COMPONENTS ASSOCIATED WITH PERCEIVED STUDENT SATISFACTION IN A TECHNOLOGY ENHANCED SECONDARY ASTRONOMY COURSE

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Submitted to the Graduate Faculty of

School of Education in partial fulfillment

of the requirements for the degree of

Doctor of Education

University of Pittsburgh

2006

UNIVERSITY OF PITTSBURGH

SCHOOL OF EDUCATION

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A technology-enhanced course has many components that contribute to student satisfaction. Although technology plays a role in the delivery of instruction, the focus of this study was to identify student satisfaction with several Components: modes of discussion, modes of research, types of learning activities, modes of submitting assignments, modes of testing, and format of course materials. Additionally, the study described relationships between the learning styles and self-reported measures of student satisfaction for the 19 students in the study.

Results from this study indicated that participants were more satisfied with chat room discussions, web-based research, web-based testing, and online availability of course materials and grades than with techniques used in traditional classrooms. Based upon these results, a teacher who is concerned about student satisfaction in technology-enhanced courses should be aware that these teaching techniques were more satisfying to students in a technology-enhanced astronomy course.

It would be useful to do more study of the characteristics of technology-enhanced courses that affect student satisfaction and related outcomes.

PREFACE

To thank all of the people who have helped, supported and otherwise made this dissertation and degree possible would require more than this single page. First and foremost I must thank my family and friends, their support was and is, a key to my continued success. I would also like to extend special thanks to my children Daniel and Abigale for understanding that Dad could not be home many nights for the last few years. These were times that were lost but were not lost in vain.

Others whom have assisted in reading, editing and supporting my efforts include: Tracey Madeley, Al Johnson, Ben Brotz, Judy and Dave Brotz, and Al Reynolds.

My committee members, Dr.'s Nous, Eichelberger, Atman, and Davis, thank you for your patience, understanding and assistance.

Lastly, Dr. John Mellekey, the person who is responsible for me becoming a teacher, thank-you. You believed in me, which allowed me to believe in me. I wish you were still here to share this special time in my life.

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1.0 CHAPTER 1 : INTRODUCTION TO THE PROBLEM

1.1 Introduction

The concept of distance education is not a new instructional concept. Take a teacher and a student separated by a large distance and continue the interaction called learning and you have the situation called "distance learning." In the last two centuries, distance learning has progressed and evolved along with the technology available. Educators in the 1800's used the postal system to correspond with students by mail. By the late 1800's, several universities offered courses via postal mail correspondence. Because correspondence courses relied on mail delivery, it was slow and interaction between teachers and students was limited and difficult, if not impossible, to achieve (Ahern & Repman, 1994; Sherry, 1996). This was, and remains, a problematic element of paper-based correspondence courses.

The advancing technology of the early 1900's brought radio into the educator's repertoire of instructional delivery methods. With the advent and popularity of television in the mid to late 1900's, various television frequencies were dedicated to instructional purposes. The invention of the personal computer and the internet have resulted in on-line distance learning becoming one of the latest instructional methods (Hansen, 2001). With the advances in the development of computer technology, on-line based learning methods now are able to approach the levels of interaction possible in a face-to-face format (Murray, 1985). As a result, many distance learning programs have changed from pencil and paper-based correspondence courses to real-time web-based classes (Galusha, 1997). The technological options for educators fall into four major

categories: voice, video, data and print. Computer technology, the advent of the graphical user interface, and the internet have given educators the tools to combine voice, video, data and print into an unprecedented, powerful instructional tool: technology enhanced education.

Rapid technological changes, shifting market conditions, and the Internet have prompted academic institutions at all levels to increase use of technology to deliver courses and adapt instructional delivery methods and educational opportunities to accommodate diverse populations of students without significant changes in budget allocations (Willis, 2002). The U.S. Department of Education statistics related to distance education report that 97 percent of public two-year institutions and 75 percent of public four-year institutions have developed distance education courses (Zhang, 2002). Additionally, an increasing number of students expect a technology component in their college coursework (Christensen, Anakwe & Kessler, 2001). As shown in a study by Sanders and Morrison-Shetlar (2001), students realize the relationship between computer literacy and success in an information-based society. This relationship between computer literacy and success is recognized in both business and education. Teachers and students have resources available from a vast array of databases, electronic billboards, and journals. Many present day students have resources such as personal computers, high bandwidth internet connections, and access to electronic databases, which a few years ago were only available on-campus (Ahern & Repman, 1994).

Although results vary, instruction using the Internet or other forms of electronic or distance learning often results in equivalent achievement when compared to traditional instruction (Hansen, 2001). This outcome is supported by studies by Christensen, et al., (2001) and Ahern and Repman, (1994) and in a meta-analysis by Machtmes and Asher, (2000), which found little difference in student achievement scores when comparing distance and traditional

learning methodologies. The demand for greater accessibility to education and the integration of technology into instruction have pushed educators and their educational institutions to offer alternatives such as distance learning (via various techniques) and greater utilization of information technology in courses (Kezar, 1999; Zhang, 2002). These courses have increasingly emphasized interdisciplinary teaching and learning, and provided individualized, interactive experiences and multi-sensory, active learning (Jones & Paducci, 1999). This approach to teaching can make learning more accessible to a larger and more diverse student body and can increase student satisfaction and motivation to learn for many students (Kezar, 1999). Consequently, educational institutions from the elementary through the university level have been re-evaluating and restructuring the way instruction is delivered to students. Under these new conditions, distance learning is becoming a mainstream instructional option in some schools (Roblyer, 1999; Ross & Schultz, 1999). Courses developed using web-enhanced methodologies have the potential to allow students to gain access to grades, assignments, and course materials without regard to time or location. Additionally, communication and other interaction with the instructor or other students can take place in a manner comparable to traditional instruction.

Student motivation appears to be even more essential for online learning than in the traditional classroom, however. Because of some aspects of online or web based courses, students may benefit if they understand their learning style and their preferential mode of communication before enrolling in this type of course (Ahern & Repman, 1994; Moan & Dereshiwsky, 2002; Wallin, 2001). Students may have very different perspectives and opinions regarding distance learning instructional methodologies, and these varying views may cause the instructor or educational institution to consider the types of courses that will maximize student learning. Another option for online learning success is for schools to provide courses with

different formats directed at the different types of students (Allen, Bourhis, Burrell & Marby, 2002; Carr, 2000).

Aside from the evidence concerning completion rates and course satisfaction, the learning style of the students could be an important issue when considering distance learning and web-enhanced instruction. The relevance of learning style and course satisfaction are supported in the research of Allen, Bourhis, Burrell and Marby, (2002); Carr, Fullerton, Severino and McHugh, (1996); Grasha and Yangarber-Hicks, (2000); and Ross and Schultz, (1999), but other studies, such as Terrell and Dringus (2000), have not found learning style related to success in on-line courses. The learning style(s) that promote success in a distance or web enhanced course may be significantly different than those related to success in a traditional course, and students' preferred learning styles may be related to their performance (Dillie & Mezack, 1991). Examining Components in a course that students perceive contribute to student satisfaction or dissatisfaction such as: modes of discussion, modes of research, types of learning activities, modes of submitting assignments, modes of testing, and format of course would be beneficial within the aspects of course design, course modification, and minimizing student frustration (Carr, 2000). This information should be valuable as a tool for course developers and instructors.

Evidence shows that course completion rates and program retention rates are lower for distance learning courses than for traditionally taught courses (Carr, 2000; Roblyer, 1999; Sherry, 1996). The increased dropout and decreased retention rates have caused some concern with regard to retention in distance education (Cookson, 1990). Distance learning students in higher education are often adults with full time jobs and family responsibilities. These responsibilities, with the added obligations of study, can cause adult distance learners to

experience difficulties or cessation of their studies (Lim, 2001). Often schools and instructors assume that adult learners have the prerequisite computer skills required for distance learning courses and preparation for learners lacking these skills is often overlooked (Lim, 2001). Some research supports that distance learning requires more self-motivation, self-direction and self-discipline than traditional learning, which seems to suit adult learners more than children (Moore, 1987). Research by Lim (2001) identified several factors related to satisfaction for distance learners. Lim found self-efficacy, years of computer use, and experience using the Internet have a significant positive relationship to satisfaction with the learning experience. Additionally, Lim found that adult learners with higher computer self-efficacy were more satisfied with their web-based courses and more likely to enroll in future courses delivered in a similar manner. Lim (2001) also studied the relationships of age, gender, and academic status to the frequency of computer use, participation in a workshop, and participant satisfaction as it relates to computer self-efficacy. Academic status in Lim's study was defined as an adult learner's intent to take future web-based courses. According to Lim's study the aforementioned variables were not significantly related to computer self-efficacy and satisfaction.

Research by Diaz and Cartnal, (1999) suggests that instructors should utilize learning style inventories and the resulting data to improve class preparation, designing delivery methods, assist in selecting technology for instruction and adapt teaching methods to the preferences of the learners. Students interested in technology-based courses tend to be independent learners who prefer a more abstract way of thinking. This is supported in articles by Dillie and Mezack, (1991) and Grasha and Yanarber-Hicks, (2000), which suggest students are predisposed to choosing either a technology-based course or a traditional type course. Diaz and Cartnal (1999) state that distance learning students favor independent learning styles and also tend to be less

collaborative and dependent. However, these preferences were different for those who selected technology-based from those who chose traditional classroom environments. Students in a traditional classroom favored collaborative learning styles and tended to be competitive and participatory in the classroom (Diaz and Cartnal, 1999). This research suggests that students who prefer learning in a technology-based environment may have different learning preferences than students who prefer a traditional classroom. According to Grasha and Yangarber-Hicks, (2000), the majority of college students do not have well-developed independent or abstract thinking/learning styles. This may have significant implications for a teacher implementing technology into a traditional classroom environment. According to these authors, researchers implementing technology and teachers of technology-based courses should consider the students' learning styles when designing activities. Therefore, although it was not the focus of this study, investigating relationships between learning styles or combinations of learning styles to satisfaction with curriculum or instructional Components in a technology or non-technology enhanced course could provide ideas about the aspects of course design, modification and implementation useful to educators.

Based on these perspectives, determining the Components of satisfaction in a distance or technology-enhanced (web-enhanced) course may be an important tool for both instructors and educational institutions in course development and instructional capacity. These Components of satisfaction could allow instructors to design or re-design distance or technology-enhanced courses and provide academic advisors with information to guide students toward or away from non-traditional courses

1.2 Focus of the Study

A technology-enhanced course has many Components that contribute to student satisfaction. This study investigated the following Components: modes of discussion, modes of research, types of learning activities, modes of submitting assignments, modes of testing, and format of course materials. Although technology plays a role in the delivery of instruction, the focus of this study was to identify student satisfaction with the aforementioned Components. Additionally, the study examined relationships between the different learning styles of the 19 students in the course and self-reported measures of student satisfaction in a technology-enhanced astronomy course. These data were used to make recommendations to course developers and instructors utilizing technology-enhanced teaching methodologies to improve their courses and increase student satisfaction.

1.3 Problem Statement

Some researchers have found that technology-enhanced courses offered at any educational level seem to have distinct advantages and disadvantages for different learners (Ahern & Repman, 1994; Christensen, Anakwe, & Kessler, 2001; Galusha, 1997; McVay-Lynch, 2001; Roblyer, 1999). This phenomenon may be caused by a mismatch between the different aspects of such courses for some students more familiar with traditional courses. These advantages and/or disadvantages may be mediated by preferred learning styles of the student, or other contributing factors in the instructional process (Allen et al., 2002; Carr et al., 1996; Grasha & Yangarber-Hicks, 2000; McVay-Lynch, 2001), although consistent relationships have not been found.

The problem the study investigated was the identification of components of satisfaction in a technology-enhanced astronomy course, and the analysis of these components for students with different learning styles. Specifically, the research questions were:

1) To what extent were students satisfied with each of the following Components in a technology-enhanced high school astronomy course: modes of discussion, modes of research, types of learning activities, modes of submitting assignments, modes of testing, and format of course materials?
2) What learning styles, or combinations of learning styles, were related to student satisfaction with technology-enhanced Components or non-technology enhanced Components in a technology-enhanced astronomy course?

1.4 Rationale

This study focused on student satisfaction with modes of discussion, modes of research, types of learning activities, modes of submitting assignments, modes of testing, and format of course materials in a technology-enhanced astronomy course and the variance of satisfaction, for students with different learning styles. The research was designed to contribute to curriculum development and technology-based teaching in the following ways. First, technology-based learning and teaching requires significant resources; determining the Components related to student satisfaction may influence the implementation of this methodology in the classroom. Second, this study delineated a few selected learning style components represented by the students and perceived student satisfaction with components unique to distance learning in a technology-enhanced science course.

1.5 Limitations

This study has been limited by conditions determined by administrative policy such as scheduling and enrollment. This study included 19 high school astronomy students from Greater Johnstown High School with ages ranging from 15 to 18 years. Given this limitation, generalizations beyond this specific population of students must be made with caution, based upon knowledge and experience of the reader. Additionally, the sample size is limited by the schedule imposed, technology requirements and student enrollment.

Greater Johnstown High School operated in a block schedule format. The instructional day consisted of a total of four 88 minute blocks of time. Using a block schedule format, students could take a total of eight classes per academic year. Typically, four classes were taken in the Fall semester and four in the Spring semester. Computer requirements limited the class to no more than 20 students as the largest capacity lab available seated 20.

As stated previously, the purpose of the study was to examine student satisfaction with selected components of a technology-enhanced course. Overall satisfaction of students with different learning styles was also described for the few learning styles represented by the 19 students. The results were then used to make recommendations for increasing student satisfaction to course developers and instructors utilizing technology-enhanced teaching methodologies. The second chapter, provides a review and analysis of the relevant literature to the topics of student satisfaction, characteristics of technology-enhanced teaching and learning and learning styles. The methods and procedures of the study are presented in Chapter 3 and the results of the statistical analysis of the data are presented in Chapter 4. The final chapter of the study is concerned with the summary of findings, discussion, implications for practice, and suggestions for further research.

2.0 CHAPTER 2 - LITERATURE REVIEW

2.1 Introduction

Transformational learning, which can best be determined as the process through which students take control of their academic careers through making decisions concerning their educations while working with a dedicated educator, has strong correlates within distance learning. Aided through the adaptation and integration of technology, the processes of distance learning are intended to help students engage in their education and complete coursework or attain a degree in a timely manner. However, the literature clearly demonstrates that these traits are dynamic, and that there is a dominant need for the students to interact with their education through self-motivation and application, as well as demands the commitment of a dedicated educator.

This chapter will provide a review of the available literature on distance learning, with the intention of providing a framework for the research efforts in this dissertation. The focus of the literature review will be through investigating factors of success found within distance learning, and how these qualities are integral to the process of distance learning. This latter field of review will concentrate on the attributes of transformational learning and how distance learning is best engaged through these attributes.

2.2 Synchronous Teaching and Learning

Synchronous teaching allows for real-time contact and communication between students to occur, even in circumstances in which the participants may be separated by distance (Marjanovic, 1999). Synchronous communication has advantages over asynchronous communication – when those participating in the dialogue are separated by time as well as space, or are otherwise unable to communicate in a real-time conversational mode – including real time interaction, instant feedback, and the potential for visual contact and interaction between the instructor and students. Synchronous technologies, although they require the most expensive and complex equipment to successfully implement in a distance learning program, enable students to interact at the same time while in the same place (e.g.: local area networks or peer-to-peer networking), or at the same time while in different locations (e.g.: remote networking). Technology is thus a mainstay of synchronous teaching in distance education as it facilitates the connectivity between students, their classmates, and their educator (Nistor et al, 2003). Immediate interaction can be achieved via interactive video or through text-based, computer-mediated chat systems (Marjanovic, 1999).

Synchronous teaching in distance learning education has improved dramatically through the improvements in communication technologies. Traditionally, synchronous distance education was achieved through using video broadcast and supplemental audio via phone lines or satellite. Such systems were awkward to use, provided poor quality, were unreliable, and did not offer multipoint conferencing. Recent advantages in networked conferencing via the Internet and broadband ISP have reduced shortcomings of IP-based synchronous leaning through integrating streamlined audio and video capabilities among multiple users. These technological advantages have the potential to allow students and instructors to attend the same classroom

despite geographic location; the capacity of streamlined distance learning programs is improved immeasurably through offering this service to distance learning students.

The support and interaction that are hallmarks of synchronous groups enable more effective learning and improved overall performance and satisfaction among distance learners, which are reported to be comparable to the same results found within a traditional classroom setting (Doherty, 2000; Marjanovic, 1999). Yet there are advantages that are embedded in synchronous learning in distance education that are not found within the traditional classroom setting; because all participants in synchronous learning must be present at the same time, (although not necessarily in the same location), the interactive nature of live synchronous learning seems to provide creative interaction, thinking, and collaboration that transcend the norms of the traditional classroom (Lee, 1999). Lee (1999) also indicates the need to effectively communicate a point or a perspective to those who can not respond to physical cues insist that the speaker work to identify their ideas and communicate them clearly to others.

An additional positive aspect of distance learning is that the synchronous learning process is not necessarily exclusive of a traditional classroom setting. For example, universities have found it possible to consolidate small local groups of students within a larger region and conduct classes of 80 or more students utilizing synchronous satellite connections between the student groups and the instructor (Mariani, 2001). The data indicate that learners are aided in developing knowledge through collaboration, which does not exclude the effectiveness of distance learning or preclude its applications (Liaw & Huang, 2000). Emphasis upon traditional classroom formats used to aid learning, such as projects which integrate group work, can be applied in this distance learning setting (Liaw & Huang, 2000; Mariani, 2001). Student support should also be a consideration because learners are supposed to discuss material and also apply higher order

thinking skills; students are likely to need some type of collaborative support with both other students and the instructor. Interactive synchronous communication is theorized to be effective as it provides support for both individual and large group distance settings (Shotsberger, 2000). In addition, some researchers have found interaction is related to achievement, and is central to the expectations of learners and instructors in distance education (Doherty, 2000, Liaw & Huang, 2000). Finally, the traits that promote interconnectivity that are found within synchronous learning can provide a foundation for effective learning, interaction similar to that of a traditional classroom, increased learning and satisfaction, and some authors indicate that these traits also seem to increase completion rates in distance courses (Allen et al., 2002, Carr, 2000, Doherty, 2000).

2.3 Asynchronous Teaching and Learning

Asynchronous instruction allows students to access course materials, assignments, and assessments at times convenient to the student rather than on a rigid traditional schedule. Asynchronous technologies enable students to interact at any time, in any location, providing flexibility, opportunities for remediation, research, and more time for reflection (Liaw & Huang, 2000). Asynchronous learning was initially adopted as a result of limits on technology used to promote the distance learning classroom, as low bandwidth limited the amount of data that could be effectively exchanged. These limitations resulted in largely text-based communication options such as e-mail to form the basis of the classroom structure. Asynchronous systems may be more useful as a supplement to a traditional classroom than in the implementation of distance learning, for these technologies help to supplement information as opposed to facilitate the development of an online classroom experience (Marjanovic, 1999). As to this latter point, researchers theorize that asynchronous communication helps the students supplement their

existing classroom experiences as it stimulates interactivity between students by extending contact time and allowing reflection before responding to questions and comments (Liaw & Huang, 2000, Shotsberger, 2000).

Asynchronous communication has additional advantages including location and time independence, quality improvement, and greater higher order learning. (Morse, 2003). Additionally, the benefits of an asynchronous learning environment include flexibility, increases in participation quality and quantity, and more communication (Morse, 2003). These advantages in the asynchronous approach may result in a more learner-centered approach and in giving the students increased flexibility by allowing them to work at their own convenience (Shotsberger, 2000; Wagner, 1997). Asynchronous learning does have challenges that include difficulties with technology, coordination difficulties between students and the instructor, and delayed responses from participants (Morse, 2003). Compared to synchronous communication, either face-to-face or distance, asynchronous communication requires significantly more time to communicate and effectively exchange information between participants (Shotsberger, 2000). Regardless of the challenges involved in the asynchronous model of communication, it predominates web-based instruction, especially at the post-secondary level (Shotsberger, 2000).

There are some additional negative trade-offs that are embedded within the use of asynchronous technologies. Evidence from student performance in the asynchronous classroom setting indicates a greater potential for examples of plagiarism or other forms of non-ethical work submission to occur within this format (Nistor et al., 2003; Child, 2005). It appears as though the environment created by the distance learning reduces the degree of supervision the instructor can apply to student work (Brown, 1997; Nistor et al., 2003; Child, 2005). Adult students frequently use distance learning programs to attain their degree in order to receive job-

related benefits (e.g.: raises, bonuses, benefits, promotions, etc.), and the incentives found in attaining a degree in a rapid time frame provide incentives to cheat (Child, 2005).

2.4 Web Enhanced Teaching and Learning

Web-enhanced learning is neither traditional classroom learning nor distance learning, but rather a melding of the two. Web-enhanced learning is defined as "use of computers and Web-based courseware to enhance the traditional face-to-face classroom environment by exposing students to content-specific information and allowing application and expansion of personal knowledge" (Sanders & Morrison-Shetlar, 2001). The benefits of the traditional classroom, including face-to-face communication and non-verbal cues from the teacher and students, are combined with benefits of web-enhanced models. Using the Internet, students have the ability to communicate with the teacher and other students via e-mail, chat rooms, and discussion groups. They can access course information and assignments, and they can work on assignments at their own pace (Ahern & Repman, 1994). In this teaching model, students and teachers will find themselves playing different roles where the teacher is no longer the sole source of knowledge, and the student actively participates in what and how knowledge is imported (Galusha, 1997).

In a traditional classroom, instructional resource materials typically include a textbook and other printed media. Printed media remains a static, or non-changing, form of instructional resource material and indicates persistent knowledge until another edition is purchased. While many classes benefit from having a permanent resource, many courses incorporate a changing informational system (e.g.: technology) and need to acquire new resource materials in order to keep current with new data. The challenge of keeping printed media current to the needs of the classroom is compounded by the costs incurred through updating (Bento & Bento, 2000).

Alternatively, web resources are continuously evolving, easily accessible, and continuously updated. Web resources such as public and academic libraries, databases, journals, and thousands of indexed sources are available without restriction (Bento & Bento, 2000; Liaw & Huang, 2000).

Many textbook and reference publishers are seeking to support or otherwise supplement their printed materials through offering extensive online resources for students and faculty. For example, Prentice Hall offers websites that provide interactive quizzes with instant feedback, online testing, downloadable PowerPoint presentation "notes," and Internet-based assignments specifically tailored to topics in their texts. This canned approach allows an instructor in a traditional classroom with web access to enliven and expand content (Turoff & Hiltz, 1995). Schools that specialize in distance learning and web-based learning, such as the University of Phoenix Online, are currently in the process of launching marketing strategies in which the courses offered to students are supplemented directly through a textbook written specifically for that class. Criticism of this marketing strategy indicates that, while the supplemental hard-copy text aids in formalizing the educational process, there is a monopoly on the teaching aids and similar materials offered within these programs; such a monopoly indicates that a student learns specifically from materials that are sanctioned and sold by the online university in question, thus creating conditions for a closed educational system that seems almost mercenary in nature (Smithback, 2004).

Criticism aside, there is no question that course management can be aided through implementing technology. Assignments, syllabi, notes, and other typical "paperwork" can be distributed electronically rather than reproduced and handed out via "paper" technology. Students and instructors can acquire access to new forms of information as a means of rounding

out existing course syllabi and coursework. Students can access course information via the web regardless of location or time and instructors can edit, revise, and distribute materials easily (Bento & Bento, 2000). Indeed, there is an ongoing discourse within the field of traditional learning in which the integration of technology transforms even the traditional classroom setting into one that can take advantage of the benefits to be obtained from web-based technologies (Brown, 1997). Educators and students in conventional, non-computerized classes now frequently refer to a syllabus on the class web site, turn in homework digitally via the Internet and email accounts, and even perform a majority of research for class projects online rather than in the school library. The heavy emphasis upon web-based technologies in the modern traditional classroom setting appears to blur the line between distance learning and conventional face-to-face learning.

In summary, distance learning, in the context of this study, refers to instruction over a distance, using technology. Distance learning can utilize two distinct approaches: 1) Synchronous teaching, which allows students and teachers to be in direct contact via video and audio technologies, communicating in real time and 2) Asynchronous teaching which allows students access to all course materials, but without real-time communication. Both systems emphasize communication and interaction among students and with the instructor. Such forms of interaction engage the learner, support learning, support understanding and enhance the learning process (Wagner, 1997). It is evident that regardless of the methodological approach, the advances of computer technology have facilitated the distribution of instruction and learning and continue to build bridges between teachers and students. However, despite the evident positive outcomes from within these technologically-enhanced learning processes, criticism in

the form of monopolistic resource and reference allocation and the technological gap that reduces universal access to all forms of distance-learning rightfully persists (Jung et al, 2001).

2.5 Distance and Web-Enhanced Learning

The oldest, and arguably the simplest, form of distance learning is the correspondence course (Allen et al., 2001). Distance learning has evolved from pencil and paper-based correspondence courses to synchronous web-based courses (Galusha, 1997). In a very generalized sense, distance learning refers to the instruction or teaching delivered to remote locations via an electronic medium. Web-enhanced learning refers to use of computers and web-based courseware to enhance traditional face-to-face classroom environment (Christensen et al., 2001; Ross & Schultz, 1999). Increasingly, the use of technology to foster distance learning is becoming more common at all educational levels (Ahern & Repman, 1994). This is due in large part to the advantages found in asynchronous and synchronous learning offered through distance learning, as well as numerous additional advantages that can be acquired through integrating technology into education. These advantages have encouraged many students to approach distance learning as having the ability to meet their educational requirements.

Reasons students choose distance learning over traditional classroom learning include: 1) the student is either unable or unwilling to use the on-campus course equivalent, 2) he/she has a preference for this form of instruction, 3) the available forms of education were poor in his/her situation, and 4) the types of distance education available were an improvement over his/her current situation (Allen et al., 2002; Stone, Tudor, Grover & Orig, 2001). To add to the aforementioned reasons students choose distance learning over traditional learning, an increasing number of students are expecting a technology component to their classes (Christensen et al.,

2001). This expectation may be a result of the fact that students are realizing the relationship between success and computer literacy in today's society (Sanders & Morrison-Shetlar, 2001).

There are limitations on distance learning. First and foremost is the persistence of the "digital divide," which is the gap between those who have access to the forms of technology necessary to participate in distance learning from those who do not have access (Jung et al, 2001). This digital divide transcends matters of computer literacy, as it also draws upon matters of economic and minority disparities. Second, cheating is increasingly a problem in American education, and the distance learning classroom offers an immediate advantage to those who wish to attain a degree with minimum investment (Child, 2005). Third, many traditional classrooms and educational establishments wish to engage in distance learning but are not able to provide high quality courses, suggesting the overall offerings by any institution offering distance learning might not be of high quality (Mariani, 2001). There are, of course, other limitations, but that is not the focus of this review.

2.6 Success in Distance Learning

Advancing technology has brought a dramatic change to the field of education, but not as great as has been predicted for the past 20 to 40 years. Technology has the potential to open the doors of instructional institutions to a larger audience, providing options for traditional and non-traditional students and extending instruction to students who would otherwise not be able to attend a traditional classroom (Wright, et. Al., 2000). This dramatic change has allowed learning to take place over vast distances between the student and the teacher. Questions that need to be considered include:

- What are the determinants and/or categories used to classify satisfaction in a web or technology-enhanced course? If an instructor could provide teaching methodologies and activities that caused increased satisfaction, increased achievement may result.
- What makes some students satisfied with web or technology-enhanced courses but frustrates others? Why do some students simply not do as well in a distance course as they would in a traditional classroom and others are frustrated to the point of dropping out? Distance learning and web-enhanced courses are very similar, and both present unique challenges for both instructors and students. If a student can identify areas of difficulty before enrolling in a distance learning or web or technology-enhanced course, he/she may be able to address these areas or choose an alternate method for instruction.

In 1994 more than $2.4 billion was spent on educational technology in K-12 schools, and this amount has grown every year since (Jones & Paolucci, 1999). Critics of this spending argue that the research supporting the massive adoption of this technology in classrooms is not justified (Jones & Paolucci, 1999). It can be argued, however, that a web or distance-based course can offer greater flexibility than a traditional course. This greater flexibility may meet the needs of many additional students and thus maintain or increase enrollments or simply accommodate existing students in a different delivery format. Because of new federal mandates, specifically the "No Child Left Behind Act," schools are now facing unprecedented penalties if the required goals are not met. As a result of the legislation, academic underachievement (e.g.: when one or two students drop out or fail to graduate in four years) in a secondary school could make the difference of being identified as not adequately meeting yearly progress benchmarks, resulting in the risk of having the school labeled as a failing school. Giving students the flexibility to

complete courses through distance learning, and/or offering supplemental educational services via distance learning technologies, may increase achievement and possibly prevent a student from dropping out. While extensive research has not yet been carried out to test these assumptions, it has been suggested that implementing distance learning into traditional secondary education can garner improvement through providing much-needed supplemental learning aids (Christensen, et al., 2001; Willis, 2002).

Based upon the historical increases in technology that have affected the distance learning environment, it can be theorized that technological improvements will continue to enhance and simplify delivery of information to students. There are, however, fundamental differences between traditional classroom and distance-based teaching and learning. These differences result in a larger percentage of students dropping out in distance-based courses. Researchers report dropout rates approaching 50% in distance education, and note that the components associated with the increased rate of attrition in distance learning are not clear (Moore & Kearsley, 1996). Identifying relevant components of satisfaction within a distance learning classroom or distance education course may provide insight for instructors creating or modifying technology or distance-based courses to lead to less attrition and a higher success rate.

2.7 Components of Success in Distance Learning

The composition of the student population in post-secondary education has changed dramatically from the 1980s, when college-age students were typically in the 18-24 year age range. Today the student population contains more older students (well above traditional college age), is more diverse, and the students have varying degrees of academic readiness (Buchanan, 1999). Gifford (1992) noted that forty percent of all college students are older than 25 years of age. This older student population is steadily increasing the need for more flexible instructional programs (Edwards, 1997). This new student population often faces challenges the typical college student does not, such as family and employment-related commitments. Additionally, some of these learners are challenged due to geographic location and need an alternative to traditional education. These learners need a more flexible way to continue their education. Distance learning may provide a more flexible method of completing coursework and degree programs.

Students in high schools can also take advantage of distance learning and web-enhanced learning programs. Some rural schools simply cannot offer advanced placement programs because of the small student enrollment. The result may be class enrollments too small to justify an instructor, thus the courses are simply not offered as part of the curriculum. Gifted students in any school system may need the challenge of courses not offered at their home school such as foreign languages, computer programming, and advanced mathematics and science courses (Berman & Tinker, 1997; Wildavsky, 2001). Students with extended illnesses, pregnancy, suspensions, expulsions and school phobias may also need an alternative to the traditional classroom (Berman & Tinker, 1997). Distance and/or web enhanced learning can provide an avenue for these students.

An extension of web-based learning is the formation of online high schools. These schools offer complete curricula and sometimes include computers for the home learner. Critics of these online schools claim that there is a limited pool of students they serve very well, they lack face-to-face contact, and do not promote the social skills needed by adolescents. Students and parents of online schools also admit that it takes a special type of learner, one who is focused and motivated, to thrive in an online school (Ahern & Repman, 1994; Sherry, 1996; Wildavsky, 2001).

In summary, an older student population has more personal and family commitments and full-time employment, in addition to school-related responsibilities. Geographic location can eliminate educational alternatives for some students, particularly in areas which are isolated and in areas with limited educational opportunities. The need for advanced placement courses in rural schools is apparent; however, additional staff needed for these offerings and other budget limitations may prohibit course offerings. Distance learning courses may offer solutions for advanced placement and alternative education in some high schools. Distance learning courses may provide options for advanced placement courses, courses with low enrollment that cannot justify offering a class, and alternative programs for students with behavior problems, pregnancy, illness and social phobias such that the students can not or choose not to participate in a traditional classroom.

Student-instructor and student-student communication is an important and integral component of any instructional system and plays a vital role in student learning (Grasha & Yangarber-Hicks, 2000). Students need interaction and involvement and collaborative learning tends to create an environment of increased understanding and skill development when learners take on active roles in the classroom (Galusha, 1997; Marjanovic, 1999). Instructors are looking

for ways to enrich instruction, and to promote communication and collaboration, and technology has opened possibilities for this type of group collaboration and communication in distance learning (Galusha, 1997; Sanders & Morrison-Shetlar, 2001). Collaborative learning can be as simple as small group discussions in a traditional classroom or as advanced as technology-aided chat-rooms and discussion groups between students across continents. Regardless of the format, collaborative learning can have its problems, including shy, passive students not participating or not willing to engage in direct communication, individual students dominating discussions to students simply "letting others do all of the work." Additionally, student computer experience is directly related to the use of technology-based communication tools as a medium for communication (Allen et al., 2002). These challenges provide significant obstacles for instructors in both traditional and distance collaboration teaching situations (Marjanovic, 1999). From an educational standpoint, communication between students and instructors is extremely important, and distance teaching and computer-mediated methodologies have the potential to exploit this type of communication. In a synchronous-based communication study, however, Davenport and McKim (1996) found great improvements in participation and discussion quality compared to that of a traditional classroom. Distance learning and computer-mediated learning has grown in popularity in recent times; however, some students still need, and sometimes prefer, face-to-face contact with an instructor or they feel disconnected (McVay-Lynch, 2001; Sanders & Morrison-Shetlar, 2001). Regardless of the instructional format, computer-mediated communication remains useful in both distance and traditional classroom formats (Marjanovic, 1999). In fact, communication in a distance learning course has been shown to have a negative correlation to the dropout rate (Grasha & Yangarber-Hicks, 2000; Laabs, 2000).

In part, a result of the expense of the technology and related infrastructure, the equivalent of traditional face-to-face communication is difficult to achieve for many educational institutions. Therefore, the majority of students in distance learning settings are required to communicate in a non-traditional way through electronic mail, discussion groups, and "chat" rooms. Successful distance learning courses require an active communication environment among students and instructors, though, and the separation of students and teachers imposed by distance learning removes a vital link of communication—face-to-face interactions. This link, however, can be replaced or otherwise substituted through the use of the alternative forms of communication, the non-traditional electronic technology (Keegan, 1986). The use of non-traditional electronic communication technology as an effective communication tool is supported in a study by McVay-Lynch (2001) which indicates that 95% of students demonstrated the ability to communicate effectively using the e-mail, discussion boards, and chat rooms as substitutes for the traditional face-to-face contact. Findings also indicate that students are able to engage in these activities at their own time, utilizing a feature of asynchronous learning in which the student does not have to be temporally aligned with the lesson in order to benefit or otherwise acquire knowledge (Sherry, 1996).

Additional evidence of the importance of communication in distance learning is stressed in a report by the Office of Technology Assessment (1989). Distance and web-enhanced learning can be frustrating, lonely and isolating, and a lack of communication can quickly degenerate distance learning to a correspondence course (McVay-Lynch, 2001; Sherry, 1996). Two-way communication can provide more effective learning and increase satisfaction and completion rates (Allen et al., 2002). The power of communication is summed up very well by Sir John Daniel of Open University, United Kingdom. "Communication between people is the

most popular and powerful use of the Internet and web, instructors should use this powerful tool (the web) to increase communication between students and students with instructors rather than dumping course content onto a students computer screen" (Chamberlin, 2001). The power of communication as a tool for success is also supported by evidence in one study which identified the traits of an online "study buddy," in which student-to-student communication played a positive role; students that did not have this peer-to-peer contact were nine times more likely to drop out than those who did (Carr et al. 1996).

Discussion boards (also known as web boards) allow asynchronous communication and collaboration among students and between students and instructors. Asynchronous technologies enable any-time, any-place communication providing time for reflection, intervention, and research (Marjanovic, 1999). Information may be composed offline or directly via dialogue boxes in a web browser and posted to a central location. Messages may be edited by the sender and also responded to by other students and the instructor. Responses are arranged in a logical "tree" format of threads in chronological order. This format mimics a real time conversation and documents the flow of the discussion. A discussion board is different from an e-mail type discussion list in that all participants can see all "threads" or discussion topics, and this information is not sent to an e-mail address. Discussion boards can be powerful tools to prepare students before a classroom meeting or to discuss and expand classroom topics. They also provide opportunities for cooperative learning and communication between students. (Bento & Bento, 2000). Some software allows queries by author, time, date and subject, which is particularly helpful for an instructor who would like to monitor individual student activity and participation.

Chat rooms are similar to discussion boards; however, there are fundamental differences. Discussion boards are truly an asynchronous media. Chat rooms are, by their nature, synchronous when all members of the room are actively participating in the dialogue. Synchronous technologies enable same-time, same-place or same-time, any-place communication which provides immediacy in the question-and-answer process (Marjanovic, 1999). Essentially, a chat room is a live text-based conversation taking place via the web. The use of a chat room has been shown to increase student-student communication (Sanders & Morrison-Shetlar, 2001). Chat rooms provide real time interaction between students and instructors with text messages appearing in the order they are sent. Discussions can be archived and referenced after the group has finished. Chat rooms are appropriate for informal communication, coordination of schedules, and quick dialogue (Bento & Bento, 2000).

Research indicates that communication between student and instructor decreases dropout rates and increases retention (Allen et. al, 2002). Although face-to-face communication is usually preferred by instructors and students, mechanisms for increasing successful communication at a distance include e-mail, chat rooms, and interactive video "live" sessions. Recent advances in technology and access to increased bandwidth have enabled interactive, real time, live, line of communication (Guernsey, 1998).

Even with such advancements, evidence suggests that completion and retention rates of students are generally lower for distance education courses than for traditionally taught equivalent courses (Carr, 2000). This claim is supported by two studies, one a case study and the other a critical review of the literature: "Effective Student Preparation for Online Learning" and "Traditional and Self Paced Instruction for Microcomputer Applications" (McVay-Lynch, 2001; Creighton & Kilcoyne, 2000). The aforementioned studies suggest that dropout rates for

distance learning courses can be as high as 35% to 58% compared to 14% for traditional courses. Distance education students tend to be older and have many more personal commitments than traditional college students. In addition, the delivery methodology in distance education may result in students having less interaction with other class members and with the instructor. Because contact may play a vital role in student retention and learning, interaction is an important factor of retention (Grasha & Yangarber-Hicks, 2000). A study by Sewart (1992) indicates that student support, communication, and immediate feedback were important components relating to decreasing the student dropout rate. Evidence from an investigation by Stone, et al. (2001), also indicates that student support plays a key role in completion rates and retention. A similar finding as discussed by Galusha (1997) also revealed that support of students in a distance education program may be a significant factor related to distance education program retention and completion. Galusha's findings are supported in a study by Sewart, (1992) which revealed that student support was an integral part of retaining students and increasing completion rates in distance learning. Galusha's research also indicates the following components related to student support issues should be addressed. First, the isolation for distance learners complicates the learning process. Second, students may need tutors and academic planners to help complete courses on time and to act as a support system.

The organization of distance learning by the academic institution may also have an impact on the completion rates of students. A decentralized distance learning program is one in which distance courses are organized and managed by individual departments rather than by a dedicated distance learning department. Students enrolled in decentralized programs have marginally higher completion rates. Additionally, marginally higher student GPAs and increased

levels of individual assistance are associated with this decentralized approach to the organization of distance learning (Stone et al., 2001).

2.8 Learning Style

A student's learning style has a significant impact on his/her retention of content regardless of the type of instructional setting in which education occurs; this indicates that students with learning styles that are conducive to the current educational institution's teaching and communications format will likely excel, while students who do not have conducive learning strategies find themselves unable to achieve at expected performance levels (Nistor et al, 2003). Some studies indicate that students learn best when they can address and confirm knowledge in their preferred learning mode (O'Connor, 1997).

Some researchers have evidence that students' performance, when faced with technology-based learning, is related to their learning style (Grasha & Yangarber-Hicks, 2000). Some research suggests that students who need less structure, are more abstract thinkers, and who work well individually, do well in technology-based courses (Christensen et al., 2001). The aforementioned students could be considered an introverted/intuitive (IN) learning type according to the Myers Briggs Type Indicator. Consequently, some students simply do not learn very well without the direct face-to-face communication that takes place in a traditional classroom setting (Roblyer, 1999) and would not be as successful within a distance-learning program. To summarize, learning style may have an impact on students' retention of course material whether delivered using traditional or distance methods. Distance learning programs can provide instructional opportunities consistent with the preferred learning styles of some students.

Many authors have stated that learning styles, or types, are extremely important. According to the theory, types can tell an instructor: 1) how students may learn best, 2) what activities different types of students should feel comfortable completing, and 3) how to aid in the grouping of students for the most compatible teams. Using type as indicative of a student's learning preference is one way that educators can understand why certain instructional methodologies work very well with some students and completely fail with others. Understanding how type influences the instructional process or when or where type has no influence, can help a teacher to make significant improvements in instruction and learning (Lawrence, 1993). Although, at present, there is only limited and inconsistent empirical evidence concerning learning style and student achievement, it is an intriguing theory which may warrant further study.

Carl Jung, a Swiss psychologist, developed his theory of psychological type to explain human behavior and personality. Jung took what many observers called random actions and saw patterns which he categorized into four psychological functions. These include: sensing, intuition, thinking, and feeling. Jung categorized these functions into two groups: perception processes (sensing and intuition) and judgment processes (thinking and feeling) (Lawrence, 1993). The first type pair (sensing and intuition) was related to the preferential mode of gathering information. According to Kroeger and Thuesen (1988), there are two ways to conduct this process: sensing or intuition. Sensing is defined as the perception of observations by the senses. Intuition is defined as the perception of meanings, relationships and possibilities by way of insight (Lawrence, 1993). Both sensing and intuitive types use both processes; however, one type is usually preferred and therefore more fully developed. Sensing types prefer settings where knowledge and manipulation of tangible things is more important than theory.

The sensate also confronts situations using conventional knowledge rather than new breakthroughs (Lawrence, 1993). Intuitive types develop the ability to understand abstract and theoretical relationships to predict future possibilities and are often creative and rely on new and untried solutions to problems (Larwence, 1993).

The second type pair (thinking and feeling) involves the preferential mode of making decisions. According to Kroeger and Thuesen, (1988) there are two ways to conduct this process: thinking or feeling. Thinking is defined as using logic in decision making processes. Feeling is defined as making judgments using a system of relatively subjective, personal values (Lawrence, 1993). Thinking types use their abilities to look objectively at problems and to make decisions based on the facts observed. Feeling types prefer to come to conclusions based on personal beliefs, empathy and compassion. Both thinking and feeling types use both processes; however, one type is more fully developed and preferentially used (Lawrence, 1993).

Because all people develop preferences for both their perceiving and judging processes, four preference pairs are a result. These pairs represent the dominant perceiving and judging processes identified by Jung and others. The four pairs are defined below (Lawrence, 1993):

- Sensing-Feeling (SF) – This type is interested in facts but makes decisions using their own personal values.
- Sensing-Thinking (ST) – This type is interested in facts collected and verified by the senses. Decisions are made based upon step-by-step reasoning.
- Intuition-Feeling(NF) – This type makes decisions based upon their own personal values and possibilities rather than facts at hand.
- Intuition-Thinking(NT) – This type makes decisions based upon possibilities and can weigh these possibilities with factual analysis.

In summary, Jung's theory of psychological types concludes that all mental activity can be divided into four basic psychological functions which include: sensing, intuition, thinking, and feeling. All people use all four processes; however, we differ in how much, how often, and how well each processes is used. One function in each pair (sensing/intuition or thinking/feeling) is dominant and is displayed in how a person interacts with his/her surroundings. Isabel Myers-Briggs and her mother Katherine Briggs developed the MBTI, the Myers Briggs Type Indicator, which is based upon the theories of Jung to delineate personal type preferences.

In the MBTI model, 16 psychological types are described through patterns which describe a particular individual's preferences for gathering information and making decisions. The patterns which make up the groups include:

E – extroversion – an extrovert's interest turns outward to the world of action, people and things, or

I – introversion – an introvert's interest turns more often to the inner world of ideas and private things.

S – sensate – pays most attention to the facts that come from the personal experience, can more easily see the details, or

N – intuitive – pays most attention to the meanings behind the facts, can more easily see the "big picture."

T – thinker – makes decision by examining data, staying impersonal, or

F – feeler – makes decisions by paying attention to personal values and feelings.

J – judger – runs outer life with settled judgments, or

P – perceiver – runs their outer life in an open, receiving way

The creation of these psychological types (Myers-Briggs Type Indicator) represents a 20-year period of work for the authors. The MBTI is a self-report inventory based on Carl Jung's theory of psychological type and has been designed specifically to create a practical application for Type theory.

2.9 Type and Temperament in Jungian Measures

In order to further extend the discussion on personality types, a discussion of the literature on temperaments in addition to the MBTI is necessary. These two forms of personality traits are similar but, when combined, provide a more meaningful way to judge the preferences of the individual.

David Keirsey and Marlin Bates assembled an organized categorization of combinations of type called "temperaments" based upon Jungian theory (Keirsey & Bates, 1984; Kroeger & Thuesen, 1988; Mamchur, 1996). According to this theory, temperaments offer an accurate predictor of behaviors such as how people teach, learn, lead, and relate to others (Kroeger & Thuesen, 1988). The first letter of temperament is either S or N, which is how a person gathers information (sensing or intuition). The second letter is somewhat dependent on the first.

Persons who are sensors (S) have an information gathering preference for concrete activities that they can see or touch. The second letter determines what is done with the data once it is collected. Judging and Perceiving are the second letter choices for this temperament. A judger (J) will organize and categorize information whereas a perceiver (P) will continue to

collect data. The sensing types will have two distinct groups, SJ and SP (Kroeger & Thuesen, 1988)

Persons who are intuitive (N) have an information gathering preference that is abstract and conceptual. The second letter determines how the data is evaluated once it is collected. Thinking (T) and Feeling (F) are the second letter choices for this temperament. A thinker will evaluate data objectively, whereas a feeler will evaluate data subjectively. The intuitive types will then have two distinct types, NF and NT (Kroeger & Thuesen, 1988)

According to these authors, the four temperaments have distinct preferences for instructional methodologies, in an educational setting. For example, Machmur, (1996) indicates that the temperaments have the following preferences:

- The (SJ) prefers routines, procedures, organization, directions, sequential instruction, drill and practice, tests, less open to learning new things.
- The (NF) work well in groups/cooperative education, articulate, strong desire to please and help others, like to please teachers, cannot take criticism.
- The (NT) ability to speak and write clearly, understands complex systems, skilled at planning, likes discussions and questioning .
- The (SP) prefers projects that require movement and hands-on tasks, resourceful, practical, can become bored if inactive, like contests, and games where outcome is unknown.

According to Kroeger and Thuesen, (1988), current educational practices favor students with profiles of intuition and feeling (NF). This favoritism is a result of the intuitive type's being comfortable with theory and quietly thinking about material, and the feeling type having a strong

need to please teachers, parents, etc. (Kroeger & Thuesen, 1988). The result of this are students who excel academically and ultimately pursue careers that are easy for them to attain but possibly resulting in a career that is a mismatch to their "style" (Kroeger & Thuesen, 1988). Another problem is that temperament difference between teachers and students can account for difficulties that some students have being successful with certain teachers and not others. The learning type of a teacher affects the exchange of information, classroom atmosphere (rules, routines, etc.), and lesson design (Murphy, 1992). Teachers generally teach using methodologies with which they are comfortable learning (Mamchur, 1996). It is often difficult for teachers to understand that others could learn using instructional methodologies different than the ones that are successful in their own educational and learning processes (Mamchur, 1996).

The combinations of introversion/extroversion and sensate/intuition are the two factors that, some authors hypothesize, most fully affect how one acts and learns in an academic setting (Shindler, 2000). Using the type sorted into four categories offers a simple and effective use of type theory. A teacher can use the type combinations IS, ES, IN and EN as a simple way of organizing and adapting classroom instruction to focus on students strengths (Lawrence, 1993). A typical classroom of 35 students has an uneven distribution of the four types e.g. IS-8, IN-4, ES-15, EN-8 (Lawrence, 1993). This distribution can often result in biases as traditional instruction favors certain types of students. These biases exist because in a typical classroom: 1) students generally work individually with their own sets of materials, 2) the environment is quiet so students can concentrate, and 3) topics are introduced sequentially, followed by examples and evaluation (Nistor et al, 2003).

According to MBTI theory, this format favors the introverted student, who prefers to work quietly and absorb information before verbalizing (Lawrence, 1993). This format,

although well suited for some introverts, does not lend itself to students with an extroverted type. Extroverts think and learn best in an action-based environment, working in groups and interacting with others. Likewise, intuitive students need quiet time to internalize concepts before applying knowledge to situations or problems. Sensate type students like to verbalize with others what they are thinking and like to do rather than passively watch (Shindler, 2000).

When the categories of extroversion/introversion (E/I) and sensate/intuitive (S/N) are combined, a student's preferred learning modalities are defined (Shindler, 2000). The following table summarizes the four combinations of the Jungian dimensions discussed above that most affect learning.

Table 2.1 – Learning Type Combinations Hypothesized to Affect Learning

Extroverted-Sensate (ES) - Action oriented realists - 40% of population	This type loves action and things happening. They like to get practical results from their work, and like to work in groups. For them too much watching is a waste of time, they want to do. They like to share what they are doing and thinking. They get impatient when things are too slow, complicated, or abstract.
Introverted-Sensate (IS) - Thoughtful realists - 25% of population	This type is the most careful and steady. They don't mind working alone or with one other. They like practical results and are good with details, and technical things. They are often the least expressive; they see much but usually share little. They don't like careless ideas, plans, or too many new things at once.
Extroverted-Intuitive (EN) - Action oriented innovators - 25% of population	This type is really motivated and likes to make things happen. They like to work in groups on new and interesting things. They like to take their theories and apply them with others. They share easily, especially what's inside. They don't like details, routines, or the same old thing for too long.
Introverted-Intuitive (IN) - Thoughtful innovators - 10% of population	This type is the best at solving problems. They like to work at their own pace on their own ideas. They like to make creative, and scientific things. They would rather express themselves through their thoughts, instead of socializing with others. They don't like doing busy work or things that don't make sense.
	(Shindler, 2000, Teaching Across Type section, para. 10)

2.10 Learning Styles in Distance Learning

Online learners seem to have some distinguishing characteristics. According to a study by Halsne and Gatta (2002), the dominate learning style for females taking online courses was visual learning. This corresponds with Hickson and Baltimore (1996), who found that middle school age females have more of a preference for visual learning tasks than males. Auditory or kinesthetic learning styles are the dominating learning styles for traditional learners in research studies (Halsne & Gatta, 2002). However, the researchers caution that studies tend to frame male learners as subjects more than females or mixed gender populations, thus suggesting that gender-centered learning styles might be distorted in the use of male-dominate subjects (Halsne & Gatta, 2002). No information was given to resolve this discrepancy, but the researchers did indicate that further study was needed.

Regardless of the instructional model used, some learning style authors indicate that students may be more successful if: 1) the teaching style of the instructor and the learning style of the student are matched, 2) students can expand their learning preferences, and 3) instructors understand the learning preferences of the different learning types and provide activities to support these students (Mamchur, 1996).

Students that have a high need for interaction, because of their personal learning style, level of maturity and/or academic level, should be advised that a distance learning environment may be more difficult, more time-consuming, and less enjoyable. In a study by McVay-Lynch, (2001), however, ninety-four percent of approximately 50,000 students were able to determine their learning style and provide an accommodation plan to be successful in a distance learning environment. This knowledge helped students take control of their learning, and increased confidence in the distance learning format (McVay-Lynch, 2001). Proponents of distance

learning also report that the interactivity of the computer plays into maintaining student focus. "Rather than passively listening to a lecture, a computer user is given a specific goal and has to figure out how to achieve it. This requires a student to absorb the knowledge by practical application, through trial and error" (Keegan, 2000).

In addition to the organization of programs, research indicates that communication and learning styles are also components related to students' success in academia. Communication is related to achievement, retention, and satisfaction in the distance-learning classroom (Allen et al., 2002; Moan & Dereswiwsky, 2002). Traditional teaching methods that include large amounts of lecture can have deficiencies in communication and can be very passive. Likewise, distance-learning methods also can make a student feel disconnected and as though technological hurdles may be difficult to overcome. Achievement, in general, has been found to be similar in traditional and distance learning methods. Therefore, combining these instructional methods into a technology-enhanced classroom may enhance communication and increase student satisfaction.

Distance education research identifies characteristics that make for a more successful distance education student such as maturity, assertiveness, the ability to communicate using text, and time management skills (Campbell-Gibson, 1990; Buchanan, 1999 & Moore, 1990). Research by Diaz and Cartnal, (1999) suggests that students may be predisposed to taking technology or non-technology-based courses. Buchanan states that web-based learning is not appropriate for all students and suggests using pre-assessment measures for potential students. Knowing the components associated with student satisfaction in a technology-enhanced course would be useful for evaluating instruction and modifying courses. The results of this study of students' satisfaction related to teaching and learning should be useful for instructors and designers of technology-enhanced courses to assist in the development of new courses.

2.11 Failure within Distance Learning Programs

Research in distance learning has tended to emphasize student outcomes for individual courses rather than for total academic programs (Merisotis & Phipps, 1999). The emphasis upon the role of the student as a part of the educational process is enhanced, as opposed to the overall role of education in a "one size fits all" approach. "Virtually all of the comparative or descriptive studies focus upon individual courses. This raises serious questions about whether a total academic program delivered by technology compares favorably with a program provided on campus" (Merisotis & Phillips, 1999). More recent literature has explored the impact of the distance learning process upon the classroom in terms of the individual student response to the learning environment. Overall, the literature has not identified whether academic institutions as a whole are responsible for identifying and promoting high standards of academic excellence in distance learning courses.

As an example, the University of Phoenix Online is a distance-learning program that is not affiliated with any traditional brick-and-mortar educational institute. Created specifically as a for-profit, publicly-traded business, the University of Phoenix Online has a comparatively low dropout rate as compared to other distance learning programs and indicates that 65 percent of students graduate (Symonds, 2003). The rate of students leaving this program, although less than other online or distance-learning classes which have a rate of 50 percent or more students discontinuing the classes, is still extremely poor when compared to the traditional classroom setting (Nistor et al., 2003). A traditional university or college that lost fifty percent or more of its students during the course of their academic careers would be considered a failure (Smithback, 2004).

The reasons for failure to complete distance learning programs are challenging in terms of which students receive access, as well as the conditions under which access is gained. The learning style literature suggests that there may be incompatibility between certain personality types and the learning environment.

2.12 Summary of the Literature Review

Conditions or components found within the distance learning setting promote an emphasis upon the integration of technology and the student to achieve increased satisfaction and positive educational outcomes. There are multiple methods through which technology can be applied, and the type and the scope of technological application is likely to promote student learning depending on the quality of technology, quality of materials, and perhaps the learning style of the student. There are some indications of a relationship between the learning style of the student and the predictability of performance within educational settings, although some meaningful counterevidence exists as well. Students manifest learning types, or specific personalized approaches which connect them to their academic materials. According to MBTI theory, those students who are self-motivated and who work closely with an educator who models their basic personality styles may perform better, regardless of the instructional format, than students who need a highly structured environment to promote their academic development. Patterns in learning style and the perceptiveness of the student may play a role in identifying whether a student is likely to respond to the distance learning process. Many variables affect academic success for individual students. When or how learning style variables become important to teaching and learning are, at present, unclear. More study of these and other personal and contextual variables as they relate to tracking and learning is needed.

3.0 CHAPTER 3- METHODS AND PROCEDURES

3.1 Introduction

This chapter includes the following sections: Research Questions, Description of Subjects, Description of the Research Instrumentation, Study Design and Treatment of Data, and Description of Procedures.

The study was designed to identify components related to satisfaction in a technology-enhanced science course. As a result of the limited number of students in the sample, meaningful relationships between learning style and the components in this technology-enhanced course could not be adequately delineated. Relationships between them were described to provide information about the likely value of further research in this area. The Paragon Learning Style Inventory was used to identify learning styles of participants.

3.2 Research Questions

1. To what extent were students satisfied with each of the following components in a technology-enhanced high school astronomy course: modes of discussion, modes of research, types of learning activities, modes of submitting assignments, modes of testing, and format of course materials?
2. What learning styles, or combinations of learning styles were related to student satisfaction with technology-enhanced components or non-technology enhanced components in a technology-enhanced astronomy course?

3.3 Subjects

The subjects for this study were 19 high school students in grades 10-12 at Greater Johnstown High School, Johnstown, PA. This sample represents all students in the elective science course Astronomy at Greater Johnstown High School of the 2002-2003 school year. A total of 19 students, 9 males and 10 females, with ages ranging from 15 to 18 years were enrolled in the course.

3.4 Research Instrumentation

The instrument used to assess learning style was the Paragon Learning Style Inventory (PLSI). The Paragon Learning Style Inventory is a learning style inventory that obtains a measure of the Jungian psychological/learning dimensions. Unlike many Learning Style Inventories, the PLSI is written for ages 8 and older (Shindler, 2000).

The Paragon Learning Style Inventory was developed in 1990 and revised in 1992. The revision included additional items that increased the number of questions from 36 to 48 and eliminated items that were determined to not function well. The revised 48 item instrument has shown excellent stability, and reliability for populations tested.

> "While reliability is the primary concern of many instruments of this type, as much attention was given to construct validity when developing the PLSI. The factors or dimensions are not only independent, but they also reflect the proportions within the population. For example, the PLSI will obtain about 50-50 thinkers and feelers, and judgers and perceivers. This is not true of other instruments of this type"(Shindler, 2000, About PLSI section, para. 3).

According to Shindler, the author of the PLSI inventory, the PLSI reports similar reliability and validity to the Keirsey Bates (KB) Temperament Sorter. Reliability with any instrument of this type is much better as the age of the subject increases to about the age of 20 (Shindler, 2000). However, the PLSI was written specifically for ages 9 and up. Therefore, the

PLSI inventory should be an appropriate inventory to determine type profiles for the age group represented by the subjects in this study which range from 15 to 18 years.

The instrument to measure student satisfaction (Appendix A) is a researcher-generated questionnaire. This questionnaire contains 15 questions to assess the respondents' opinions regarding satisfaction of the technology-enhanced astronomy course in which they were currently enrolled. The 15 opinion questions were arranged on a 5-point scale, ranging from highest level of satisfaction to lowest level of satisfaction, to assess levels of satisfaction with various components in the course. Components included student perception of satisfaction with discussion groups, e-mail, chat rooms, face-to-face discussions, research techniques, accessibility of grades, availability of course materials, and corresponding traditional classroom activities. Blackboard course management software was utilized and this software platform allows users to communicate through discussion groups, chat-room and e-mail. The aforementioned components were considered as technology-enhanced discussion. Face-to-face discussion also was included as a non-technology-enhanced discussion factor. Other technology-enhanced components included web based research, online accessibility of grades, online availability of course materials, and online based testing. The corresponding non-technology-enhanced components included paper-based research, classroom availability of materials and paper-based testing.

3.5 Study Design

This study represents a descriptive study that includes correlational investigation. The data collected in the study were used to describe: 1) satisfaction with components of a

technology-enhanced course, and 2) overall relationships between a student's preferred learning type combinations and overall satisfaction with in a web-enhanced secondary astronomy course.

3.6 Procedures

Learning style profiles were determined by using the PLSI inventory. The PLSI inventory was given to the test subjects during the introductory activities of the course. Based upon the literature, the combinations of learning styles that are expected to have the largest effect on teaching and learning are the categories of extroversion/introversion (E/I) and sensate/intuitive (S/N). Therefore, these categories were the focus of the learning type data collected. Results were tabulated and compared using the statistical comparisons outlined below.

Satisfaction data were collected at the end of the course using the researcher-designed self-reporting satisfaction survey. Student responses to items relating to technology-enhanced strategies (items 1, 2, 3, 5, 7, 9, 11, 13 and 14) were summed to produce a total score for overall satisfaction with technology-enhanced instructional methods. Similarly, student responses to items relating to non-technology-enhanced strategies (items 4, 6, 8, 10, 12, and 15) were summed to produce a total score for satisfaction with non-technology-enhanced methods. The items in the aforementioned groups were stated in such a manner that summing the scores across all items results in high scores representing greater satisfaction and low scores lower satisfaction. These overall satisfaction scores for the two types of components were adequate for the preliminary investigation of those learning style characteristics that were investigated. Independent sample t-tests and ANOVAs were used to examine the relationship between selected learning styles (based on the number of students with particular learning style characteristics) and satisfaction with technology-enhanced and non-technology-enhanced instruction.

Two types of statistical analyses were used in this study, t-tests and ANOVA. The t-test is a parametric test that assumes a normal distribution in the population. To evaluate this assumption, the distribution of satisfaction scores was examined. All comparisions with the exception of the discussion types were analyzed using t-tests. ANOVA was used to compare the three types of discussion measured in this study. Analysis of variance (ANOVA) performs comparisons like the t-test, but for an arbitrary number of components. A 0.05 level of significance was used for all statistical tests.

Student satisfaction with each factor identified in Research Question 1 was investigated using student responses to the specific items on the questionnaire . For example, to address modes of discussion, the items dealing with Chat Room (Item 2), Discussion Group (Item 3), and Face-to-Face (Item 4) were used. Means and standard deviations were calculated and an ANOVA was carried out to see if students varied in their satisfaction with these modes as they experienced them in the class. When only two characteristics represented a factor, a t-test was used. In all cases, a level of 0.05 was used to determine statistical significance. The items used to address each of the components are listed in Table 2.

Table 3.1 – Questionnaire Items Used to Address Each Satisfaction Component

Factor Characteristics	Item Number
Discussion	
e-mail	1
Chat-Room	2
Discussion Group	3
Face-to-Face	4
Research	
Web-Based	5
Text Based	6
Types of Learning Activities	
Web-Based	7
Cooperative In-Class	8
Submitting Assignments	
Electronic	9
Paper	10
Testing	
Web-Based	11
Paper Based	12
Gradebook	
Online Gradebook	13
Format of Course Materials	
Web-Based	14
In Class	15

Differences in overall satisfaction for students with different learning styles were described only for those characteristics of learning styles represented by six or more students. As a result, satisfaction differences were investigated for extroverted/intuitive (EN) and introverted/sensate (IS) learning styles only. Several t-tests were used to compare overall satisfaction with technology-enhanced methods and with non-technology methods. Similar comparisons of satisfaction were made between E and I and S and N characteristics of learning style. The learning type profiles of study participants are listed in Appendix B.

4.0 CHAPTER 4 – FINDINGS

4.1 Introduction

The purpose of this study was to examine student satisfaction in terms of components associated with technology-enhanced courses and to explore learning styles of students in terms of their overall satisfaction in a technology-enhanced astronomy course. The components included modes of discussion, modes of research, types of learning activities, modes of submitting assignments, modes of testing, and format of course materials. The study included 19 students enrolled in the elective science course Astronomy at Greater Johnstown High School. There were a total of 9 males and 10 females with ages ranging from 15 to 18 years.

This chapter is divided into two sections, one for each of the research questions. The first section deals with the analysis of components associated with satisfaction in a technology-enhanced course. The second section deals with the analysis of a student's preferred learning style in relationship to their overall satisfaction with the technology-enhanced course.

4.2 Components of Satisfaction

A series of analyses were carried out to compare students' satisfaction with technology-enhanced and non-technology-enhanced components: modes of discussion, modes of research, types of learning activities, modes of submitting assignments, modes of testing, and format of course materials.

The first analysis in this series pertained to modes of discussion. Table 3 shows the results of a repeated-measures ANOVA that was conducted to compare students' satisfaction with three forms of discussion: chat-room, discussion group, and face-to-face.

Table 4.1 – Student Satisfaction with Three Modes of Discussion

Method	Mean	SD	F	p
Chat Room	4.42	1.12	5.09	0.011
Discussion Group	4.16	0.689		
Face-to-Face	3.58	1.02		

As shown in Table 3, the significant results of the ANOVA indicate differences in student satisfaction among the three modes of discussion comparing student satisfaction ($p<0.011$). Tukey post-hoc comparisons revealed that the only significant difference in satisfaction was between the chat room discussion format and the face-to-face format. Tukey's honestly significant difference (HSD) = critical value of q X square root (Mean square error/n) with a critical value of q = 3.49, square root(mean square error/n)=Square root (.693/19) = 0.191 and HSD=(3.47)(.191)=0.6628. The results showed the following: 1) chat room vs. discussion group 4.42-4.16=0.26., (since 0.26 is less than 0.66 this relationship is not significant). 2) chat room vs. face-to-face 4.42-3.58=0.84, (since 0.84 is greater than .66 this relationship is significant), and 3) discussion group vs. face-to-face 4.16-3.58=0.58, (since 0.58 is less than .66 this relationship is not significant). Based on the analysis of this data, students are more satisfied with chat rooms than face-to-face discussion. However, the analysis did not show any more satisfaction for the chat-room than for discussion groups.

This significant difference in satisfaction corresponds well to comments from students regarding chat room discussion. Comments indicating more satisfaction included references to:

shy students being more comfortable, fewer interruptions from classmates, opportunities to gather thoughts before responding, ease of expressing thoughts without fear of ridicule from other students, more comfortable typing than talking, and a fun way of discussing topics. Only one comment indicating less satisfaction was submitted regarding chat rooms. In this comment the student did not like the fact that every person in the class could read her/his post to the discussion.

Comments regarding discussion groups were split more evenly between more and less satisfying experiences. Comments indicating greater satisfaction included references to feeling less timid and enjoying the creative discussion. Three comments indicating less satisfaction were submitted regarding discussion groups. In these cases, the students did not like the fact that some students responded to questions with off-topic answers, reading in class and discussing topics with others.

Finally, comments regarding face-to-face discussions were split evenly between more and less satisfying experiences and had very few comments overall. Comments indicating more satisfaction included references to expressing yourself and hearing others and being able to use facial expressions to show how strongly one feels. Similar to comments from discussion groups, two comments indicating less satisfaction were submitted regarding face-to-face discussions. In the first comment, the student did not like face-to-face discussion because it made her/him feel nervous and afraid of making mistakes and in the second comment the student response reflected a dislike of reading in class (See Appendix C for all student comments).

The second analysis pertained to mode of researching topics. Table 4 shows the results of a dependent-samples t-test that was conducted to compare satisfaction with web-based and text-based research techniques.

Table 4.2 – Student Satisfaction with Modes of Researching Topics

Method	Mean	SD	t	p
Web-Based	4.16	0.688	6.088	<0.0005
Text-Based	2.74	1.19		

As shown in Table 4, the data comparing student satisfaction to modes of research indicates a significant difference in satisfaction ($p<0.0005$) between web-based and text-based modes of researching topics. Based on the analysis of this data, web-based research was the more satisfying to this population of students.

The significant difference in satisfaction corresponds well to comments from students regarding web-based research versus text-based research. Comments indicating more satisfaction using the web for research included references to ease of finding information and ease of doing many things at once. No negative comments regarding web-based research were received.

Comments regarding text-based research consisted of less satisfying experiences only. The student comments included: a dislike for books, difficulty in finding information in books, dislike of reading, outdated information in text resources, and limited information in books versus web resources. No positive comments were received regarding text-based research.

The third analysis pertained to learning activities. Table 5 shows the results of a dependent-samples t-test comparing satisfaction with web-based vs. cooperative in-class activities.

Table 4.3 – Student Satisfaction with Types of Learning Activities

Method	Mean	SD	t	p
Web-Based	4.05	0.705	0.00	0.999
Cooperative In-Class	4.05	0.911		

As shown in Table 5, there was no significant difference between the two formats ($p<0.999$). Based on this result, learning activities using web-based methods did not increase the level of satisfaction of this student population.

The lack of significant difference in satisfaction between web-based and cooperative in-class discussions is also apparent in the student comments. Only "more satisfied" comments were received for both types of activities. Comments regarding more satisfaction for web-based activities included: ease of use, having all information needed on one site, and learning in a different way. Likewise, comments regarding more satisfaction for cooperative in-class activities included: liking the ability to ask questions, opportunities for bonding and teamwork, and having partners to help with answering questions.

The fourth analysis pertained to modes of submitting assignments. Table 6 shows the results of a dependent-samples t-test comparing satisfaction with electronic vs. paper submission.

Table 4.4 – Student Satisfaction with Modes of Submitting Assignments

Method	Mean	SD	t	p
Electronic	4.05	1.31	1.49	0.154
Paper	3.37	1.07		

As shown in Table 6, there was no significant difference between the two modes of submission ($p<0.154$). Based on the analysis of this data, the mode of submitting assignments using electronic methods does not affect the level of satisfaction of this student population.

The lack of significant difference in satisfaction between electronic versus paper submission of assignments is also apparent in the student comments. Comments were fairly evenly split between more and less satisfied and electronic and paper submission. Comments regarding more satisfaction for electronic submission included: liking to type better than to write,

less likelihood of losing assignments, easier to turn in, and more convenience. Comments regarding less satisfaction for electronic submission included: restriction on how the assignments could be done, not having a computer at home, and problems with electronic delivery.

Comments regarding handing in paper assignments also were split; however, there were more "less satisfied" comments than "more satisfied". Comments regarding more satisfaction for handing in paper assignments were related to problems with technology when handing in papers electronically. Students liked the fact that handing in paper-based assignments assured them that the teacher received their work. Comments regarding less satisfaction for paper-based submission included: liking to type better than to write, having less paperwork to keep track of, and not taking advantage of the technology available for handing in assignments.

The fifth analysis pertained to modes of testing. Table 7 shows the results of a dependent samples t-test comparing satisfaction with web-based vs. paper-based testing.

Table 4.5 – Student Satisfaction with Modes of Testing

Method	Mean	SD	t	p
Web-Based	4.63	0.597	6.824	<0.0005
Paper-Based	2.58	1.07		

As shown in Table 7, the analysis comparing student satisfaction to modes of testing indicates a significant difference in satisfaction ($p<0.0005$) for web-based testing. Based on the analysis of this data, testing using web-based testing methodologies was more satisfying to this student population. Student comments regarding online testing confirm the significant difference in satisfaction. Comments referring to "more satisfied" included: online testing is interesting and different, easier, more convenient and faster, more relaxing, and less stressful and grades are available immediately after testing, No "less satisfied" comments were submitted for online-based testing.

Comments regarding paper-based testing consisted of a majority of "less satisfied" comments with only one "more satisfied" comment. The comment referring to "more satisfied" stated that the student liked paper-based testing because it is the way he/she always took tests. Comments referring to "less satisfied" included: less comfortable testing environment, dislike of writing, and tests can only be taken in class.

The sixth factor in this series pertained to the availability of an online grade book. No paper-based grade book was available for this study; therefore, no statistical analyses were possible. However, comments regarding satisfaction were collected for this factor. Comments referring to "more satisfied" included: liking the ability to check grades at home or anytime, ease of access to grades, ability to check missing assignments, and ability to show grades to parents. No comments regarding "less satisfied" were received.

The seventh and final analysis in this series pertained to the format of course materials. The results of a dependent-samples t-test comparing satisfaction with web-based vs. in-class materials are shown in Table 8.

Table 4.6– Student Satisfaction with Format of Course Materials

Method	Mean	SD	t	p
Web-Based	4.42	0.692	6.028	<0.0005
In-Classroom	2.53	1.17		

As shown in Table 8, the analysis of the data comparing student satisfaction to format of course materials indicates a significant difference in satisfaction for web-based availability of course materials ($p<0.0005$). Based on the analysis of this data, web-based availability of course materials is more satisfying to this student population. Student comments were consistent with the significant difference comparing web-based to classroom-based availability of course

materials. Comments regarding "more satisfied" to web-based availability of course materials included: ease of getting documents if misplaced, ease and convenience of access, and the ability to view all course materials. No "less satisfied" comments were received for web-based availability of course materials.

The majority of comments regarding classroom-based availability of course materials were in the "less satisfied" category. Comments included: dislike of books, inability to finish lost or forgotten work, difficulty in getting make-up work, and inability to get work from home.

4.3 Student Preferred Learning Style as a Predictor of Satisfaction

Analysis that addressed the second research question describes relationships between the general learning styles among these 19 students and student satisfaction on technology-enhanced or non-technology enhanced components in a technology-enhanced astronomy course. The learning styles that were selected for these analyses were extroverted-sensate (ES), extroverted intuitive (EN), introverted-sensate (IS), and introverted-intuitive (IN). In the general population, the distribution of learning styles is IS-8, IN-4, ES-15 and EN-18 (Lawrence, 1993). The distribution of learning types in this study were as follows: IS-7, IN-3, ES-1 and EN-8. Because of this distribution, the study group could be considered atypical from the distribution of learning type combinations when compared the ratio of learning types in a typical classroom. As a result of the small sample size, comparisons utilizing all four learning type combinations were not possible and only the combinations of EN and IS were examined. Therefore, alternative statistical analyses using Pearson Product Moment Correlations and t-tests were used to relate satisfaction with the technology-enhanced and non-technology-enhanced teaching methodologies to the various components of learning style.

The EN and IS combinations occurred most frequently; therefore, an independent-samples t-test was conducted to compare the satisfaction of these two combinations. The results of comparing satisfaction of technology-enhanced and non-technology-enhanced methodology to EN and IS Learning Types are shown in Table 9.

Table 4.7 – Satisfaction of EN and IS Learning Types with Technology-Enhanced Methodology

	EN (n=8)		IS (n=7)			
Measure	Mean	SD	Mean	SD	t	p
Satisfaction with Technology-Enhanced Methodology	39.38	3.66	36.29	4.68	1.43	0.175
Satisfaction with Non-technology-enhanced Methodology	18.38	4.72	18.57	5.32	-0.076	0.941

As shown in Table 9, the analysis of the data comparing EN and IS learning types indicated no significant difference between these types regarding satisfaction with either technology-enhanced ($p<0.175$) or non-technology-enhanced ($p<0.941$) teaching methods. Based on the analysis of this data, learning type combinations did not predict overall satisfaction with either technology-enhanced or non-technology enhanced methodology among the 15 students tested in a technology enhanced course.

As stated in the limitations of this study, the sample size was limited due to student enrollment and the schedule imposed. As a result of this small data set, comparing student satisfaction and the learning style combinations ES, EN, IS, and IN was not possible. Therefore, additional statistical comparisons using t-tests were used to compare satisfaction of Extroverted (E), Introverted (I), Sensate (S) and Intuitive (I) types to technology-enhanced and non-technology-enhanced teaching methods.

An independent-samples t-test was carried out to compare the satisfaction of students classified as Introverted (I) and Extroverted (E). The results are shown in Table 10.

Table 4.8 – Satisfaction of Extroverted (E) and Introverted (I) Types with Technology-Enhanced Methodology

	E (n=9)		I (n=10)			
Measure	Mean	SD	Mean	SD	t	p
Satisfaction with Technology-Enhanced Methodology	39.78	3.63	37.00	4.67	1.43	0.169
Satisfaction with Non-technology-enhanced Methodology	18.67	4.50	19.00	4.50	-0.161	0.874

As shown in Table 10, the analysis of the data comparing extroverted and introverted learning types indicated no significant difference between extroverted or introverted types regarding satisfaction with either technology-enhanced ($p \leq 0.169$) or non-technology-enhanced ($p \leq 0.874$) teaching methodologies. Based on the analysis of this data, the individual learning type of extroversion or introversion did not predict overall satisfaction with either technology-enhanced or non-technology-enhanced methodology in a technology-enhanced course.

An independent-samples t-test was carried out to compare the satisfaction of students classified as Sensate (S) and Intuitive (I). The results are shown in Table 11.

Table 4.9 – Satisfaction of Sensate (S) and Intuitive (I) Types with Technology-Enhanced Methodology

	N (n=8)		S (n=11)			
Measure	Mean	SD	Mean	SD	t	p
Satisfaction with Technology-Enhanced Methodology	37.12	4.94	39.18	3.84	-1.023	0.321
Satisfaction with Non-technology-enhanced Methodology	18.88	5.00	18.82	4.12	0.027	0.979

As shown in Table 11, the analysis of the data comparing sensate and intuitive learning types indicated no significant difference between these types regarding satisfaction with either technology-enhanced ($p \leq 0.321$) or non-technology-enhanced ($p \leq 0.979$) teaching methodologies. Based on the analysis of this data, the individual learning type of sensate or intuition did not predict overall satisfaction in a technology enhanced course. Thus the different learning styles were unrelated to their reported satisfaction with either technology-enhanced or non-technology-enhanced course characteristics addressed in this study.

4.4 Summary of Results

Chapter Four was divided into two sections. The first section examined students' satisfaction with technology-enhanced and non-technology-enhanced teaching methodologies of the following: modes of discussion, modes of research, types of learning activities, modes of submitting assignments, modes of testing, and format of course materials. The second section examined satisfaction with overall technology-enhanced and non-technology-enhanced methodology of the general learning types of the 19 participating students. Data were analyzed using ANOVA (with post-hoc comparisons) and t-tests with rejection levels set at 0.05.

The analyses indicated the following:

- Statistical analyses and comments show significant levels of student satisfaction related to the use of the following components in a technology-enhanced classroom:
    - Chat Rooms rather than face-to-face for discussions, although discussion groups scored very similarly to Chat Rooms.
    - Web based research

    - Web based testing
    - Course materials on-line
    - Online course grades
- Comparisons of PLSI learning styles: IS vs. EN, Introverted vs. Extroverted, and Sensate vs. Intuitive types showed no difference in satisfaction on overall technology-enhanced or non-technology-enhanced components.

The statistical analyses and student comments identified components for which students reported higher levels of satisfaction in this technology-enhanced course (i.e., chat rooms for discussions, web based research, web based testing, availability of course materials on-line, online availability of course grades). Comparisons of students who were IS vs. EN, Intuitive vs. Extroverted or Sensate vs. Intuitive failed to show significant differences in satisfaction based upon the PLSI inventory classifications and the course-related components used in this study. Despite the views of some authors, even with the limited number of students in this study, there was no evidence that learning style related in any way to satisfaction with the technology-enhanced course or methodology.

5.0 CHAPTER 5 – DISCUSSION AND IMPLICATIONS

5.1 Purpose and Objectives

The purpose of this study was to examine student satisfaction with selected technology-enhanced vs. non-technology-enhanced components in a technology-enhanced astronomy course which included: modes of discussion, modes of research, types of learning activities, modes of submitting assignments, modes of testing, and format of course materials. Learning style was examined in relation to overall student satisfaction with technology-enhanced components. The components and associated student comments were examined and analyzed with respect to the students' perceived satisfaction of the selected components of the course.

The following research questions were examined in this study:

1) To what extent were students satisfied with each of the following components in a technology-enhanced high school astronomy course: modes of discussion, modes of research, types of learning activities, modes of submitting assignments, modes of testing, and format of course materials?
2) What learning styles, or combinations of learning styles were related to student satisfaction with technology-enhanced components or non-technology enhanced components in a technology-enhanced astronomy course?

5.2 Methods and Procedures

The subjects in this survey included 19 high school students with ages ranging from 15 to 18 years, enrolled in an elective Astronomy course. Subjects in this study were given a learning style survey and questionnaire by the researcher. The learning style survey (Shindler, 2001) was given to all subjects to determine their specific learning types. The student questionnaire was designed to elicit student satisfaction ratings with respect to technology-enhanced vs. non-technology-enhanced instructional methodology utilized in the course. Students responded to all questions on the satisfaction survey using a five-point scale, with 1 indicating the least satisfaction and 5 indicating the greatest satisfaction. All data collection was done in a classroom setting.

Students were divided into sub-groups based upon composites of their extroversion/introversion (E/I) and sensate/intuitive (S/N) types. Sample size did not permit analyses to compare satisfaction scores to students in the four possible categories (i.e. ES, EN, IS, IN). Therefore the only comparisons possible were the type combinations (E vs. I and S vs. N) and pairs (EN vs. IS) (See Appendix B).

5.3 Research Question 1: Summary and Discussion

The first research question dealt with examining student satisfaction with technology-enhanced vs. non-technology-enhanced components in a technology enhanced astronomy course. The analysis of the data collected relative to the satisfaction of students indicated several components related to satisfaction with various aspects of technology enhanced classes. In addition to the statistical ratings, students' comments were collected regarding their satisfaction. Student comments regarding components that showed a relationship to increased satisfaction

were informative in three areas. First, the anonymous nature of discussion allowed students to respond without fear of peer reactions. This lack of fear was suggested by comments in both chat room and discussion groups. Second, web-based availability of course materials and web-based testing gave the students flexibility in retrieving classwork and completing assessments. Third, student comments also suggested a less stressful testing environment while utilizing the web-based testing format. Although the aforementioned components (chat room/discussion groups, web-based availability of course materials and web-based testing) were the only ones to show significant relationships to increased satisfaction, many student comments reflected positive feeling toward the use of technology in the classroom. A complete compilation of student comments is located in Appendix C.

The comparisons examined student satisfaction with technology-enhanced vs. non-technology-enhanced components of the course. Students reported higher satisfaction with the following components in a technology-enhanced astronomy course.

The analysis of the data revealed "chat room" discussion of topics was more satisfying to students than non-technology-enhanced face-to-face type discussions. Student comments regarding satisfaction of chat room discussions also supported the statistical analyses, although they reported similar levels of satisfaction with discussion groups. For example, student comments regarding more satisfaction in chat room discussions included: less worry of peer reactions to comments, easier to express ideas, fewer interruptions, and more time to think about answers before responding. This finding demonstrates that web-based "chat-room" communication in the classroom resulted in a more satisfying effect for the learner than face-to-face discussions. The literature also shows that students involved in collaborative discussions within forums such as chat-rooms and discussion groups showed an increase in understanding of

subject material (Jones & Paolucci, 1999). Techniques to promote communication and collaboration create environments of increased learning and understanding (Galusha, 1997; Marjanovic, 1999; Sanders & Morrison-Shetlar, 2001). Sanders and Morrison-Shetlar (2001) recommend using chat room features to make students more comfortable using this type of communication tool as students who used electronic communication regularly were better able to answer questions on tests. Research also indicates that two-way communication can provide more effective learning and increased satisfaction (McVay-Lynch, 2001; Sherry, 1996). Results from the current study indicate that chat room and discussion groups utilized in a technology enhanced course were more satisfying to students than non-technology-enhanced face-to-face discussions.

The analysis of the data collected demonstrated that web-based testing was more satisfying to students than non-technology-enhanced paper and pencil type testing. The satisfaction with web-based testing may be related to decreased turn-around time of receiving web-based assessment results. Online testing allows the students flexibility in the time and location of the test, and enables instructors to provide multiple format assessments and even have computer scored options. Student comments regarding more satisfaction with web-based testing referred to web-based testing being easier, more convenient and faster, yielding immediate assessment feedback, being less stressful and allowing more time to think, and providing ease in correcting or changing answers. Although issues arise such as test proctoring and technical problems, the increase in student satisfaction may result in higher levels of achievement.

Course materials available on-line were more satisfying to students than course materials being available only in the classroom. Student comments regarding satisfaction of online availability of course materials also support the statistical analyses. For example, student

comments regarding increased satisfaction with online based course materials referred to, easy access to course materials from home, access to class materials if absent, and replacement of forgotten/lost materials. These comments are consistent with the literature regarding the increase of accessibility with web-based course materials (Bento & Bento, 2000). By placing course materials online, students can download and print classroom materials without seeing the instructor or even visiting the campus. In an on-line course having materials available online is a necessity, however, in a technology-enhanced classroom, this resulted in a more convenient, less restrictive classroom. Online materials are essentially an "online file cabinet" with student access regardless of time or location, which results in less photocopying of materials and easier distribution of course materials.

5.4 Research Question 2: Summary and Discussion

The second research question dealt with using a student's preferred learning style as a predictor of satisfaction in a technology-enhanced astronomy course. Answering this research question required that the specific learning style combinations represented in this small sample be related to overall satisfaction on either overall technology-enhanced or non-technology-enhanced components in a technology-enhanced astronomy course. The learning style combinations used for these analyses were limited to extroverted intuitive (EN) and introverted-sensate (IS) due to the small sample size. The result indicated no significant difference between EN or IS types and satisfaction of web-enhanced ($p \leq 0.175$) or non-technology-enhanced ($p \leq 0.941$) teaching methodologies. This result is consistent with a meta-analysis by Allen, et.al., (2002) that found little difference among students with different learning styles in preference or satisfaction between technology and non-technology-enhanced courses. Based on the analysis of

this data, the hypothesis that learning type predicts student satisfaction of technology enhanced courses can be rejected. Similar results were obtained when comparing sensate (S) with intuitive (N) and extroverted (E) with introverted (I).

To summarize, students identified several components that increased satisfaction which are integral parts of a technology-enhanced course. These components included: Chat Room Discussions, Web-Based Research, Web-Based Testing, and Online Availability of Course Materials and Grades. Based on the responses of these 19 students in a technology-enhanced class, instructors of technology-enhanced courses should consider the following when designing their courses: 1) Utilize web based communication, specifically chat room type discussions and discussion boards, 2) Implement web based testing for assessments, and 3) Digitize course materials and guides so that they may be available in an online format. Based upon this study, learning style does not appear to relate to student satisfaction in a technology-enhanced course.

5.5 Discussion of Problems

The following issues should be considered when interpreting results and when continuing this type of research. One issue was related to computer hardware. During the research, the school in which the research was being conducted was in the process of moving to a new facility. The result was several interruptions of computer network availability and consequently, loss of web access. This may have affected responses to the satisfaction survey; however, this impact is unknown as no comments regarding the computer network were received from the students. Another issue was the small sample size. The sample size was limited by schedule and student enrollment, which was acknowledged as a limitation of the study. This limitation resulted in the study sample's being too small to permit an adequate analysis of some questions or issues related

to learning styles. An issue related to on-task behavior was observed regularly in chat-room type discussions. Students had to be monitored closely to remain focused on issues being discussed. Some students, without re-direction, tended to use the forum to gossip. Overall, this distraction was not a major problem as the instructor monitored all live sessions closely.

In a follow up of this study a comparison between technology-enhanced and non-technology-enhanced components and how they relate to student achievement would be informative, although admittedly complex to design. This study focused on components associated with satisfaction; determining if these components are also associated with increased achievement would be useful to course developers and instructors. However, using the results of this study, the components of a technology-enhanced course relating to an increase in student satisfaction may be better delineated for more accurate measures of satisfaction.

5.6 Implications for Practice

This study investigated selected components in a technology-enhanced astronomy course that contributed to student satisfaction. Results from this study indicated that students were highly satisfied with the following components of the course: chat room and discussion board discussions, web-based research, web-based testing, and online availability of course materials and grades. Chat room and discussion board discussions appear to be components related to increased student satisfaction. Comments reflecting greater satisfaction referred to: shy students being more comfortable, fewer interruptions from classmates, opportunities to gather thoughts before responding, ease of expressing thoughts without fear of ridicule from other students, more comfortable typing than talking, and a fun way of discussing topics. The satisfying effect of on-line testing and on-line availability of course materials appear to be related to communication.

On-line testing comments referring to "more satisfied" included: online testing is interesting and different, easier, more convenient and faster, more relaxing, and less stressful and grades are available immediately after testing. Course materials comments regarding "more satisfied" to web-based availability of course materials included: ease of getting documents if misplaced, ease and convenience of access, and the ability to view all course materials.

Based upon these results, a teacher who is concerned about increasing satisfaction might employ the following technology-enhanced techniques. Chat Room Discussions had a positive correlation to student satisfaction in this study. Student comments regarding Chat Room Discussions centered on the anonymous nature of chat room discussions. Specifically, students felt that discussing topics via computer gave them time to respond, not having fear of peer reactions, and a lack of interruptions. On-line Testing also had a positive correlation to student satisfaction in this study. Specifically, students felt that on-line based testing was easier than paper-based tests, more relaxed, gave immediate feedback and was easier to correct test answers. Finally, course materials available on-line had a positive correlation to student satisfaction in this study. Specifically, students liked the fact they could retrieve course documents regardless of location via the Internet.

In summary, as a result of this study the researcher can recommend that instructors of technology-enhanced courses utilize technology-enhanced instruction with an emphasis on technology-enhanced communication. These include, but are not limited to, chat-rooms, discussion-groups, and e-mail. The aforementioned technology-enhanced components were the only ones to show significant relationships to increased satisfaction; however, many student comments reflected positive feeling toward the use of technology in the classroom in general. Therefore, the students participating in this technology-enhanced science course were more

satisfied with technology-enhanced components than with similar approaches used in traditional classrooms.

5.7 Suggestions for Further Research

Suggestions for further research include the following:

- There was a wide range of final grades from this study group. This distribution of grades may suggest that even though students may be satisfied with selected components of the technology-enhanced course, their achievement levels may vary. This study focused on components of student satisfaction in a technology enhanced course. However, examining relationships between components of satisfaction and achievement may reveal components associated with higher levels of achievement.
- To what extent do modes of discussion (face-to-face, discussion group or chat room) affect learning? This study focused on how these modes were related to satisfaction. In the study, three specific modes were used and analyzed as variables; chat rooms, discussion groups, and face-to-face. Examining relationships between discussion type and learning may provide insights leading to increased learning in addition to satisfaction.
- Compare students who are most satisfied with technology-enhanced instruction with students who are not satisfied with technology-enhanced instruction and a variety of personal and academic characteristics, such as past achievement, IQ, age, career plans and course grades, including achievement in the class. The results of this type of study may begin to identify variables that affect satisfaction and achievement in technology-enhanced classes for all types of students.

APPENDIX A

STUDENT SATISFACTION SURVEY

Survey for Web-Enhanced Learning

Name: _____

Directions:

In this current Astronomy course you have had experience using technology which may have been different from a traditional classroom. Please rate each item regarding your level of satisfaction as a student using the item or experiencing the activity. Rate on a scale of 1-5, with 5 being the highest level of satisfaction and 1 being the lowest level of satisfaction.

	Satisfaction				
	Low				High
1. E-mail	1	2	3	4	5
2. Chat room for use in class discussing questions	1	2	3	4	5
3. Discussion group for group discussing questions	1	2	3	4	5
4. Face-to-face discussion for discussing questions	1	2	3	4	5
5. Using the web to research Astronomy topics	1	2	3	4	5
6. Using text references (books) for research	1	2	3	4	5
7. Using interactive web based sites for learning activities	1	2	3	4	5
8. Cooperative in–class activities	1	2	3	4	5
9. Handing in assignments electronically	1	2	3	4	5
10. Handing in “paper” assignments	1	2	3	4	5
11. Online Testing	1	2	3	4	5
12. Paper and Pencil Testing	1	2	3	4	5
13. Online Gradebook	1	2	3	4	5
14. Course materials available on-line	1	2	3	4	5
15. Materials available only in class	1	2	3	4	5

Student Interview Questions:

1. On page one of the survey you rated items regarding your satisfaction. On any items you rated a "5" please list the item number and explain how and why you rated this item a "5".

On page one of the survey you rated items regarding your satisfaction. On any items you rated a "1" please list the item number and explain how and why you rated this item a "1".

APPENDIX B

STUDENT COMMENTS ON SATISFACTION

Chat Room Comments

More Satisfied

It helps you talk and interact in a different way.

People tend to be shy in class, but in a chat room, where identities are not known, they tend to say what they are thinking.

It made me more satisfied because sometimes I do not like to respond in class. The chat room made me able to gather my thoughts before responding.

I thought it got the class to talk more, you didn't have to say anything out loud.

It is a fun way to learn what your classmates think.

It was a more fun way of discussing topics.

It is more enjoyable to be able to have a classroom chat room. It is a good way for everyone to be able to express their ideas. We were able to hear everybody's idea even if that person is one who never talks in class.

I also liked the chat room because you could express how you felt in a modified atmosphere.

I enjoyed using the chat room because it put a twist on class work.

With the chat rooms I am able to explain what I think to the class and I can also click over to research and find more on that particular subject.

I think it is better to use chat rooms to discuss questions because you are not talking so nobody can interrupt you.

Less Satisfied

I do not like having every person read what I am typing. I am quiet in class but I am even more quiet when it comes to that.

E-Mail Comments

More Satisfied

Hand in assignments anytime.

E-mail is easy and fast.

It is much easier for me to e-mail questions and assignments.

I would rather do e-mail than writing.

It is a fast and easy way to communicate.

I really like e-mailing you the assignments because you didn't have to worry about losing the papers.

Less Satisfied

I didn't like e-mailing assignments, it would be easier to turn it in in person.

Discussion Group Comments

More Satisfied

We got into interesting discussions and because not everyone agreed on everything, we were able to debate on subjects and it got us thinking and learning in creative ways.

I like to discuss questions in a group. You get a better answer.

It gives the classroom an edge to just listening to teachers.

I like the discussion group because I wasn't as timid to voice my opinion as I would in a normal class setting.

Less Satisfied

I didn't like the discussion group because there were some people who responded with off-topic answers.

I don't like to sit in a classroom and read, I would rather do it typing and online.

I don't like talking out in class or discussing things with other people.

Face to Face Comments

More Satisfied

It allows you to express yourself and hear others as well.

Face-to-face is different and gives students a chance to do things different than they have been doing for their entire school life.

Face to face I can show how strongly I feel by my facial expressions.

Less Satisfied

I don't like to sit in a classroom and read, I would rather do it typing and online.

I don't like face-to-face discussion too much because sometimes you feel a little bit nervous and you are afraid to make mistakes.

Research Using the Web Comments

More Satisfied

It was a lot easier to find information and gives you more information.

Using the web makes it easier to do many things at once.

The web is faster.

I think it is better to use the web to research Astronomy topics because you can find more information in there and its easy to do.

Less Satisfied

No Comments Received

Research Using Books Comments

More Satisfied

No Comments Received

Less Satisfied

I don't like books

Textbooks can be a hard source to find information from

I don't like to sit in a classroom and read, I would rather do it typing and online.

The internet was easier to look up information on.

Textbook research is kind of boring.

Text is outdated and is much slower to find information.

I don't like using text books for research, because the information is very limited compared to the information available online.

Sometimes its very hard to search for information in the textbooks, because some information in one book, another information is in another book. So it takes a lot of time to find something in different books.

Web Based Activities Comments

More Satisfied

Using interactive web based site taught me things in a different way. It is not the same as a teacher talking to you.

It has all the information you need right on the site.

It is a lot easier to use the web.

Using the web makes it easier to do many things at once. You can learn things and do it quicker and easier

Less Satisfied

No Comments Received

Cooperative In Class Comments

More Satisfied

Having cooperative in class activities allows mw to learn hands on. It allows me to ask questions too.

I feel I learn more when you do things together.

It gives the class a more bonding sense and teamwork.

It is fun to have active projects in class.

Cooperative in-class activities are good, because if you don't know the answer for the question, your group-partners can help you.

Less Satisfied

No Comments Received

Electronically Handing in Assignments Comments

More Satisfied

I like to type (better) than write.

It was easier to me that way. I can type faster than I write

Its easy and you can't really lose papers.

We are able to work on assignments at home and able to turn it in without the fear of losing the paper, Easier to remember.

I lose a lot of papers and having most assignments online was very helpful

It makes it easier to turn it in, when you do it you don't forget to bring it.

Handing in assignments electronically is more convenient.

Less Satisfied

I didn't like this because it restricted me on how I could do the assignments. I had to have a computer and a lot of time and do them where I was going to be.

I'd just rather turn in assignments in person.

I didn't like handing in assignments electronically because one time the teacher didn't receive my essay.

Handing in Paper Assignments Comments

More Satisfied

Handing in work in person is easier in case it wouldn't get through w/electronic or computers wouldn't work.

I liked handing in paper assignments rather than handing them in electronically because I knew for sure that they were received.

Less Satisfied

I don't like to sit in a classroom and read, I would rather do it typing and online.

I didn't like the fact that we had to hand in paper assignments because I lose a lot of papers and having most assignments online was very helpful

After 11.5 years of taking home books and countless numbers of worksheets it gets both boring and annoying. Now that we have quickly expanding technology, we should take full advantage of it.

Online Based Testing Comments

More Satisfied

It is a interesting and different test taking experience

It is easier, more convenient and faster.

I feel that I can think better.

It was easy to do a test online because you could use your book or other material.

I like to type and it made me more relaxed.

A better/different way of testing.

Grades available immediately after testing.

I liked online testing because it was less stressful than sitting there w/a paper and pencil.

I just like it better taking some old test gets old.

Online testing is good because you have more time to think and if you are wrong it is easier to correct your mistakes.

Less Satisfied

No Comments Received

Paper Based Testing Comments

More Satisfied

I liked (would) rather take a test with paper and pencil just because I have been tested that way throughout my schooling.

Less Satisfied

I do a lot better on tests when they are oral or online. Seeing the paper makes me nervous and I freeze. Doing things this way allowed me to comfortably do work.

Papers can get lost and writing hurts sometimes.

I don't like to sit in a classroom and read, I would rather do it typing and online.

These tests were hard and you might have to write, but online you just have to click.

I didn't like paper and pencil testing because doing the tests on the computers was beter mainly because it was multiple choice.

It takes more time to take it, you can only do it in class.

Online Based Grade Book Comments

More Satisfied Comments

You can check your grade at home.

The online grade book allows you to look at your grade anytime

They are easier to access, especially when you don't have class

It was nice to get our grades anytime online.

You can check your grade all the time.

I liked being able to get online and checking my grades and seeing that I needed to hand in.

You can look at your grade at any time you can get online.

I liked the online grade book because I could check my grade anytime I wanted to and show my parents.

Less Satisfied

No Comments Received

Online Based Course Materials Comments

More Satisfied

Do assignments at home or at school and turn them in quickly.

If you forget a paper in school you can just print one up.

They are easier to access, especially when you don't have class

Easier to do things.

The materials online was right there. You didn't need to go somewhere else to get them.

If materials are available online you can see what you are going to study and learn during this course

Less Satisfied

No Comments Received

Classroom Based Course Materials Comments

More Satisfied

Materials available in class, I like because I could take them home or do work in a study hall.

Less Satisfied

I don't like books.

If you forget something at home, you can't do it.

If I missed a day, I could not get the materials conveniently online.

I don't like to sit in a classroom and read, I would rather do it typing and online.

You should always use a wide variety of materials in different places. Not only in class because it is boring and restless.

If absent for long periods of time it is not possible to make up work.

I didn't like when some materials were only available in class. If you lost the material or never got it you couldn't get it online at home.

You have to be in class to get what you need.

After 11.5 years of taking home books and countless numbers of worksheets it gets both boring and annoying. Now that we have quickly expanding technology, we should take full advantage of it.

APPENDIX C

STUDENT LEARNING STYLE PROFILES

Learning Type Profiles of Study Participants

Participant	E/I	S/N	T/F	J/P
1 - 5	E	N	F	P
6 - 8	E	N	F	J
9	E	S	F	P
10 - 11	I	N	F	J
12 - 13	I	N	F	P
14 - 15	I	S	T	J
16	I	S	F	P
17 - 19	I	S	F	J

E – Extrovert
I – Introvert
S – Sensate
N – Intuitive
T – Thinker
F – Feeler
J – Judger
F – Feeler

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