Communications

	IMs with Instructor	Emails to Instructor	Posts to Listserv	Total IMs, Emails, & Posts	Final Grade
Student 1	4	15	0	19	97.6
Student 2	1	13	3	17	96.1
Student 3	1	6	1	8	95.4
Student 4	4	15	0	19	98.7
Student 5	2	26	2	30	92.6
Student 6	1	27	1	29	98.9
Student 7	3	33	1	37	95.3
Student 8	2	12	2	16	99.1
Student 9	6	17	2	25	94.7
Student 10	2	9	1	12	91.4
Student 11	1	8	0	9	80.8
Student 12	2	11	0	13	95.2
Student 13	2	9	1	12	96.4
Student 14	1	5	0	6	94.9
Student 15	1	14	0	15	97.2
Student 16	6	6	0	12	98.9
Student 17	8	29	3	40	94.2
Class Avg.	2.76	15.00	1.00	18.76	95.14

Results

Class Personality Profile

The class means of each of the personality measures were compared to national means when possible. The 16PF, for instance, publishes national mean scores for each edition of the questionnaire. By comparing how the Tech Tools class as a whole performed relative to national norms, one can determine a personality profile for the class. Table 5-8 shows the class means for the personality characteristics measured by the 16PF and how each compares to 16 PF national means. A two-sided significance test

was performed to determine if there was a statistically significant difference between the Tech Tools scores and the national means. National mean scores were not available for the Simmons Survey or the Rosenberg Self Esteem Inventory.

Table 5-8 Tech Tools Mean Scores vs. National Mean Scores on the 16PF

Global Factors	National Average (n=10,261)	SD	Class Average (n=17)	SD	p
Extraversion	5.70	1.81	5.82	1.94	0.795
Anxiety	5.60	1.97	5.47	1.97	0.787
Tough-Mindedness	5.43	1.79	5.65	1.93	0.646
Independence	5.46	1.60	5.76	1.79	0.484
Self Control	5.54	1.56	5.94	1.64	0.312
Primary Factors					
Warmth	5.81	1.79	5.53	1.55	0.453
Reasoning	5.58	1.89	6.53	1.46	0.008*
Emotional Stability	5.34	1.79	5.47	1.81	0.764
Dominance	5.23	1.70	5.18	1.55	0.889
Liveliness	5.64	1.85	5.47	2.03	0.734
Rule-Consciousness	5.54	1.80	6.06	1.48	0.147
Social Boldness	5.63	1.96	6.00	2.00	0.447
Sensitivity	5.36	1.82	4.82	1.33	0.097
Vigilance	5.67	1.90	5.53	2.07	0.779
Abstractedness	5.50	1.76	5.47	1.94	0.952
Privateness	5.36	1.82	5.06	2.01	0.542
Apprehension	5.66	1.77	5.71	1.65	0.912
Openness to Change	5.67	1.78	5.94	2.08	0.589
Self-Reliance	5.52	1.83	5.53	1.46	0.952
Perfectionism	5.43	1.84	5.88	1.93	0.337
Tension	5.30	1.66	5.18	1.51	0.734

* denotes $p < .05$

As Table 5-8 indicates, there is no statistically significant difference between the Tech Tools means and the national means for any of the 16PF global factors. However, there is a statistically significant difference between the national and class means for one of the primary factors at the $p < 0.05$ level. The Tech Tools students earned higher than average scores on Reasoning. According to the 16PF Fifth Edition Administrator's

Manual, the Reasoning scale equally represents verbal reasoning, numerical reasoning, and logical reasoning. High scorers frequently have higher reasoning ability than do those who score lower on this measure.

Description of Correlations with Educational Significance

Pearson correlations were calculated between the personality measures and student final grade, number of Instant Message conversations with the instructors, number of emails sent to the instructors, number of listserv posts, and number of total electronic communications (IMs + emails + listserv posts). Table 5-9 and Table 5-10 show correlation matrices for these variables.

Table 5-9. Correlation Matrix for 16 PF Factors vs. Final Grade, IMs, Emails, Listserv Posts, and Total E-Communications.

	Final Grade	IMs with Instructor	Emails to Instructor	Listserv Posts	Total Electronic Communications
Extraversion	0.18	0.11	0.28	0.42	0.31
Anxiety	-0.01	0.21	0.60	-0.06	0.56
Tough-Mindedness	0.09	0.27	0.06	0.27	0.14
Independence	0.03	-0.11	0.16	-0.10	0.10
Self Control	0.06	0.16	-0.03	-0.18	-0.01
Warmth	0.15	-0.04	0.24	0.30	0.23
Reasoning	0.28	-0.22	0.00	-0.20	-0.06
Emotional Stability	-0.02	0.00	-0.55	0.00	-0.48
Dominance	-0.11	-0.06	0.39	0.04	0.33
Liveliness	0.19	0.01	0.15	-0.06	0.08
Rule-Consciousness	0.33	0.42	0.11	-0.08	0.18
Social Boldness	0.15	0.20	0.03	0.09	0.08
Sensitivity	-0.26	-0.19	0.01	-0.35	-0.07
Vigilance	-0.06	0.27	0.31	-0.06	0.32
Abstractedness	-0.05	-0.17	0.27	0.21	0.22
Privateness	-0.06	-0.14	-0.30	-0.53	-0.35
Apprehension	-0.22	0.09	0.54	-0.07	0.47
Openness to Change	-0.06	-0.29	-0.27	-0.40	-0.34
Self-Reliance	-0.08	-0.16	-0.18	-0.48	-0.24
Perfectionism	-0.01	-0.07	0.25	-0.12	0.19
Tension	0.21	0.11	0.61	-0.12	0.53
Final Grade	-----	0.18	0.12	0.05	0.15

Table 5-10. Correlation Matrix for Simmons, Rosenberg Scores & Years Experience vs. Final Grade, IMs, Emails, Listserv Posts, and Total E-Communications.

	Final Grade	IMs with Instructor	Emails to Instructor	Listserv Posts	Total Electronic Communications
Energy	0.16	-0.07	0.08	0.39	0.09
Stress	-0.14	0.10	0.31	-0.10	0.27
Optimism	-0.29	0.02	-0.29	0.18	-0.23
Self-Esteem	-0.31	0.11	0.08	-0.08	0.08
Work	-0.20	0.06	-0.10	0.21	-0.05
Detail	-0.10	0.18	0.02	0.24	0.08
Change	0.25	0.27	-0.20	-0.12	-0.12
Courage	0.34	0.09	0.42	0.14	0.40
Direction	-0.04	0.18	0.43	0.51	0.46
Assertive	0.46	0.06	0.41	0.04	0.37
Tolerance	-0.16	-0.14	-0.53	-0.28	-0.51
Considerate	-0.28	-0.04	-0.49	-0.24	-0.46
Sociable	-0.32	-0.16	-0.11	-0.22	-0.15
RSE	-0.13	0.01	-0.42	0.01	-0.36
Years Experience	0.38	-0.31	0.15	0.30	0.10

As the data above indicates, strong correlations exist between several of the variables. Due to the small spread between the students' final grades (only 7.7 percentage points separated 16 of the 17 students) and the small sample size, none of the correlations between final grade and the personality measures are statistically significant at the $p < 0.05$ level. However, several correlations were high enough to suggest educational significance between the variables. A good example is the correlation between the Simmons measure for Assertiveness and final grade. The strong positive correlation ($r = 0.46$) between the two variables shows that the students in Tech Tools who scored higher on this measure also earned a higher grade than their classmates that scored lower on Assertive. This data also indicates that over 20% of the variance in final grade can be explained by its relationship with assertiveness as measured by Simmons.

Four other measures yielded correlations greater than 0.30 or less than -0.30 which indicates that at least 9% of the variance in final grade can be explained by this relationship. The Simmons measure for Courage was correlated with the students' final grade ($r = 0.34$) and suggests a positive relationship between the two variables. According to Measuring Emotional Intelligence, Courage "is the willingness to risk injury, loss, hardship, or physical discomfort to reach a desired goal". The Simmons measure for Sociability was also correlated with grade ($r = -0.32$) and suggests that students who are less sociable as measured by Simmons had higher final grades in Tech Tools than those students who are deemed more sociable by the Simmons Survey. The other Simmons factor that yielded a correlation in excess of 0.30 was Self-Esteem ($r = -0.31$). This data indicates that the students in Tech Tools with lower self-esteem earned higher numerical grades than their classmates with higher self-esteem. This negative relationship between self-esteem and student grade is similar to the findings of Flynn (2001) and her research of personality and student measures of success in the Tech Tools course.

The primary factor Rule Consciousness as measured by the 16PF also yielded an educationally significant correlation with student final grade ($r = 0.33$). Students who scored highly on this primary factor tended to have a higher final grade than students who scored lower. According to the 16PF Administrator's Manual, this factor measures "the extent to which cultural standards of right and wrong are internalized and used to govern behavior". Therefore, students who were more rule-conscious as measured by the 16PF tended to make higher final grades in Tech Tools than did their classmates who were deemed less rule-conscious.

Although years of teaching experience is not a component of personality, the correlation between amount of teaching experience of the students in Tech Tools and their final grade ($r = 0.38$) is worth noting. In this section of Tech Tools, the students with more years of experience in teaching earned higher grades than those students with less teaching experience.

Description of correlations with statistical significance

As the correlation matrices in Tables 5-9 and 5-10 show, several of the personality characteristics measured in this study have statistically significant correlations with the amount of student communication within the Tech Tools course. For this sample size ($n = 17$) any correlation greater than 0.48 or less than -0.48 is statistically significant at the $p < .05$ level. Using this criterion, only one of the 16PF global factors is significantly correlated with measured communications. Anxiety is highly correlated with the number of emails the students sent to the instructors ($r = 0.60$) and the total number of monitored electronic communications the students made ($r = 0.56$). Both of these results suggest that the higher the students' score on the 16PF for Anxiety, the more they communicated with the instructors by email and overall. Interestingly, the relationship with Anxiety does not hold true for IMs with the instructor or number of posts to the class listserv. It appears from this data that the relationship between Anxiety and total electronic communications is simply an artifact of the relationship between emails and Anxiety and due to the strong correlation between Anxiety and number of emails sent to the instructors.

Several of the 16PF Primary Factors have correlations with measured communications that are high enough to be statistically significant. Of these, only Tension is correlated with more than one category of electronic communications. Similarly to the results for the global factor Anxiety, Tension is highly correlated with both emails to the instructors ($r = 0.61$) and total electronic communications ($r = 0.53$) while showing no correlation between Tension and IMs or listserv posts. As in the relationship between Anxiety and communications, it is obvious that the main contributor to the relationship between Tension and total electronic communications is the strong correlation between student scores on Tension and the number of emails these students sent to the instructors and is therefore an artifact of this relationship.

Two other primary factors of the 16PF yielded statistically significant correlations to number of emails sent to the instructor. Emotional Stability has a strong negative relationship with emails ($r = -0.55$), meaning the higher a Tech Tools student scored on this measure, the less they communicated with their instructor via email. Apprehension has a strong positive relationship with emails ($r = 0.54$) with students scoring high on Apprehension communicating with their instructors more often by email than their classmates who scored lower on this trait. Unlike Anxiety and Tension, however, neither Emotional Stability nor Apprehension had a strong enough correlation with the number of emails sent to affect the significance of the correlation with total electronic communications.

Only one other personality characteristic measured by the 16PF yielded a statistically significant correlation with any of the tallied communications. Privatness, described by the 16PF as “the tendency to be private and nondisclosing”, is negatively

correlated with number of posts to the class listserv ($r = -0.53$). The students who scored highly on this trait posted to the listserv less than students who made lower scores on Privatness. Although the correlations between Privatness and the use of other communication methods are also negative, none are large enough to be statistically significant.

Correlations calculated between tallied communications and personality characteristics measured by the Simmons Personal Survey yielded several correlations that were significant at the $p < 0.05$ level. The strongest among these is the relationship between Tolerance and number of emails sent to the instructors. The correlation is negative ($r = -0.53$) with high scoring students on this measure communicating with their instructors less often by email than their classmates who scored lower on Tolerance. These same students also communicated less often in general as the correlation between Tolerance and total electronic communications ($r = -0.51$) indicates. Neither IMs with the instructors nor listserv posts yielded statistically significant correlations with Tolerance.

The Simmons measure for Direction also produced a statistically significant correlation with tallied communications. Students who made higher scores on Direction communicated with their instructors via email more often ($r = 0.51$). Although these students also posted more messages to the class Listserv, the correlation was not significant ($r = 0.43$). These results are also similar to the findings of Flynn (2001). Her results indicated positive relationships between Direction, emails and IMs with the instructors.

One other Simmons measure yielded a statistically significant correlation between the personality trait and the amount of electronic communications within the Tech Tools course. Students who were deemed more Considerate by the Simmons Survey tended to send less email to their instructors than their less considerate classmates as the negative correlation between the two variables ($r = -0.49$) indicates. Although small negative correlations exist between Considerate and the other tallied communications, none are statistically significant.

Correlations calculated between the other traits measured by the 16PF and the Simmons Personal Survey yielded no relationships that were statistically significant at the $p < .05$ level. This is also the case with student scores on the Rosenberg Self Esteem Inventory and the students' self-assessment of their Technology Skill Level prior to the Tech Tools course. Neither of these measures yielded any correlations that were statistically significant.

Correlations between the instruments

Since the 16PF, Simmons, and Rosenberg instruments purport to measure aspects of an individual's personality, correlations were calculated between the measures to determine the level of inter-correlation present among each of the variables. Appendix B shows the correlation matrix for all of the variables measured by the three personality instruments used in the study.

It should be noted that several personality traits with similar descriptions have surprisingly low correlation levels. The most obvious is the correlation between the student scores on the Simmons measure for Self-Esteem and their score on the Rosenberg

Self-Esteem Inventory ($r = 0.17$). This is unacceptably low for two instruments supposedly measuring the same trait. This low correlation can be explained by a likely error in the scoring of one student's Self-Esteem score on the Simmons instrument. The student scored a 0.1 on a scale of 0 – 10 which indicates that the student has very low self esteem. Conversely, this same student scored the highest possible score of 40 on the Rosenberg Self-Esteem Inventory, which suggests that he has very high self esteem. After removing this outlier, the correlation between the two measures for Self-Esteem increases to $r = 0.60$. Although this is a more acceptable correlation level, it remains a low correlation between two measures of the same trait. Removing the outlier had no impact on the correlations between Simmons Self-Esteem and Final Grade or Simmons Self Esteem and any of the tallied communications.

Another surprisingly low correlation exists between the Simmons measure for Change and the 16PF measure for Openness to Change ($r = -0.06$). Simmons and Simmons (1997), state that the measure for Change “measures to what degree people like change in their environment, in what they believe, or in their behavior”. The 16PF describes Openness to Change as the degree to which people “seek ways to improve things” and how much they enjoy experimenting (Russell and Karol, 2001). The descriptions sound similar enough that one should expect that the two measures are much more correlated than what the data indicates.

Other similar traits measured by both Simmons and the 16PF also show lower than expected correlations with one another. The Simmons measure for Sociability is not as strongly correlated with the 16PF measure for Social Boldness ($r = 0.32$) considering that both purport to measure an individual's level of comfort in social situations.

Similarly, the Simmons measure for Stress is only moderately correlated with the 16PF measure for Tension ($r = 0.36$).

Regression Analysis

A regression analysis was conducted to determine if prediction equations for success were present in the Tech Tools course. Student data from the 16PF, the Simmons Personal Survey, the Rosenberg Self Esteem Inventory, and the preliminary Tech Tools questionnaire was compared to the students' final grade and level of electronic communication. Because of the inter-correlation of many of the factors among the 16PF and the Simmons (see Appendix A), these instruments were analyzed separately.

Looking at the 16PF factors and using student final grade as the dependent variable, the regression analysis determined a model that included eight Primary Factors and explains 95% of the total variance in student final grade in Tech Tools as the r^2 value of 0.95 indicates. The variables associated with this model are Warmth (-), Reason (+), Sensitivity (-), Vigilance (+), Privatness (-), Apprehension (-), Perfectionism (-), and Tension (+). The regression statistics for these variables are shown in Table 5-11.

Table 5-11. Regression Table for 16PF Variables

Parameter	Mean Square	F	Estimate	p
Intercept			98.19	< 0.0001
Warmth	14.12	7.45	-1.05	0.0259
Reason	122.82	64.78	2.49	< 0.0001
Sensitivity	59.68	31.48	-1.81	0.0005
Vigilance	56.83	29.98	1.28	0.0006
Privateness	24.22	12.77	-0.85	0.0072
Apprehension	166.11	87.62	-4.04	< 0.0001
Perfectionism	26.21	13.83	-0.93	0.0059
Tension	178.26	94.02	4.06	< 0.0001

From the data above, the regression model for final grade in the Tech Tools course can be expressed by the following prediction equation, Prediction Equation 1:

$$\text{Student Grade} = -1.05W + 2.49R - 1.81S + 1.28V - 0.85Pr - 4.04A - 0.93Pe + 4.06T + 98.19$$

Where W = Warmth, R = Reason, S = Sensitivity, V = Vigilance, Pr = Privateness, A = Apprehension, Pe = Perfectionism, and T = Tension. Figure 5-1 shows a scatter diagram for Prediction Equation 1 with predicted final grade plotted against actual final grade. The solid line represents a perfect prediction model.

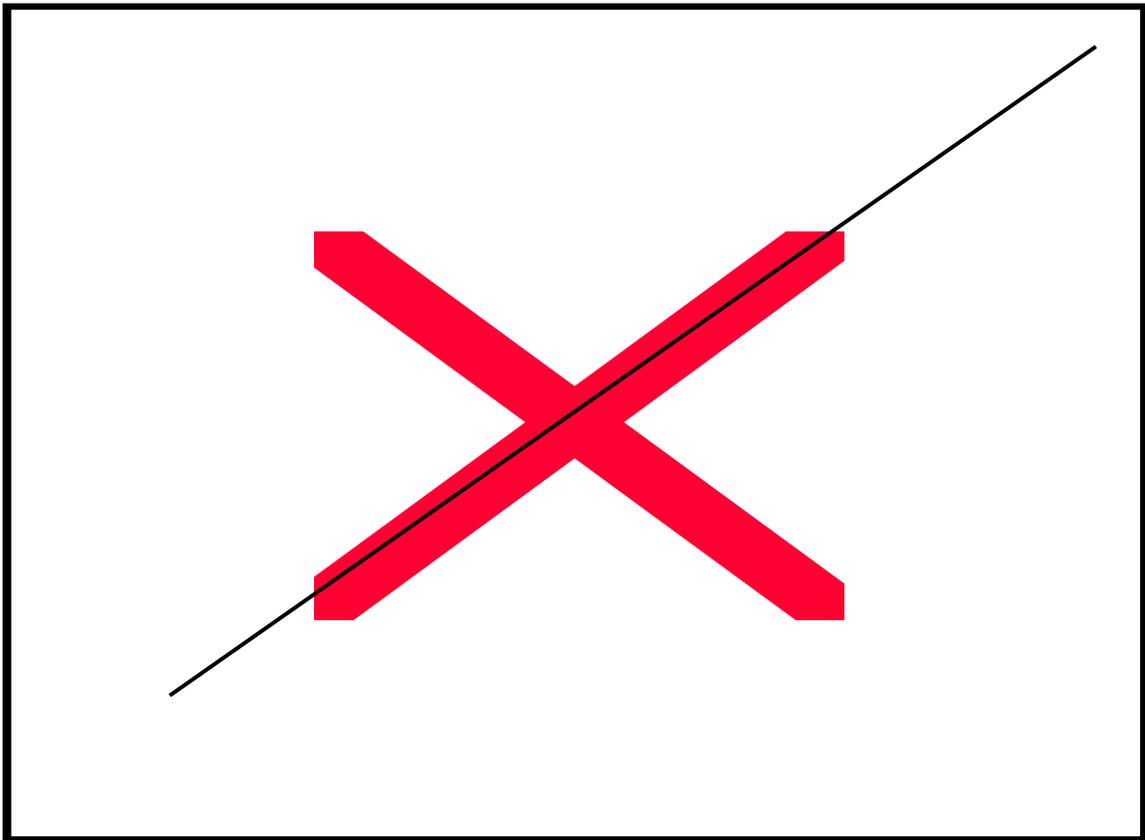


Figure 5-1. Predicted vs. Actual Grade: Predictions using selected 16PF Variables

The coefficients in the equation indicate that three variables play a major role in predicting the success a student will have in Tech Tools. Students who make high scores on the 16PF measure for Tension will generate higher predicted grades. The same is true for high scores on Reasoning. High scores on Apprehension, however, will have the opposite effect on predicted grades.

The regression analysis produced one other model for predicting final grade in the Tech Tools course. It includes three Simmons variables, all positively related to Final Grade: Assertive (+), Change (+), and Tolerance (+). It explains 68% of the variability in Final Grade ($r^2 = 0.68$). The regression statistics of these variables are shown in Table 5-12.

Table 5-12. Regression Table for Simmons Factors

Parameter	Mean Square	F	Estimate	p
Intercept			48.93	0.0011
Change	48.64	5.15	2.21	0.0409
Assertiveness	131.10	13.89	3.68	0.0025
Tolerance	46.32	4.91	1.7	0.0452

From the data above, the regression model for final grade in the Tech Tools course can be expressed by the following prediction equation, Prediction Equation 2:

$$\text{Student Grade} = 2.21C + 3.68A + 1.70T + 48.93$$

Where C = Change, A = Assertive, and T = Tolerance, all of which are measured by the Simmons Survey. Figure 5-2 shows a scatter diagram for Prediction Equation 2 with predicted final grade plotted against actual final grade. The solid line represents a perfect prediction model.

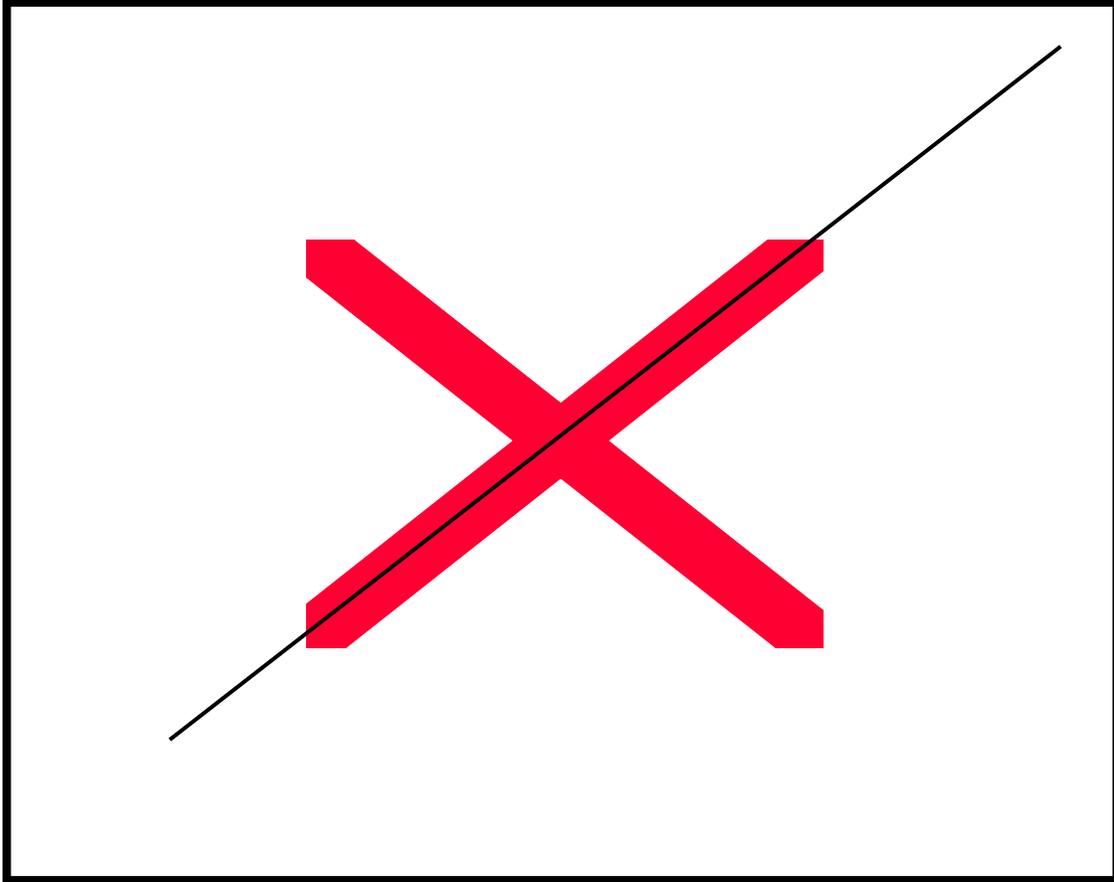


Figure 5-2. Predicted vs. Actual Grade: Predictions using Simmons Factors

The coefficients in this equation indicate that three Simmons variables play a major role in predicting the success a student will have in Tech Tools. Students who make high scores on the Simmons measure for Assertive will generate higher predicted grades. Similarly, the higher the students score on the Simmons measures for Change and Tolerance, the higher their predicted grade will be.

The regression analysis produced no models involving self-esteem as measured by Simmons Survey or the Rosenberg Self-Esteem Inventory. This is also the case for the tallied communications. By themselves or in combination with each other, none of the communication methods were related to final grade.

The regression calculations in this study have shown that the relationships between certain personality traits and final grade in Tech Tools are such that it is possible to use student scores on the Simmons Survey and the 16PF to predict academic success in the Tech Tools course. These regression equations also show how several traits compliment or counteract one another in a student's academic success in Tech Tools.

Conclusions

There are several areas where it appears that the students' personality and other individual traits play a role on how successful they were and how they responded in the Technology Tools for Science Teachers course. Below are several conclusions drawn from the results of this study.

Profile of the Tech Tools Class

Since the Technology Tools for Science Teachers course is a requirement for alternative licensure science teachers at NC State University, an analysis of class averages on the personality measures and other data provides insight into the kinds of students this program is serving. For instance, the data indicates that students enrolled in this particular section of Tech Tools possess higher than average reasoning skills. Previous research shows that level of education affects scores on Reasoning (Rieke and Conn, 1994) as persons with higher education levels score higher than those with less education. Therefore there should be no surprise that the students in Tech Tools earn higher than average scores on this personality trait. As alternative licensure science

teachers, these students have already earned a minimum of a bachelor's degree in a science content area and are currently enrolled in post-baccalaureate coursework.

Individual Characteristics of Students and Their Success in Tech Tools

As previously mentioned, the small spread among the students' final grades impacted the analysis of data in that no correlations between final grade and personality traits were found to be significant at the $p < 0.05$ level. Considering the narrow distribution of final grades, however, the high correlation between the Simmons measure for Assertiveness and final grade ($r = 0.46$) is definitely worth noting. According to Measuring Emotional Intelligence, Assertiveness measures to what degree an individual tries to motivate others and to what degree an individual resists complying with others. The Tech Tools requirements are very specific, yet there is plenty of room for creativity within the assignments. The students who are more assertive more than likely took the initiative to learn material in the course. In fact, the correlation between Assertiveness and email communications is high ($r = 0.41$) although not statistically significant. Although nothing is mentioned in the literature, the Simmons measure for Assertiveness may be related to an individual's ability to self-direct, which has been identified as a characteristic necessary for success in online courses. Regardless, further exploration of this measure in particular is needed to learn more about how it relates to final grade in Tech Tools.

The other Simmons measures described in the results as having educationally significant relationships with student success in Tech Tools: Courage, Sociability, and Self-Esteem, all have interesting inter-correlations with other variables used in this study.

For instance, Courage is highly inter-correlated with Assertiveness ($r = 0.89$). The Simmons definition for Courage, “the willingness to risk injury, loss, hardship, or physical discomfort to reach a desired goal”, may enable someone to be more assertive in certain situations. Since Tech Tools employs a unique format, requires rigorous effort, and is required before an alternative licensure teacher receives permanent licensure, taking the course can be perceived as taking a risk. Therefore, students who possess courage are more likely to succeed in such a course than their more cautious classmates. The data seems to support this idea.

The negative relationship between Sociability and final grade is not a surprise. According to Measuring Emotional Intelligence, Sociability is the “tendency to meet people, spend time talking, and be group oriented”. Since none of these things occur readily in a web-based course such as Tech Tools, it appears that sociable students are at a disadvantage compared to less sociable students. Simmons further describes low scorers on this trait as reserved and describes them as desiring privacy and enjoying “boundaries that can separate themselves from others”. The format of Tech Tools definitely favors the reserved student. This advantage of reserved students over their more sociable classmates apparently translates into greater success in the course.

The negative relationship between Self-Esteem as measured by Simmons and final grade is consistent with earlier research conducted by Flynn (2001). Although Flynn concludes that this result is not contrary to previous research, a review of the literature provides ample evidence a plethora of research exists that supports the idea that if a correlation exists between self-esteem and academic achievement, it is a positive correlation and not a negative one.

This unique negative relationship requires further exploration from several different perspectives. The sample sizes involved in this project and in Flynn's research are relatively small ($n = 17$ and $n = 11$, respectively), therefore it is important to explore the relationship between success and self-esteem with larger sample sizes. Furthermore, more research needs to be conducted to determine if the Simmons measure truly measures self-esteem as it is defined by psychologists. Although Simmons & Simmons define self-esteem as the "tendency to value oneself and to be self-accepting", they consider low self-esteem synonymous with humility. This is a somewhat unique view of self-esteem and humility.

In addition, the Simmons measure for self-esteem was not as highly correlated with the Rosenberg Self Esteem Inventory as one might expect. Since the Rosenberg Inventory is widely used and respected in psychological research, the relatively low correlation between it and the Simmons self-esteem measure is an extremely important and troubling result.

Another area of exploration involving the Simmons measure for self-esteem involves its apparent relationship with the Simmons measure for sociability. The inter-correlation between the two variables is high in this study and should be compared with other research involving these two personality characteristics.

The relationship between the 16PF factor Rule-Consciousness and final grade is also worth noting. As stated earlier, Rule-Consciousness measures an individual's endorsement of conventional cultural values. The data indicates that students who are more rule-conscious received higher grades in Tech Tools than their less rule-conscious classmates. Interestingly, the 16PF Administrator's Manual describes low scorers on this

measure as needing autonomy and flexibility, two things that a web-based course should provide.

Since subscribing to widely accepted cultural values is more socially acceptable than rejecting them, it is possible that the correlation between student final grade and their score on this measure is actually a product of instructor bias towards the less rule-conscious individuals. How such bias is promoted in a web-based course and how this compares to possible bias in traditional courses are two definite areas which should be explored further.

The role teaching experience plays on academic success in Tech Tools is another interesting result. This is especially important because of the unique attributes of the alternative licensure teacher. By the very nature of the alternative licensure program, none of the participants have much experience, but it is clear from the data that the more experienced teachers performed better in Tech Tools than their less experienced classmates.

The amount of teaching experience possessed by students enrolled in Tech Tools played a significant role in the students' performance in the course. The requirement that alternative licensure teachers must earn six semester hours of coursework per year places a heavy burden on new teachers who are learning to develop lesson plans, grade papers, and manage a classroom full of students for the very first time. Because NC State University's summer session schedule conflicts with most school system's schedules, alternative licensure teachers have few options for when to take required courses. This is especially problematic for first year teachers, many of whom choose not to take a course during their first ever semester of teaching. This was the case with some of the teachers

in Tech Tools with several rookie teachers taking another course in addition to Tech Tools during the spring semester of 2002.

This scenario very likely contributed to the students' achievement in Tech Tools. The workload for Tech Tools is rigorous and the assignments time-consuming, so students who have more time to accomplish the assignments have an advantage. In the case of alternative licensure teachers, the more experienced teachers more than likely have more time than the less experienced teachers. Future iterations of Tech Tools should consider teaching experience as a prerequisite for the course. This may also be true for other rigorous courses that alternative licensure teachers are required to complete.

Personality and Levels of Communication in Tech Tools

The results involving methods of electronic communication and personality measures yielded both interesting and statistically significant results. The high correlation between the 16PF global factor Anxiety and the number of emails sent to the instructors shows that anxious students in Tech Tools communicated with the instructors via email more often than students with low anxiety. This global factor consists of the primary factors Emotional Stability, Vigilance, Apprehension, and Tension. High anxiety includes a tendency to be reactive rather than adaptive, distrustful and vigilant, worrying and apprehensive, and tense (Russell and Karol, 2002). Apparently these factors created a need for the students to communicate often with the instructors. However, this strong correlation is not present with the other methods of communication: Instant Message sessions (IMs) and posts to the course listserv. It is possible that the nature of high anxiety contributes to this behavior. Since anxious students tend to be

reactive, it is likely that these students will send an email instead of waiting for office hours to enter into an IM session with an instructor. Also, if anxious students are more distrustful as the 16PF suggests, then it is less likely that these students will rely on the assistance of their peers through the use of the course listserv.

As previously mentioned, the primary factor Tension contributes to the global factor Anxiety and also yielded a high correlation with email communications to the instructors. High scorers on this factor tend to have a restless energy and become fidgety when made to wait, whereas low scorers tend to feel relaxed and tranquil, and are generally more patient (Russell and Karol, 2002). From these descriptions, one can conclude that students with high levels of Tension as measured by the 16PF will be more inclined to pose a question immediately via email than to wait and attempt to discover the answer themselves or wait for virtual office hours or an upcoming face-to-face session. Neither Tension nor methods of communication are correlated with final grade in Tech Tools, therefore Tension apparently does not play a role in the level of success a student has in the class, but rather influences his behavior during the course.

The other two 16PF primary factors that produced high correlations with emails to the instructors, Emotional Stability and Apprehension also contribute to the global factor Anxiety. High scorers on Emotional Stability tend to take life in stride and manage events and emotions in a balanced way, while low scorers tend to react to life and feel a lack of control over it (Russell and Karol, 2002). This certainly can explain why low scorers sent more emails than high scorers. If a student took the assignments and technical problems in stride, he would be less inclined to send the instructors an email.

High scores on Apprehension tend to worry about things while low scorers tend to be more self-assured (Russell and Karol, 2002). Again, this can explain why certain students emailed their instructors more often than others. A student who tends to worry about assignments, quality of work, technical problems, and course rigor will most likely communicate more often with instructors than students who are more self-assured.

As mentioned in the results, one 16PF factor was found to be strongly related to how often a student posted to the Tech Tools listserv. The relationship the 16PF primary factor *Privateness* has on students' posting to the class listserv may be the most interesting result of the study. High scorers on *Privateness* tend to be personally guarded and maintain their privacy, while low scorers tend to talk about themselves and are self-revealing (Russell and Karol, 2002). The more private a Tech Tools student was, the fewer posts he made to the listserv. It appears that the community-like nature of Listservs inhibits the students who are not as self-disclosing. This is certainly an area requiring further research. Listservs are viewed as an important tool in web-based education and in education in general because they have the potential to create a community of learners. From the data of this study, it appears as if some students are not as comfortable with participating in a community of learners even if it is a virtual community.

The Simmons measure for *Direction* was the only other personality trait that produced a statistically significant correlation with listserv posts. *Direction* is the tendency to set goals, form opinions, and make decisions (Simmons and Simmons, 1997). None of these descriptors shed any light on why students who scored high on this trait posted to the listserv more often than low scorers. It is also not clear why posting to the

listserv was the only communication method that produced a statistically significant correlation with Direction. Emails produced a high correlation ($r = 0.43$) but not high enough to be significant at the $p < 0.05$ level. There was very little correlation between Direction and IMs with the instructors. It appears that self-directed students in Tech Tools preferred asynchronous communication over the synchronous method. The idea of students' level of Direction as measured by the Simmons instrument and its relationship with synchronous and asynchronous communication is another area for deeper study.

One of the more telling results from this study is the strong negative correlation between the Simmons measure, Tolerance, and number of emails sent to the instructors. Tolerance is the "degree to which a person is patient or is willing to put up with inconvenience from others" (Simmons and Simmons, 1997). The spring 2002 Tech Tools course was filled with events that some would consider inconveniences. Several technical problems occurred with the main server used to upload assignments, and both instructors became unavailable at a critical time during the course. As previously mentioned, the workload for Tech Tools is rigorous and the alternative licensure requirements for the Tech Tools students allowed little time for outside stresses. Therefore it is not surprising that students who possess greater tolerance for inconveniences communicated less than students who possess less tolerance. What is surprising is that this trait had very little impact on the student's final grade in the course. This is another area for further research. Determining what role, if any, do Tolerance and patience play in determining the success and behavior of students enrolled in courses such as Tech Tools would assist course advisors in placing students in those courses.

The level of Consideration a student possesses definitely influenced how often they sent emails to the instructor, as the data indicates. In this case, considerate students were less likely to send emails than their less considerate counterparts. The absence of a strong correlation with either of the other communication methods may be just as telling. It is possible that considerate students choose not to send emails to the instructors out of consideration for the instructors' time outside of class time and office hours. This may explain why no correlation exists for IMs with the instructors – an activity that occurs during office hours.

Personality Traits as Predictors for Web-Based Courses

There are other conclusions that can be derived from this study, especially regarding methodology. The most obvious is the need for research conducted to determine the validity of the Simmons Emotional Intelligence Survey and its use in educational research. The Simmons Instrument has been used predominately in business settings and relationship counseling, and therefore has not undergone the rigors of academic research. In Measuring Emotional Intelligence, Steve Simmons suggests several applications for the survey, none of which includes educational or psychological research. Research on the Simmons Survey is important because of some of the data the survey generated in this study and in Flynn's (2001) study. Determining the validity of the measures involved in the survey would provide more information in addition to what has been discovered in this project.

Whether or not the predicting variables found in the regression analysis can also be used to predict success in other courses, especially traditional classrooms, is another

area of interest that should be explored for additional research. It is possible that these predictors are not unique to web-based courses such as Tech Tools. Information such as this is extremely valuable to the field.

Another conclusion drawn from this research study is the importance of personality within web-based courses and the role it plays in the overall experience of students. Although predicting academic success in a class is an extremely important area of research, it is clear from this study that a lot happens within a course that can be impacted by personality, yet these events will many times have nothing to do with grades.

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Chapter Six

Exploring the Dynamics and Culture of a Web-Based Course for Science Teachers

Introduction

The literature reflects many benefits to students of web-based education. Boone and Anderson (1995) suggests that a major benefit of web-based education is its ability to provide learners who are remote geographically or who are under time constraints the same opportunities as learners who are not hindered by similar constraints. Huntley and Mather (1999) also agree with this position. In addition Gibson (1998) discovered that learners who are interested in innovative ways of learning or have had a negative past experience with traditional education are deeply satisfied with and successful in web-based coursework. Nelson-Nisan (1999), in a study of teachers using web-based education for professional development, found no significant difference in achievement in a comparison of a traditional classroom learner and the web-based learner, but there was a significant in level of satisfaction. The web-based learners possessed higher levels of satisfaction with the educational process than the learners in a traditional classroom. Chute, Thompson, and Hancock (1999) speculate that one of the reasons for this high level of satisfaction may be the level of control the learner has on what is learned and the pace at which the content is delivered.

Web-based education seems to be most positively embraced by non-traditional students. Since non-traditional students tend to be older with different responsibilities (such as family and full-time jobs) than their traditional student classmates, the flexibility offered by the Web appears to be a great benefit. Grill (1999) described the typical American distance learner as one who is 25 – 50 years of age, taking courses to learn new

subjects and skills or to update old ones, and experienced in participating in education.

Hudson (2000) surveyed adult students, all over the age of 25, about the benefits of web-based courses and heard five major benefits articulated. They are:

1. The ease of communicating online makes it possible for students to feel as close or closer to online classmates than they ever felt to classmates in traditional classes.
2. Web-based courses give students opportunities to search the Web and master computer skills that are essential in today's world.
3. The Web enables students to reach other students and their instructors at times other than normal classroom hours making it easier for students to share information and offer support.
4. The flexibility of Web-based courses allows adult learners to balance their educational pursuits with their job and family responsibilities, thus allowing people with limited time the opportunity to further their education.
5. Web-based courses allow students to develop self-sufficiency and engage in independent thinking.

As mentioned previously, Technology Tools for Science Teachers is designed as a post-baccalaureate course for inservice teachers and is required for all lateral entry teachers seeking a science teaching certificate from NC State. The requirements of the course dictate that these students are nontraditional, have time constraints, and for the most part are similar to the profile of the American distance learner as described by Grill.

Some researchers have employed qualitative methods to study the dynamics of distance education. In a study to identify qualitative factors that affect learning in a web-based university course, Sujo de Montes and Gonzales (2000) used a variety of methods to collect data. These methods included an open-ended questionnaire given to participating students at the middle and end of the semester, electronic journals kept by the participating students, and in-depth interviews with four of the participants at the end of the semester.

In a study of web-based undergraduate and graduate courses in special education, Stenhoff, et al (2001) used an online survey to investigate student impressions of student-teacher and student-technology interactions. The web-based classes used an Internet-delivered interactive teleconferencing system to provide means for synchronous audio and video communication among students and teachers. Survey results indicated that the instructors with the most experience with distance learning received higher ratings on all of the student survey questions regarding student-teacher interactions than their less experienced colleagues. Students of the more experienced teachers also accessed the website more often and generally felt that the technology was more useful than did students of the less experienced teachers. Stenhoff et al proposed that the level of experience teachers have with distance education impacts their students' experiences and perceptions of the class and the perceived effectiveness of the distance learning methods.

Gifford (1998) conducted a study to determine the perceptions of graduate students regarding the time they spent in taking a course via the Internet. The graduate students completed a course in research on curriculum and instruction solely on the web and through email. They were responsible for both individual and group assignments

which were completed through the web site and/or email. Results from a survey after the completion of the course indicated that the majority of students felt that more time was required for the web-based class than if the course had been offered in the traditional classroom. Gifford did not address whether this perception was related to the content in the class or use of the technology. Survey results also indicated that the students felt that self-discipline and self-motivation were necessary qualities of students if they were to be successful in a web-based class. Gifford suggested that course content needs to be evaluated thoroughly before establishing distance education classes.

Harmon and Jones (2000) conducted a qualitative analysis on an intensive graduate level course in Web-based instruction that was also delivered via the Web. Harmon and Jones collected data through interviews, chat logs, and bulletin board interactions and discovered themes of the data as it relates to web-based instruction. Harmon and Jones found that students preferred asynchronous interactions over synchronous interaction, but that weekly chat sessions were critical in developing the participants a sense of community. Harmon and Jones also discovered that the amount of time the class required was a huge obstacle for many students. Students that fell behind in the material of the class quickly became disengaged and would not participate in the class.

Technology Tools for Science Teachers

A recent course offering through NC State University's Science Education department is Technology Tools for Science Teaching (Tech Tools) – a web-based graduate level course designed to teach inservice science teachers how to use

instructional technology in the classroom. Tech Tools utilizes an extensive website which serves as the main method of delivering instruction. In addition to the website, students are provided access to a dedicated listserv, access to the instructors and the rest of the class through instant messaging (IM) and email, virtual office hours to converse with the instructors through IM, and monthly face-to-face class sessions for personal interaction with the instructors and other students.

The technology tools the students learn to use include instant messaging, the listserv, digital cameras, website design software, microcomputer-based lab equipment, calculator-based lab equipment, and data analysis software. To optimize the learning opportunities in the course, the instructors provided each student with a laptop computer and all of the equipment necessary to complete the course. The course syllabus is located on the course website and directs the students to the web-based instructional units and the assignments. Each unit includes pre- and post-tests to measure the students' knowledge gains. Students submit assignments by uploading them onto a private server, sending them to the instructors as email attachments, posting to the listserv, or presenting during a face-to-face session.

As a distance education course, Tech Tools offers a different environment for participants than if the course was offered through traditional means. However, efforts have been made to promote the class as a community of learners by providing Listserv and IM capability and offering face-to-face class sessions. Questions linger about the dynamics of web-based courses such as Tech Tools and what kind of impact does new technology have on the web-based education environment. This article describes a

qualitative research project conducted in the spring of 2002 designed to explore the culture and dynamics of the Technology Tools for Science Teachers course.

Methodology

Participants

The participants in this study were selected from the 17 students enrolled in Technology Tools for Science Teachers (Tech Tools) for the spring semester of 2002. All of the students in the class were inservice science teachers and 16 of the 17 students were “lateral entry” teachers, a program in North Carolina that allows people with undergraduate degrees in a content area to receive temporary licensure for public school teaching until they are able to complete all the requirements for initial licensure from an institution of higher education. At NC State University, the science education lateral entry students are required to take the Tech Tools course as part of their program requirement.

Data Collection

Extensive qualitative data was collected throughout the duration of the Tech Tools course. Each IM session and email exchange with the instructors was saved, as well as all posts to the Tech Tools listserv. In addition, the researcher selected ten students for IM interviews during the last three weeks of the course. The students were selected to represent a cross section of personality types based on their scores from the Sixteen Personality Factor Questionnaire, the Simmons Emotional Intelligence Survey, and the Rosenberg Self-Esteem Inventory. The researcher attempted to select students

with opposing scores on certain personality types (i.e. Extraversion vs. Introversion, High vs. Low Self-Esteem, Traditional vs. Openness to Change, etc.). The IM interviews were conducted as open-ended interviews, with additional questions arising from the students' responses to other questions. Typical questions included "What was your overall experience in the Tech Tools course?" and "If given the chance, would you take another course with a format similar to Tech Tools?" The interview data, the emails and IMs with the instructors, and the listserv posts of these ten students were analyzed extensively using classic qualitative analysis techniques to determine possible patterns in their electronic communications.

Results

Analysis of the qualitative data yielded interesting themes that, upon inspection, provide insights into the dynamics and culture of the Tech Tools course. The findings are described below.

Motivations for Taking the Tech Tools Course

Lateral entry teachers are required to complete all requirements of the program within five years. Each year the teachers have to successfully complete six semester hours of coursework in their program. In addition, they also must pass the Praxis teaching exam within the first two years. They are teaching full-time throughout this process.

Although the Spring 2002 Tech Tools course is a required course for lateral entry teachers, there is no requirement as to when these teachers actually take the class. The reasons cited by the students are as varied as the students themselves. It is clear, however, that the intense requirements for lateral entry teachers limited the choices of the

teachers. George, a six-year teaching veteran who will have five courses left to take after Tech Tools, stated that his reasons for taking the course so early in the licensure process were because “it’s required and I’m just knocking them off as I get them”. One of the reasons George seems so matter-of-fact might be his natural low anxiety level as measured by the 16 PF (Anxiety = 3.0). His 16PF Interpretive Report describes George as possessing a “characteristic, imperturbable style” and that he “typically feels sure about himself”. Another factor that may have contributed to his description of the timing of the course is his six years of teaching experience. The effect of teaching experience and the amount of stress these lateral teachers are under is a recurrent theme in the study.

Martha and Raquel are both first year teachers in the lateral entry program and were enrolled in two classes during the Spring of 2002. Their natural anxiety levels as measured by the 16PF fall within the average range for most people but their descriptions of why they were taking Tech Tools so early in the licensure process seem filled with anxiety. Martha took the course in Spring 2002 because

I was told to! Like you said it is early in the process and well, I am relatively clueless. It was suggested that I take it because it was one of the last classes still open. I found out that I needed to take more hours before June. I didn’t know it until right before Christmas so I was scurrying to find anything. I am one of a few new teachers though. We are all overwhelmed to say the least. Why did I leave my other job?!

Raquel describes similar circumstances surrounding her choice:

I have to take six credit hours per year. I didn’t get hired until a week before school started in August and there is no way I could have taken a course first semester. I was already planning on taking a class in the spring but then found out that I had to have the credits by June 30th or I would be paid as a substitute teacher next year. I knew I couldn’t take a class first session summer school because our school doesn’t get out until June 4th and first session is practically over. I got in touch with my advisor and he said to take this course.

It appears from the statements above that the requirements of the lateral entry program force some students to make decisions about courses (when, how many) that they would normally not make. This seems to impact first year teachers more adversely than their veteran colleagues.

Impression of Workload and Years of Teaching Experience

An analysis of student responses regarding the required workload of the Tech Tools course shows a definite relationship between years of teaching experience and perceived rigor of the course. More specifically, the students who complained that the workload in Tech Tools was excessive were all in their first year of teaching. The students who had multiple years of teaching experience generally felt that the work requirements of Tech Tools were appropriate. Anyone who has worked as a teacher knows firsthand how demanding the rookie year is. First-time lesson planners, graders, and disciplinarians spend inordinate amounts of time at school and at home doing the work of a teacher. It seems that this amount of work impacted the rookie teachers in Tech Tools. Maralee, a first year teacher, describes the Tech Tools workload as

a lot more work than any other graduate course I ever took. And maybe the actual work didn't take as long, but it was the "figuring out what you were doing" and the technology struggles that take so much time. Also the variety of school conflicts that often interfere with the fairly rigorous timeline of due dates...I mean I know that you can't expect to take a grad class and not have any work, but when you have a class full of hard-working NEW teachers that are already running on empty all of the time, the course load is a little too demanding.

Raquel, another first year teacher, agrees:

I like the class. The instructors are really nice and helpful but I think it's a little demanding. I don't know in comparison to other grad-level classes because this is my first one. I just know that I work around 60 hours a week and spending 15 hours a week on assignments is tough...I would definitely have enjoyed the class more if I wasn't so new to teaching and constantly struggling all of the time to be prepared.

The veteran teachers had an entirely different view of the Tech Tools workload.

Matthew, a second-year lateral entry teacher said that he “thought it (the workload) was manageable...Early on I thought the load was light.” Susan, a third-year teacher, believes

The class has had several assignments to do but I feel the load has been appropriate. If it was not for the assignments I would not be learning as much...I feel the assignments have been fair and taught to me in an orderly way.

These distinctly different responses between first-year and multi-year teachers are consistent with all of the other students who expressed opinions about the workload of the Tech Tools course. It is clear from the data that the amount of teaching experience of the students certainly effected the students' perceptions on how much work they had to complete in the Tech Tools course.

The Imagine Server

Scottish poet Robert Burns writes that “the best-laid schemes o' mice an' men gang aft agley”. Indeed, no matter how hard or well plans are made, those plans can often fail to become reality. This certainly is the case with the planned use of the Imagine server in the Tech Tools course. The developers of Tech Tools planned for the students to turn in assignments by uploading them to a separate server. The server,

named Imagine, belongs to Dr. Johnson and was to replace the multitude of free servers that students used in prior Tech Tools classes. The use of multiple free servers created technical support issues that the instructors felt ill equipped to handle. They believed that having the students upload to a single location would eliminate these problems.

However, the students and instructors began encountering serious technical difficulties with the server at the outset of the Tech Tools course as it crashed continually during the demonstration of its use during the first class session. The next day, Maralee sent an email to Dr. Washington informing her that there were more problems. “I tried from home to get onto the Imagine Server and it locked up again. I know you were going to talk to someone on Monday but I just thought you would like to know that maybe it wasn’t all of us trying to get on at once.” For the next eight weeks, the instructors and NC State’s technical support staff attempted to repair the server. On numerous occasions the instructors posted messages to the listserv informing the students that Imagine had been repaired and that they should begin using it. Each time students would respond like Melissa:

There was an email sent out saying that we should be able to get onto Imagine now. Well, I tried to do so on Thursday and I still couldn’t get on. My computer kept freezing when it went to connect. I believe that one of our assignments this week needs to be sent to Imagine so I am wondering what I need to do.

Like most other students, Melissa asked these questions via an email to one of the instructors. Some students also communicated these questions to the instructors via IM. One student, Cathy, made a post to the listserv. The instructors usually responded directly to the student making the inquiry via email or IM. The instructors used the listserv to

post all updates on the status of Imagine. Finally, with only five weeks left in the semester, Dr. Washington tells the students:

The Imagine server needs to be completely rebuilt, so you will not be uploading any files to imagine for the rest of the semester. All the remainder of the assignments will be turned in by email attachment, class listserv, or on disk the last day of class.

The Imagine server was to play a significant role in the Tech Tools course, and since this role involved the turning in of assignments and the awarding of grades on these assignments, students and instructors were extremely interested in maintaining updated information about Imagine's status. Because of these circumstances, students and instructors communicated often about Imagine. In fact, more than 1 out of every 10 of the electronic messages analyzed contains some reference to the Imagine server.

The topic of Imagine also dominated discussion about technical problems of Tech Tools. Incredibly, discussions of Imagine made up nearly three-fourths (73.6%) of all communications that referenced technical difficulties in the Tech Tools course. It is safe to say that students and instructors spent a large amount of time discussing the Imagine server, and that they rarely discussed technical problems if they were not related to Imagine.

As discussed before, several students indicated that the Tech Tools course created high amounts of stress for them. Interestingly, during the interviews, none of those students mentioned that problems with Imagine were a specific source of this stress. However, these students' communications to the instructors show that Imagine complicated their already busy schedules. Maralee reported to an instructor that she worked with it "for 2 hours Sunday night thinking it was just taking a long time but

finally gave up.” Raquel seems concerned about how the Imagine problems would affect her grade: “Please let me know what to do. I can’t afford to lose any points right now”.

Other students did identify Imagine as a weakness in the course. Craig stated that “The Imagine server has affected me because I had loaded some of my web page work on to it and had to struggle to get it off”. Cathy mentioned that her web pages “may never see the light of day because the Imagine server never did work”. She also said “the Imagine thing did turn out to be a nightmare”.

Students enrolled in any course that is as technically-based as Technology Tools for Science Teachers are bound to encounter difficulties with hardware and/or software. In the case of the Imagine server problems within the Tech Tools course, students and instructors showed flexibility that was critical for the successful completion of the course. One should not assume, however, that this process was painless for the students or the instructors.

Limitations of Electronic Communications

Another potential difficulty with a distance learning course such as Tech Tools is the limitations related to electronic communications. Spelling and punctuation errors, the absence of nonverbal cues (body language, voice inflection, etc.), technical difficulties, and the nature of asynchronous communication work together to create a fertile environment for communication problems that are not present with personal interaction. The qualitative data contains several examples of this.

In a traditional classroom setting, students are likely to have regular opportunities to interact and ask questions of the instructor either during office hours or before/after

class. It is safe to assume that the instructor will respond to the student inquiry in some way, either by answering a question or referring the student to another source. The developers of the Tech Tools course attempt to replicate this by providing monthly face-to-face sessions and supplementing them with several methods of electronic communication. All of this does not guarantee that students' questions are answered and the students may not even receive a response. Melissa describes a question she had involving one of the assignments and the problems she encountered when trying to get it answered:

I sent an email to Dr. Johnson which was never answered, then I emailed Dr. Washington and she told me to email Dr. Johnson or the guy that works with the equipment. I emailed him and he told me that I should email Dr. Johnson so I emailed him again. Finally he replied but never answered my question. Also I emailed him a question about our web pages that was never answered.

It is possible that Melissa would have received similar treatment in a traditional class, but it seems more likely that she would have clarified her question and received a response more satisfactory to her had she been able to interact personally with the instructors at the time she had the question. Other students also mentioned they encountered difficulty in accessing help when they needed it. Martha criticized the idea of having only web-based forms of communication between monthly meetings:

Dr. Johnson and Dr. Washington encouraged contact with them and other students, but a great example was Monday night when none of the assignments were working and Raquel and I were the first to do them. No one was online or home and we wasted hours trying to figure it out and contact someone.

Technical difficulties also limit the effectiveness of electronic communication as the primary mode of communication between instructors and students. During virtual office hours, the instructors would often have to conduct IM sessions with several (as

many as seven) students simultaneously. This created delays between the students' questions and the instructors' responses. In one case, Cathy wrote that she had a question and then signed off ten minutes after receiving no response from Dr. Washington. When she was asked about this, Cathy responded, "I think I answered it. I'll try and remember what it was for Saturday though". Cathy also encountered a problem with some school hardware and had no idea whether or not her assignment was affected. She wrote the next day: "We were told today that our server was acting up a bit yesterday, so the mail I sent yesterday may not have arrived. Although the computer told me it was sent, I'm beginning to wonder". In both instances, it seems that these problems are unique to electronic communications and would have been avoided had the students interacted with the instructors in-person through office hours and turning in assignments.

Another issue relating to the limitations of electronic communications is the asynchronous nature of most of the methods employed. Although there are advantages to asynchronous communication (Hammond, 2000; Miller and Corley, 2001; Ligorio, 2001), there are several examples in Tech Tools that indicate it is not an efficient way to communicate under certain circumstances. For instance, when George had a question about an assignment, he sent Dr. Johnson this email:

I have a question about question #9 in the unit 4 post test. I could not find where 'relative link' is not the correct answer for that question. Per the required reading, I found nothing that directly or indirectly corresponds to "anchor" as the correct answer. Could you please show me?

Dr. Johnson forwarded the message to Dr. Washington, who sent a response to George explaining that the post test software randomly assigns numbers to questions each time someone accesses it. Therefore he would need to provide the wording of the

specific question. An exchange of several emails followed, with George unable to provide the information Dr. Washington needed to answer his question. Four days and several emails later, Dr. Washington was able to answer George's question.

Once again, it appears that the impersonal and asynchronous nature of email contributed to the confusion around George's question, Dr. Washington's response, and the time elapsed between the question and the answer.

The Hypercritical Critique

A good example of how the absence of nonverbal cues can create problems in electronic communication is an exchange of emails and listserv posts revolving around an overzealous and hypercritical critique by one student of another student's work. Students were required to send a message to the class listserv describing how they would use a certain type of technology in their classroom. After the message was posted, other students were required to post comments regarding the description. Craig's critique of another student's post was much more negatively critical than any of the other critiques. In his critique, Craig states that the student had not adequately completed the assignment and that the essay was so brief that it limited the student's "chance of including all of the necessary information".

Dr. Washington responded by sending Craig an email stating that she thought his critique was "rude". Craig replied that his critique "was not intended to be as critical as it turned out to be" and offered to apologize to the student and to the class in general. In response, Dr. Washington wrote: "I do understand. Sometimes when we write something

in email, it may convey a different meaning to people other than ourselves who are reading it”.

This certainly seems to explain the miscommunication for which Craig is responsible. In his interview, Craig states that “the problem with non-direct forms of human contact is that it is easy for miscommunication to occur”. He continues by saying that “caution and review are certainly two important processes” to include when communicating by electronic means. According to Craig and Dr. Washington, this kind of miscommunication is inherent to electronic communication. The unspoken assumption is that the “hypercritical critique” would have been less likely to occur had it been a verbal, face-to-face activity.

Pattern of Using the Listserv

As mentioned before, the developers of Technology Tools for Science Teachers created several different ways that students could communicate to the instructors and to each other. The Tech Tools listserv was created to give students an opportunity to post questions, comments, and an occasional assignment for the rest of the class to view and respond if necessary. A review of the listserv posts during the course of the semester indicates that the students only began using the listserv as a resource as a last resort during the end of the semester.

Despite repeated reminders from the instructors about the advantages of using the Listserv, the primary users for the majority of the semester were the instructors. They would post to the listserv to update the students on the status of the Imagine server and for course details such as reminders of assignment due dates and expectations for

upcoming face-to-face sessions. They would also copy the listserv whenever they answered questions from students that were posed as direct emails and were pertinent to the class. At the beginning of the semester, the students primarily used the listserv to post assignments when they were required to do so. In fact, during the first six weeks of Tech Tools, only two students posted anything to the listserv other than assignments. Maralee asked the group for advice on how to explain a certain chemistry topic, while Cathy asked a question about the Imagine server. Students never responded to either of these inquiries and the instructors eventually answered both questions.

Over the next four weeks, student use of the listserv remained minimal. Craig⁷ posted his hypercritical critique and his subsequent apology and Maralee asked her classmates about a permission form she was no longer able to access from the web site. Dr. Washington attached the forms in a response to the listserv. On two separate occasions, George posted questions requesting information from his classmates about other possible classes he could take. No one posted a response to either request, although it is possible that someone sent information to George directly. Regardless, the listserv remained an underutilized communication tool through the first ten weeks of class. Cathy acknowledged as much in her interview:

We did our assignments and posted them to the listserv as we were told. We responded to others' postings when we were told...I suppose they thought the listserv would be more of a communication tool than it really was.

Listserv use changed dramatically during the last two weeks of the semester. Several factors worked together to prompt the students to utilize the listserv as a forum for communicating with their classmates. First, Dr. Washington, the primary instructor for Tech Tools, went on Maternity Leave for the last four weeks of class. In addition, Dr.

Johnson contracted strept- throat and was unavailable for nearly two weeks. During this time, students were responsible for collecting data through calculator-based lab equipment and downloading it onto their computer for data analysis. Most students encountered problems with the data transfer. Morgen initiated the discussion by posting the following: “Is anyone else having trouble with the transfer of data from the TI-83 to the computer? My calculator either says error or done. When it says done, I can’t find the data in the computer program”. Several students responded by concurring that they encountered similar problems. One student reported that she completed the assignment by entering the data by hand. Although there was an easier, automated method for transferring the data, this suggestion was a turning point for how students viewed and used the listserv. According to Dr. Johnson: “It all changed when I got sick and stopped answering their email. They finally realized that they could use the listserv and rely on each other for their questions.”

From that point, students began posting regular messages to the listserv. Most were questions about specific assignments, although there were a few regarding technical equipment. In most cases, either Dr. Johnson or Dr. Washington (despite her Maternity Leave) would answer the question before anyone else responded. It certainly appears, however, that the students would have responded with solutions of their own if given time.

Conclusions

The following is a summary of the themes found in the semester-long qualitative analysis of the Tech Tools course.

Lack of Teaching Experience Causes Stress for Lateral Entry Teachers

The amount of teaching experience possessed by students enrolled in Tech Tools played a significant role in the students' experiences in the course. The requirement that lateral entry teachers must earn six semester hours of coursework per year places a heavy burden on new teachers who are learning to develop lesson plans, grade papers, and manage a classroom full of students for the very first time. Because NC State University's summer session schedule conflicts with most school systems' schedules, lateral entry teachers have few options for when to take required courses. This is especially problematic for first year teachers, many of whom choose not to take a course during their first ever semester of teaching. This was the case with several of the teachers in Tech Tools with several rookie teachers taking another course in addition to Tech Tools during the spring semester of 2002.

This scenario created a level of stress among the rookie teachers that was not present with the teachers with more than one year experience. This stress was apparent when the teachers described what motivated them to take the course, how much stress Tech Tools itself caused, and their impressions of the appropriateness of the workload in Tech Tools. Future iterations of Tech Tools should consider teaching experience as a prerequisite for the course. This may also be true for other rigorous courses that lateral entry teachers are required to complete.

Technology Designed to Help May Actually Hinder

As a web-based course, Technology Tools for Science Teachers relies on electronic forms of communication as the primary mode of communication between students and instructors. Although electronic communication is convenient for distance learning, the results of this study indicate that relying on electronic communication as the primary form of communication caused some problems with the students in Tech Tools. Questions via email that are misinterpreted may take several days for clarification, whereas a personal interaction should yield an answer more quickly. Miscommunication is also possible as was seen with Craig's hypercritical critique. It appears that it is more difficult to relay intent via electronic communication and in some cases students may be more confrontational via electronic communication than through personal interaction.

The technical aspects of Tech Tools also create an environment that is susceptible to logistical failures. The problems with the Imagine server are an excellent example. Students and instructors spent significant time attempting to address the problems associated with a crashing server. This created additional stress to students who are already under a great deal of stress already. Fortunately, the instructors were able to provide alternatives to the students so there was no loss of instructional time. However, a main component of the course was non-functional. Servers crash, computers get knocked off-line, and pieces of equipment may not function properly. All of these are realities in a course such as Tech Tools and should be considered inherent to the course. Therefore any course design should address these issues specifically by providing alternatives that can be accessed seamlessly when problems arise.

Passively Promoting New Technologies May Not Work

One of the more interesting results of the study was the ineffectiveness of the listserv as a communication tool for students early in the Tech Tools course. The results indicate that the students only used the listserv as required until the instructors became unavailable to answer questions during a critical time in the course. From this one can conclude that listserv use must be encouraged, probably by forcing the students to rely on each other more often to answer questions. Had the instructors been less accessible or responsive early in the semester, the listserv may have been more often utilized by the students. Listservs have the potential to create a forum for group discussion which is one of the criticisms students have of web-based classes. However, for Listservs to become effective tools of communication, instructors must promote their use by requiring students to rely on each other through this medium.

Suggestions for Further Research

This study has hopefully assisted the field of science education by providing insights into the dynamics of the web-based course Technology Tools for Science Teachers. As an emerging field, more research should certainly be conducted on this form of distance education. One area of interest generated by this study includes further study into communication styles within the context of web-based courses and possible methods for improving communication within these types of courses. Comparing communication between students in web-based courses versus traditional classes is also an area for exploration.

It appears from this study that some of the technology that was designed to make the students' lives easier actually created more logistical problems for them. Exploring how certain technologies impact the students' experience in web-based courses would make a significant contribution to the field.

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Appendix A

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Appendix B

Correlation Matrix for All Instruments

	16 PF Primary Factors									
	A	B	C	E	F	G	H	I	L	M
A	1.00									
B	0.39	1.00								
C	-0.01	-0.19	1.00							
E	0.14	-0.10	-0.52	1.00						
F	0.45	0.16	-0.10	0.15	1.00					
G	-0.37	-0.25	-0.03	0.00	-0.43	1.00				
H	0.40	-0.04	-0.03	0.46	0.46	-0.08	1.00			
I	0.47	0.34	-0.04	0.23	0.33	-0.50	0.21	1.00		
L	0.02	-0.12	-0.36	0.20	0.25	0.17	0.26	0.06	1.00	
M	0.22	0.19	-0.07	0.53	0.15	-0.42	0.24	0.15	0.07	1.00
N	-0.47	-0.07	0.35	-0.34	-0.28	0.44	-0.47	-0.11	0.14	-0.25
O	0.24	0.22	-0.77	0.29	0.23	-0.22	-0.02	0.29	0.47	0.03
Q1	0.36	0.34	0.27	0.22	0.39	-0.45	0.21	0.56	-0.23	0.50
Q2	-0.71	-0.23	-0.05	-0.10	-0.63	0.33	-0.43	-0.21	-0.12	-0.27
Q3	-0.46	-0.07	-0.65	0.32	-0.21	0.53	-0.05	-0.32	0.17	-0.28
Q4	0.31	0.10	-0.72	0.39	0.26	0.05	0.04	0.30	0.23	-0.14
Energy	0.45	-0.14	0.13	0.19	-0.01	0.21	0.11	-0.27	-0.27	0.01
Stress	0.06	-0.41	-0.18	0.58	0.01	-0.09	0.35	0.35	0.39	0.40
Optimism	-0.14	-0.19	0.51	-0.47	0.18	-0.13	-0.25	-0.36	-0.04	-0.03
Self-Esteem	0.14	0.18	-0.28	0.12	0.25	-0.54	0.38	0.49	0.21	0.28
Work	-0.39	-0.20	0.13	-0.11	0.00	0.18	-0.35	-0.53	-0.16	-0.14
Detail	-0.39	-0.21	-0.13	0.07	0.10	0.03	-0.14	-0.37	-0.24	-0.16
Change	-0.11	0.17	0.14	-0.59	-0.27	0.12	-0.25	-0.17	0.06	-0.12
Courage	0.19	-0.13	-0.20	0.41	0.00	0.55	0.15	-0.03	-0.02	-0.18
Direction	0.11	-0.29	-0.19	0.35	0.13	0.24	0.02	-0.28	0.03	-0.06
Assertive	0.11	-0.03	-0.38	0.54	-0.06	0.57	0.25	-0.04	0.07	-0.09
Tolerance	-0.20	0.02	0.52	-0.58	0.20	-0.43	-0.15	0.00	-0.03	0.03
Considerate	-0.26	-0.03	0.40	-0.51	0.33	-0.47	-0.13	-0.01	0.00	0.00
Sociable	0.03	0.02	-0.33	0.11	0.41	-0.63	0.32	0.36	0.26	0.09
RSE	-0.23	-0.09	0.43	-0.09	0.00	-0.01	0.21	0.14	0.07	0.02

A = Warmth
 E = Dominance
 H = Social Boldness
 M = Abstractedness
 Q1 = Openness to Change
 Q4 = Tension

B = Reasoning
 F = Liveliness
 I = Sensitivity
 N = Privateness
 Q2 = Self-Reliance

C = Emotional Stability
 G = Rule-Consciousness
 L = Vigilance
 O = Apprehension
 Q3 = Perfectionism

Appendix C

Entrance Survey

EMS 594 I: Technology Tools for Science Teachers

Name _____

Answer the following questions by circling the appropriate response.

Please determine your skill level in the following areas:

1. Using e-mail

1 2 3 4 5 6
Expert -----Novice

2. Using a Listserv

1 2 3 4 5 6
Expert -----Novice

3. Using Instant Messaging

1 2 3 4 5 6
Expert -----Novice

4. Navigating the Web

1 2 3 4 5 6
Expert -----Novice

5. Using a digital camera

1 2 3 4 5 6
Expert -----Novice

6. Using a scanner

1 2 3 4 5 6

Expert -----Novice

7. Using image manipulation software

1 2 3 4 5 6

Expert -----Novice

8. Creating web pages

1 2 3 4 5 6

Expert -----Novice

9. Using calculator-based laboratories

1 2 3 4 5 6

Expert -----Novice

10. Using microcomputer-based laboratories

1 2 3 4 5 6

Expert -----Novice

11. Creating a digital video

1 2 3 4 5 6

Expert -----Novice

12. Creating panoramas and object movies

1 2 3 4 5 6

Expert -----Novice

13. Have you taken a distance learning course previously? If yes, describe your overall impression.

14. Discuss your expectations for this course and any concerns you may have about taking a distance learning course.

15. What is your professional background?

16. Where are you in the teaching licensure process?

17. Why are you taking this course at this time?

Instructions: Below is a list of statements dealing with your general feelings about yourself. If you agree with the statement, circle **A**. If you strongly agree, circle **SA**. If you disagree, circle **D**. If you strongly disagree, circle **SD**.

	1 Strongly Agree	2 Agree	3 Disagree	4 Strongly Disagree
1. On the whole, I am satisfied with myself.	SA	A	D	SD
2. At times I think I am no good at all.	SA	A	D	SD
3. I feel that I have a number of good qualities.	SA	A	D	SD
4. I am able to do things as as most other people.	SA	A	D	SD
5. I feel that I do not have much to be proud of.	SA	A	D	SD
6. I certainly feel useless at times.	SA	A	D	SD
7. I feel that I'm a person of worth, at least on an equal plane with others.	SA	A	D	SD
8. I wish I could have more respect for myself.	SA	A	D	SD
9. All in all, I am inclined to feel that I am a failure.	SA	A	D	SD
10. I take a positive attitude toward myself.	SA	A	D	SD