AN EXAMINATION OF THE RELATIONSHIP AMONG STUDENT LEARNING STYLE,

INSTRUCTOR LEARNING STYLE, AND STUDENT PERFORMANCE IN A GEORGIA

TECHNICAL COLLEGE

by

STAN C. LAWSON

(Under the Direction of Clifton L. Smith)

ABSTRACT

Since the 1970s there has been an increased focus on the concept of learning style. While there is a substantial body of literature which examines the learning styles of students in higher education, much of this research has been conducted at four-year colleges and universities and in the context of general education. This study was conducted at a technical college in Georgia. Georgia's technical colleges offer programs of study that are occupationally oriented and directed toward addressing workforce needs. The study sought to determine whether learning style was associated with student performance. Data regarding instructor learning style was collected in order to determine if student/instructor congruency in learning style was associated with student performance. For purposes of this study, performance was determined by using students' final course grades. Grades were converted from a letter grade format to a numerical value.

The theoretical framework used to define learning style was Kolb's experiential learning theory. Kolb's learning style inventory was the instrumentation used to determine learning style. Of the 682 students enrolled during summer quarter 2010 who had final grade data to be analyzed, 513 students completed a useable learning style inventory (75% response rate). Over

one-half were found to be divergers, while only seven percent were found to be convergers. Instructors' styles were much more evenly distributed across the four learning styles. A one-way ANOVA indicated that learning style was associated with student performance. Specifically, the analysis revealed that higher grades were associated with the converger learning style as opposed to other learning styles. Effect size, which measures the strength of these associations, was determined to be small.

Final grades were divided into two groups. One group consisted of grades earned under conditions of congruence in learning style—that is, the student and the instructor had the same learning style. The other group consisted of grades earned under conditions of incongruence— that is, the student learning style was different from that of the instructor. T-tests were performed to examine mean scores and variation. The results indicated that there was no statistically significant difference between the two groups.

INDEX WORDS: Learning style, Cognitive style, Kolb's learning style inventory, Experiential learning theory, Technical colleges, Technical institutes, Two-year colleges, Community colleges, Technical College System of Georgia, Career and technical education, Workforce education

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DEDICATION

I would like to dedicate this dissertation to my Mom and Dad. I owe more to you than I could ever repay. There is not enough room here to describe the impact you have had on my life. This dissertation is as much yours as it is mine.

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CHAPTER 1

INTRODUCTION

This chapter introduces the problem of the study. Specifically, this chapter contains five sections: (1) Background of the Problem, (2) Statement of the Problem, (3) Research Questions, (4) Conceptual Framework, and (5) Significance of the Study.

Background of the Problem

Since the 1970s there has been an increased focus on the concept of learning style. Previous research has examined the learning styles of post secondary students with regard to variables such as age, gender, and academic discipline (Alumran, 2008; Baker, Simon, & Bazeli, 1986; Bell, 1998; Giordano & Rochford, 2005; Jones, Reichard, & Mokhtari, 2003; A. Y. Kolb & Kolb, 2005; Loo, 2002). Studies have also focused on the relationship of learning style to academic performance (Alumran, 2008; Carthey, 1993; Coate & Lehman, 2005; O'Brien & Thompson, 1994). Not only have scholars and practitioners focused on the learning style of the student, they have addressed issues related to the teaching style of teachers and how the congruency between teaching style and the student's learning style may impact student performance (Dunn & Dunn, 1978; D. A. Kolb, 1984; McCarthy, 1981; Spoon & Schell, 1998).

While there is a substantial body of literature which examines the learning styles of students in higher education, much of this research has been conducted at four-year colleges and universities. Limited research has been done which reports on possible differences in learning styles between students within the two-year college and the four-year college (Hansen, 1997).

The terms "community college," "two-year college," and "technical college" are used interchangeably throughout the literature. Using these terms synonymously may cause one to

assume that community colleges (designed to transfer students to four-year colleges) and technical colleges are the same in terms of who the students are, what classes students are taking, what students are learning, and how classes are taught. One should not make this assumption, especially with regard to technical colleges in Georgia. Georgia's technical colleges form a separate system known as the Technical College System of Georgia (TCSG). The mission of these technical colleges historically has been quite distinct from that of the University System of Georgia (USG) and its colleges and universities. It is this difference in mission that differentiates a technical college in Georgia from a traditional two-year college. This difference in mission is evident when examining the curriculum and the student access policies of the technical colleges.

Differences in Curriculum

The findings from learning style research in traditional two-year college settings may offer little with regard to recommendations, suggestions, or implications for practice in a Georgia technical college. The curricula and courses in these two-year colleges (which are designed to transfer credits to four-year colleges) are generally not comparable to that of a technical college in Georgia. To illustrate, a study at a community college was conducted to determine how learning styles related to the following disciplines: social sciences, mathematics, English, and science (Jones et al., 2003). The findings of such a study may not have clear implications for the Georgia technical college. Most technical certificates of credit (TCCs) awarded by Georgia's technical colleges have no general core component, and many diploma programs require as little as one math and two English courses.

Georgia's technical colleges offer programs of study that are specific and directed to address workforce needs. While there is some comparability between the Georgia technical college and the two-year transfer school (e.g. accounting and nursing programs are represented

in both types of institution), many of the programs of study within Georgia's technical colleges (e.g. welding, industrial maintenance, and automotive) are programs of study that are not addressed in learning styles studies situated in the community college setting.

Differences in Admissions and Student Access

The workforce development mission of the TCSG is reflected in the open access policy of Georgia's technical colleges. Virtually all students are admitted into Georgia's technical colleges regardless of academic background and/or academic ability. As of the time of this writing, the HOPE grant covers 100% of the cost of tuition, and a student does not need to qualify for the grant on the basis of academic performance. This makes the Georgia technical college a truly open access institution in that tuition cost and/or the lack of academic preparation are not barriers to entry. Students attending two-year and four-year colleges in the USG do not have access to the HOPE grant—rather, they must look to the HOPE scholarship to assist with tuition. In contrast to the HOPE grant, the HOPE scholarship must be earned and maintained based on academic performance.

The HOPE grant and the policy of open access, while congruent with the mission of the technical college, suggests there are a substantial number of students enrolled in technical colleges who would be unable to attend a traditional two-year college in Georgia because of socioeconomic status (SES) and/or lack of adequate academic preparation. They bring a diversity of academic and socioeconomic backgrounds into the technical college classroom. A study situated within a Georgia technical college addresses the learning styles of these students.

<center>**Statement of the Problem**</center>

The problem of this study is to examine the degree to which student learning style is associated with student performance at a Georgia technical college. This includes collecting data

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regarding instructor learning style and determining if student and teacher congruency in learning style is associated with improved student performance.

Research Questions

The following research questions provided objectives for the study:

1. What are the learning styles (convergers, divergers, accommodators, assimilators) of the students and instructors at the technical college?

2. How are the styles distributed across age, gender, socioeconomic status (SES), and program of study?

3. Are there significant differences in student performance among the four learning styles?

4. If there are differences, between which learning styles are significant differences found?

5. Is student/instructor congruence in learning style associated with student performance?

Conceptual Framework

Learning styles have been embraced by educators and researchers since the 1970s as a way of assessing individual differences. A citation analysis conducted by Desmedt and Valke (2004) found Kolb (1984) to be the most often cited first author in studies related to learning styles. Kolb's work with experiential learning theory emphasizes the important role that experience plays in the learning process. This learning theory is particularly appropriate for studying learning styles of technical college students, as Georgia's technical colleges emphasize the importance of hands-on experience in the learning process. Using experiential learning

theory as his framework, Kolb developed a learning style model which has been used extensively in higher education to assess individual differences in approaches to learning.

Experiential Learning Theory

Experiential Learning Theory (ELT) has its intellectual origins in the social psychology of Kurt Lewin in the 1940s. It emphasizes the important role that experience plays in the learning process. This differentiates the model from other cognitive theories of the learning process. At the core of the model is what is referred to as the learning cycle. Put simply, it explains how experience is translated into concepts which are, in turn, used as guides in the choice of new experiences (D. A. Kolb, 1984). The Kolb model defines learning as consisting of two dimensions: perceiving and processing.

The perceiving of information is defined in the Kolb model on a continuum from concrete experimentation (CE) to abstract conceptualization (AC). Perceiving is represented on the vertical axis in Kolb's model. The processing of information is defined on a continuum from active experimentation (AE) to reflective observation (RO). Processing is represented on the horizontal axis in Kolb's model. These two dimensions are grounded in the cognitive development work of Jean Paiget. In his view, individual cognitive development from birth to adolescence moves from a phenomenolistic (concrete) view of the world to a constructivist (abstract) view and from an egocentric (active) view to a reflective, internalized mode of knowing (D. A. Kolb, 1984).

Based on experience and the demands of the present environment, most learners develop learning styles that emphasize some learning abilities over others. Through experiences with family, work, and school, individuals develop a preferred way of resolving the conflicts between action and reflection and between immediate experience and detached analysis

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(D. A. Kolb, 1984). Kolb developed a brief, self-descriptive inventory called the Learning Styles Inventory.

Rationale for Experiential Learning Theory as Conceptual Framework

John Dewey thought that hands-on work (learning by doing) would enhance academic work (Dewey, 1938). Experiential learning theory (ELT) builds on this idea, grounded in the theory that all learning begins with an experience, which is then processed into knowledge. This theory of learning is congruent with the technical college's focus on hands-on application, where student experience is given an essential role in the learning process. Coursework is designed to give students experiences that relate to their program of study and simulate tasks that are performed in the workplace.

Students in technical colleges are often of varying ages, cultures, and backgrounds (Dougherty, 2001). Therefore, they bring varying kinds of experiences into the classroom. Teaching methods should address these differences. Education should have a "democratizing" affect upon society (Dewey, 1916). To this end, teachers should attend to all the learning styles that may be present in a diverse student population. Instructors should value the wide range of experiences that students bring to the classroom and the unique ways in which students learn so as to create classroom settings that embrace the experiences and learning styles of all students.

Significance of the Study

Since the 1970s, the use of learning styles in education has received a significant amount of attention. An important issue in higher education is the use of learning style research to create a more positive and more effective learning environment for the students (L. J. Swanson, 1995). In today's climate of increased institutional accountability, increased teacher accountability, and increased focus on student diversity, special attention to learning styles may be in order.

Successful colleges are distinguished by the ability of their faculty to understand how their students learn (Alumran, 2008). The job of teachers is to facilitate the learning process. It has been suggested that the expression "teaching and learning" might well be replaced with "learning and teaching." This reversal of terms might suggest that learning, not teaching, should receive most of educators' attention. Student learning cannot be achieved simply because a teacher teaches harder. The learning process is too complex to assume such a direct relationship (Schell & Schell, 2007). Understanding learning styles as explained by experiential learning theory may prove useful in helping the technical college sharpen its focus on student learning.

An effective teacher will explore what students already know and the sense they have made from their previous concrete experiences. Beginning with these concrete experiences allows the learner to re-examine and modify their previous sensemaking in light of the new ideas that are presented in the classroom (A. Y. Kolb & Kolb, 2005).

Significant gains can be expected when teaching methods are tailored to match students' learning styles. Data generated by many experimental studies show statistically significant increases in achievement when college adults' styles are responded to with complimentary resources or approaches (Honigsfeld & Dunn, 2006). If a teacher understands how to present material in the student's preferred style, the student has a better chance of learning the material. A better understanding of the learning styles of students within a Georgia technical college may lead to an enhanced student experience. An understanding of learning styles, accompanied with the using of appropriate andragogical techniques, may benefit student outcomes. By creating a learning space that allows students to interact with the class using their dominant learning style, it is expected that students will gain a richer and deeper understanding of the material.

Many students in technical colleges have not experienced success in an academic setting (Dougherty, 2001). In many cases they are first-generation college students. They enter the college underprepared and lacking in self-confidence. Creating an environment that promotes student success can serve to increase student retention (Tinto, 1987). The primary benefit of increased student retention accrues to the student, who is more likely to complete the program and consequently find employment in his or her field. A secondary benefit, however, accrues to the school, as increased retention rates have a favorable impact on the college. The reputation of the college is enhanced as it retains and graduates more students. There is a financial benefit to the school as well, as retention and graduation rates may be tied to funding.

Researchers have raised questions about the effect of culture on learning styles (L. J. Swanson, 1995). This has direct implications for the technical college in a global society where more classes are being delivered online and students in a given class are more diverse. Much more research is needed in the area of learning styles as it relates to international students (Henry, 2004). Given the diversity of students within Georgia's technical colleges, learning style research could serve a very practical purpose. If classes are being taught in ways that appeal to the learning styles of only a particular culture (e.g. American white males from middle class backgrounds), then the technical college is missing its mark with regard to mission. The mission of these colleges is to increase access and expand opportunity to historically underrepresented populations (Cohen & Brawer, 2003). The implementation of findings from learning style research in the technical college can serve the purpose of creating more learning opportunities for underrepresented populations.

This study may offer findings that support or contradict previous findings using Kolb's learning style model. This can potentially add to the conversation regarding the strengths and weaknesses of this instrument as a measure of learning style.

A better understanding of learning style may be welcome at a time where state governments and accrediting agencies are holding higher education institutions more accountable than ever in the areas of student learning, retention rates, graduation rates, and job placement rates. Learning style research can potentially be used to better understand what is happening in the classroom, what instructors can do to support student learning, and how faculty staff development opportunities may be organized as to better prepare faculty to teach to a variety of styles.

Since the publication of *A Nation at Risk* in 1983, educators and administers have been involved in reform efforts aimed at improving student learning. Learning style research has the potential to help educators enhance student learning. Technical college students are competing for jobs with students from all over the world. Changing technologies are making some jobs obsolete before students even graduate. Higher education institutions have the responsibility of preparing students for this demanding global economy. Technical colleges operate under the mission of educating students using the most up-to-date technologies so that they can move seamlessly from the technical college to the workforce.

CHAPTER 2

REVIEW OF THE LITERATURE

A review of the literature was undertaken to explore issues pertaining to this study and to assist in determining the appropriate research methodology. Because this study is situated within the Technical College System of Georgia and is concerned with the learning styles of its students, this chapter contains the following sections: (1) Two-Year Postsecondary Institutions, (2) Overview of Learning Styles (3) Kolb's Experiential Learning Theory, (4) Learning Styles and Higher Education, and (5) Summary.

Two-Year Postsecondary Institutions

Two-year colleges are different from four-year colleges with regard to mission and accessibility. The two-year college has been referred to in the literature as the contradictory college (Dougherty, 2001). This expression refers to various roles that a community college seeks to fulfill—preparing students for transfer to four-year schools, preparing students for the workforce, and serving the needs of the community at large. As the roles of these colleges are wide and varied, so are the students who attend. The student body, on the whole, is less prepared academically (Cohen & Brawer, 2003). Many of the students attending these institutions are first generation college students. These institutions are designed to be accessible to all students, regardless of academic preparedness.

As the background of the two-year institution is reviewed, it becomes clear that the student body within two-year colleges is likely much more diverse than that of four-year colleges with regard to academic readiness and socioeconomic background. This is especially true within

the Technical College System of Georgia (TCSG), which operates outside the University System of Georgia (USG) and is driven by a workforce mission that allows access to all students.

Background of Two-Year Postsecondary Education in the U.S.

Community colleges are a uniquely American innovation. Community colleges are often referred to as "democracy's colleges" because of their principle of open access. The community college has been called, by some, to be an innovation comparable to that of the land-grant college in the nineteenth century (Young, 1997).

Community colleges' beginnings are somewhat controversial. Many researchers state that the belief in open access and equality for all was a primary impetus for their growth. Others point to local officials, including high school teachers, high school principals, and local school boards as being the primary impetus for the growth of the two year college (Dougherty, 2001). Some researchers contend that it was the four-year universities who pushed for the establishment of these institutions in order to be relieved of the responsibility for teaching lower division, general education courses, while others cite changing workforce demands as being the primary cause of the rapid growth of community colleges. The growth of the community college should not be attributed to one single factor, as all of the aforementioned reasons are valid (Cohen & Brawer, 2003).

The history of the community college can be traced back to the early years of the twentieth century (Cohen & Brawer, 2003). During this time, the nation was moving from an agrarian to an industrial economic base (Dougherty, 2001) . Therefore, employers needed a different type of worker. This is one of the major factors attributing to the birth and growth of the community college (Stephens, 1995). The first community college was established in Joliet, Illinois in 1901.

During this time, science was seen as contributing to progress. If more people understood scientific principles, it seemed logical that the industrial-based economy would be developed more rapidly. New technologies demanded skilled operators, and it was believed that training them could be done in schools (Cohen & Brawer, 2003). The changing economy and the demand for a new type of workforce played a key role in the push to establish the community college.

However, it is not completely accurate to state that our nations' community colleges were formed simply because the economic base was becoming more industrialized. This shift from an agrarian to an industrial economic base was happening in Europe as well, yet it did not experience the phenomena of the community college as did America (Cohen & Brawer, 2003). Therefore, it stands to reason that there could be other factors that help explain the establishment and growth of the community college in the United States.

It is helpful to consider societal values in America during this time period. Society held individual mobility in high esteem. There was a widespread belief that those who applied themselves could advance. The community college was viewed as a vehicle which created such opportunity. Many types of social institutions of practical value to society were being formed during the early 1900s. The turn of the century was a time during which society strongly favored that which was practical. The question in higher education during this era was rarely "What knowledge is of the most worth?" The question was usually "What knowledge will yield the greatest benefit to individuals or society?" (Cohen & Brawer, 2003). The public viewed schooling as a contributor to the community's wealth. In short, the public viewed education as having very practical, positive outcomes.

The idea that education should be accessible to all has its roots in the nineteenth century. Publicly supported universities had been established in every state by the Morrill Acts of 1862 and 1890. Under these laws, the federal government gave land to states, which were then required to use the land (or proceeds from the sale of the land) to establish colleges. These land-grant colleges provided increased access to higher education as they were a relatively low-cost alternative to private colleges. These universities embraced the idea of service to the broader community through their agricultural and general extension divisions (Cohen & Brawer, 2003).

Access for a wider range of the population increased as the number of programs being offered in universities increased—an ever-increasing number of subjects and occupations were being introduced (Cohen & Brawer, 2003). This can be traced back to the American version of the Industrial Revolution which took place in the 1800s as the nation moved toward large scale production (Gordon, 2008). This created more specialty fields and required universities to expand program offerings to align with industry.

One explanation of the rapid growth of community colleges during the twentieth century was that increasing demands were being placed on schools in general. Whatever the social problem, schools were expected to solve it. In earlier centuries, society expected less from schools. More was expected from family, the workplace, and various social institutions. However, the easily accessible publicly supported school became an article of faith in the nineteenth century when the responsibility for educating the individual began shifting to the school. By the turn of the twentieth century, not only were schools expected to educate, they were expected to relieve society's ills (Cohen & Brawer, 2003).

Two generic names have been applied to two-year colleges. Until around the 1940's, they were most often referred to as junior colleges. During the 1950s and 1960s, the term

"junior colleges" was associated with the lower-division branches of private colleges and two-year colleges supported by churches or organized independently. The term "community college" gradually came to be used for the comprehensive, publicly supported two-year institution. By the 1970s, the term "community college" was generally used to refer to both types (Cohen & Brawer, 2003).

Technical Schools and Vocational Education

The modern day technical institute/college has its roots in vocational education. The causal factors of the vocational movement can be traced back to the latter part of the nineteenth century. It was during this time that programs were established—in the public schools—known as manual training, commercial training, domestic science, and agriculture. Traditionally, vocational education has consisted of practical, applied instruction aimed at matching the student to work positions in industry and commerce. Vocational education has gone by several names, including industrial education, manual education, and most recently career and technical education (Gordon, 2008).

Apprenticeship is the oldest form of vocational education in the United States. The traditional elements of apprenticeship agreements were food, clothing, shelter, religious training, and general education as needed in the trade. Until 1807, industrial artisans and their apprentices dominated manufacturing. The Embargo Act, the Non-Intercourse Act, and the War of 1812 combined to create the American version of the Industrial Revolution. These events all served to close the door on foreign-made goods. Seeing this as a great opportunity, U.S. businesses quickly began to invest in new technology and convert to large-scale production. Since the apprenticeship system was unable to supply the subsequent demand for trained workers, new forms of education were needed. Also contributing to the apprenticeship's decline was the

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advent of free public elementary schools, which provided the general education formerly provided by apprenticeships (Gordon, 2008).

At the 1876 Centennial Exposition in Philadelphia, Victor Della Vos, Director of the Imperial Technical School at Moscow, presented in a Russian exhibit a method to unite academic with vocational education with a series of exercises with wood and metal. Dr. John D. Runkle, president of the Massachusetts Institute of Technology (MIT), was impressed by the exhibit and was successful in convincing MIT to add laboratories to the school that required students to develop tool and machinery skills. Runkle saw this as a way to combine theory and the "hands-on" skills needed to go to work (Association for Career and Technical Education, 2010).

The manual training movement was responsible for changing the conception of what should and should not be taught in schools. It marked a shift away from the belief that high schools should be devoted solely to preparing students for college—and toward the belief that schools should also prepare students for a variety of careers that require less than a college education (Gordon, 2008).

Economic, Social and Political Factors Influencing Two-Year Postsecondary Institutions

Several economic, social, and political factors contributed to the creation and growth of the community college. In the early 1900s, a great need existed for workers trained to work within the nation's expanding industries. Also, the desire to promote social equality was a factor. The community college would allow more people access to higher education, thus promoting social equality (Cohen & Brawer, 2003).

The 1960s saw a significant growth in community colleges. Emphasis during this time was to create equality and increase access. Half of today's community colleges were created in

the 1960s (Weiger, 1999). States found community colleges attractive for several reasons. They were less expensive to build and operate than continuing to expand four-year universities. In addition, they allowed the university to focus on research by taking on students who would otherwise be the responsibility of the university. Community colleges increased access to higher education, thereby promoting social equality. Community colleges were often charged with training the workforce. In addition, the community college brought a sense of pride and prestige to the local community. Community colleges provided a wide variety of services and allowed students to attain the baccalaureate who would otherwise be turned away. All of these attributes of the community college made it a desirable form of higher education from the states' point of view (Dougherty, 2001).

Before 1960, local school districts operated free of state control because they met most of their costs through self-imposed property taxes. But as the 1950s progressed, inadequate state aid, rising costs, and stagnant local revenues left school districts unable to sustain their community colleges. Iowa and Oklahoma, once states with high enrollments in community college students, allowed community colleges to close But when the state legislatures realized that the baby boomers were coming of college age and that financing community colleges was less expensive than expanding the four-year universities, they saw the value in adopting the community college. To guarantee that students selected community colleges in sufficient numbers, state governments supported the construction of new colleges and in some cases entire new systems. This was a success—low-cost community colleges drew record enrollments, alleviating the demand for university and state college access and avoiding economic crisis in many states. The growth of the community college was as much a matter of economics as it was about the idealism of creating access and opportunity for all (Pedersen, 2001).

Legislation Affecting Career and Technical Education

During the last quarter of the nineteenth century, America moved to establish public secondary schools. As more and more people attended high school, many battles ensued over what the curriculum should look like. The narrow classical curriculum did not satisfy proponents of an expanded practical education curriculum. In 1905, proponents of vocational education argued that a broader curriculum was needed to prepare people for the new industrial age (Gordon, 2008). They wanted young people to have access to better careers. Only eight percent of youth were graduating from high school, and almost all male graduates went to college. Advocates of vocational education were concerned about our nation's ability to compete in worldwide agricultural and industrial markets. Eventually, they developed a coalition to press for federal legislation to address the issue (Stephens, 1995).

In 1914, Congress authorized President Woodrow Wilson to appoint a commission to study federal aid for vocational education. The Commission on National Aid to Vocational Education conducted an extensive investigation into the need for vocational education (Stephens, 1995). Dudley Hughes and Hoke Smith, two lawmakers from Georgia, were responsible for the Smith-Hughes Vocational Education Act of 1917. This act provided for the first federal support of vocational education. In order to receive federal funds, a state was required to establish a state board for vocational education (Gordon, 2008). Separate funding brought with it the idea of vocational education being *separate* from academic education. The impact of this legislation can be seen even today in the way that CTE is viewed as being separate from traditional academics.

Since the 1960s, the federal government has continued to influence technical education through legislation. In the 1960s, there was a concern that automation and technological change would cause unemployment among the heads of families, which was addressed through the

Manpower Development Training Act of 1962 (replaced by the Comprehensive Employment Training Act of 1973 and later by the Job Training Partnership Act of 1982). These laws were designed to encourage business and state and local governments to work together to train disadvantaged and/or dislocated workers (Guttman, 1983).

The 1960s and 70s saw legislation passed with the intention of increasing access to vocational education and improving the skills of the workforce. These laws included the Vocational Education Act of 1963 and its amendments in 1968 and 1976. The Carl D. Perkins Act of 1984 amended the Vocational Education Act of 1963 and replaced its amendments. The goals of the legislation were to improve the skills of the workforce and to provide equal opportunities for adults in vocational education. Federal funding was now to be focused *less* on expansion and *more* toward program improvement and at-risk populations (Gordon, 2008).

The impetus for the reform movement of the 1980s came in the form of the publication of *A Nation at Risk* (1983). This report of the National Commission on Excellence in Education observed that the U.S. was losing ground in international competition, and attributed the decline to the relatively low standard and poor performance of the American educational system (National Commission on Excellence in Education, 1983).

The Vocational and Applied Technology Act of 1990 amended and extended the Perkins Vocational Education Act of 1984. Sometimes referred to as Perkins II, this legislation was aimed at all segments of the population and promoted integration of academic and vocational education, articulation between segments of education engaged in workforce development, and closer linkages between school and work. This legislation marked a major shift in the way that federal legislation had addressed vocational education in the past. Since the Smith-Hughes Act of 1917, vocational education had been viewed as being separate from traditional academics.

The initiatives put forth in Perkins II tended to promote integration between vocational education and academic coursework (Gordon, 2008).

The Perkins Vocational and Technical Education Act of 1998 replaced the 1990 Perkins Act. The 1998 law authorized vocational programs for five years. The law placed special emphasis on accountability measures and the funding for special populations. The Perkins Career and Technical Education Improvement Act of 2006 emphasized increased accountability and program improvement, secondary-postsecondary connections, links to rigorous academics, and a stronger focus on business and industry (Gordon, 2008). Notably, it uses the term "career and technical education" instead of vocational education throughout.

Technical College System of Georgia

Workforce development has been important to both community colleges and technical colleges since their beginnings. However, community colleges generally have a transfer component to their mission as well (Cohen & Brawer, 2003). This is where the Technical College System of Georgia is different from the traditional community college that focuses on transfer of credits.

Georgia has long been a two-system state, with the Technical College System of Georgia (formerly the Department of Technical Education) overseeing technical education and the University System of Georgia overseeing the four-year institutions. The current mission of the TCSG reads as follows: "The Technical College System of Georgia provides technical, academic, and adult education and training focused on building a well-educated, globally competitive workforce for Georgia" (Technical College System of Georgia, 2009). Several key initiatives of the past decade suggest that there is a growing interest in seeing technical education become more integrated with traditional higher education.

In 2000, technical institutes in Georgia changed their names to technical colleges. Along with this change, the technical colleges began offering associates degrees. The name change at the time was considered part of an effort toward changing the image of technical education—specifically, to more closely align the work of the technical institute with that of the traditional college (Joe Woodruff, personal communication, 2000).

Technical colleges in Georgia have long been accredited by the Commission on Occupational Education (COE). This reflected the workforce mission of the institutions. In recent years, however, a move toward seeking SACS accreditation has begun to take place. SACS accreditation is the regional accreditation that is held by the schools within the University System of Georgia. At the time of this writing, approximately one third of all technical colleges in Georgia are SACS accredited, while another third are in the process of becoming accredited. The remaining third are in the process of preparing to make application (Erica Harden, personal communication, 2008). Not being SACS accredited has been cited as part of the reason that USG schools generally do not accept transfer credits from technical schools.

In 2006, the Associates of Applied Technology degrees ceased to be awarded by Georgia technical colleges—the degree name changed to Associates of Applied Science degrees (Dawn Lawson, personal communication, 2009). This is one step closer to the Associates of Science offered by USG schools. The name of the agency has changed—what used to be the Department of Technical and Adult Education was changed in 2009 to be the Technical College System of Georgia (TCSG). This name parallels that of the University System of Georgia.

TCSG is currently converting course numbers from a three-digit system to a four-digit system. The new course numbers align more closely with the four-digit numbers used by USG schools. Beginning in the fall of 2011, Georgia's technical colleges will move from the quarter

system to the semester system.

Instructors in English, math, and social and behavioral sciences are required to have 18 graduate hours "in field"—a requirement which is only important in the event that a student would want to transfer a course to a four-year college or university.

All of these initiatives, when looked at collectively, suggest that there is some interest in more closely aligning the TCSG with the USG. However, the TCSG still has a mission that is directed primarily toward workforce development and open access. The workforce education/open access mission draws students who may be different from their four-year college counterparts with regard to age, academic background, and socioeconomic status (Cohen & Brawer, 2003).

Overview of Learning Styles

A review of the literature as it relates to learning styles reveals that there are multiple instruments and models used to address the construct. Various models, instruments, and underlying theories are used to define the construct of learning style (Curry, 1983). Multiple disciplines have contributed to the field over the years.

One of the major challenges in the literature is in understanding what is meant by the term learning style. According to Riding and Cheema (1991), there are as many definitions as there are theorists. Different learning style models are built on different theories—therefore, the definition of learning style is subject to be different from model to model. Learning style is sometimes used synonymously with the term cognitive style. At other times, the two are viewed as being separate constructs.

Cognitive style describes a person's typical or habitual mode of problem solving, thinking, perceiving, and remembering (Allport, 1937). Many learning style models define

learning style in such a way as to include cognitive style. However, these models view the construct of learning style as being broader than cognitive style. The researcher or practitioner using these learning style models is usually more interested in the practical, educational, and training applications and is therefore more "action-oriented" (Riding & Cheema, 1991). Generally speaking, educators and researchers interested in learning style are going to show an interest in factors beyond the realm of some of the "pure" cognitive models. The term cognitive style has been reserved for more theoretical, academic descriptions.

Background of Learning Style

Learning styles began receiving a great deal of attention in the 1970s. However, the background of learning style research can be traced back to the early 1900s and the field of cognitive style. Cognitive style theories are generally accepted to be those formulated in the 1950s and 1960s and tied closely to laboratory research (Bonham, 1987). While cognitive style theories are considered more widely researched than many of the learning style models, they are not oriented to practical application. Learning style, which was to come into prominence in the 1970s, was concerned with the practical setting of the student and the classroom learning experience. The learning style theories to evolve in later years would not be limited to cognitive aspects—they would focus on numerous elements of learning beyond that of cognitive style. Learning style came to be known as the way students consistently respond to and process information in a learning environment.

Cognitive style research has its roots in the New Look movement in perception. This movement's public inaugural came in 1949 at a meeting of the American Psychological Association. A new emphasis was to be placed on the adaptive role of perceiving in the psychological make-up of the individual (Witkin, Goodenough, & Oltman, 1979). As the field

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expanded, researchers added cognitive style theories that focused on other aspects of cognition such as formation, information processing, and memory (Bonham, 1987).

Three major groups have dominated the research related to cognitive theory. The Fels Institute focused on conceptual style and cognitive tempo, the Menninger Foundation's work focused on cognitive controls, and the Brooklyn Group focused on field dependence/independence. This research on cognitive styles enjoyed the substantial support of government grants, as opposed to the learning style research that would follow. According to Truluck (1996), the field dependence/independence work of the Brooklyn Group has become the best known and most widely researched of the cognitive style theories. Henry Witkin, also known as the father of cognitive style, developed the field dependence/independence dimension of cognitive style (Witkin et al., 1996).

Field dependence/independence is a cognitive model that measures an individual's ability to separate an object from its surroundings (Witkin, Dyk, Fattuson, Goodenough, & Karp, 1962). Students who are field-independent prefer to learn in isolation, whereas field-dependent students prefer integration. Field-independent learners are intrinsically motivated, structure their own learning, and devise their own study strategies. They tend to choose college majors in science, math, and engineering. Field-dependent learners are more extrinsically motivated, prefer to work under clearly defined performance goals, need structure and guidance from the instructor, and prefer to interact with other students. These students are more drawn to areas such as counseling, teaching, and other fields related to the humanities (Cassidy, 2004).

The instrument used to measure field dependence/independence is referred to as the Embedded Figures Test (EFT). This test measures the ability of the student to discern a shape from its surrounding field (Witkin et al., 1979). The measure has been criticized in that it

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appears to be highly correlated with intelligence—this may make it a measure of intelligence as opposed to an identification of style (Cassidy, 2004). One of the weaknesses of the embedded figures test is that it measures only one ability (the ability to see the object) while the opposite ability is implied (Stitt-Gohdes, 2001).

In 1979, the National Association of Secondary School Principals (NAASP) and St. John's University sponsored the National Learning Styles Network. Dr. James Keefe, the Director of Research of the NAASP, assembled a task force which was charged with defining learning style (Keefe & Ferrell, 1990). Learning style was defined as a composite of cognitive, affective, and physiological factors that serve as stable predictors of how a learner perceives, interacts with, and responds to the learning environment (De Bello, 1990).

The result of the partnership between the NASSP and St. John's University's Center for the Study of Learning and Teaching Styles was the Learning Styles Profile. The LSP model encompassed physiological/environmental, cognitive, and affective domains as well as an information-processing perspective (De Bello, 1990). It also incorporated cognitive items from Witkin's Embedded Figures Test (Witkin et al., 1979).

The LSP was based on aspects of Charles Letteri's idea to relate learning style to information processing (Spoon, 1996). Letteri's (1980) information processing model originally defined cognitive style using other research instruments which diagnosed seven cognitive dimensions including: field dependence/independence; scanning/focusing; breadth of categorization; cognitive complexity; reflective/impulsive; leveling/sharpening; and tolerant/intolerant. He later rewrote the items into a single instrument. These dimensions may be viewed along the continuum of analytic vs. global. For example, field independence,

focusing, and reflective would all be at the analytic end of the continuum, whereas field dependent, scanning, and impulsive would be at the global end of the continuum.

Also closely identified with the research on learning styles at St. John's University is the work of Kenneth and Rita Dunn. The Dunns were perhaps one of the earliest teams of research practitioners in the field of learning styles. Their model can be classified as multidimensional, as it views learning style as consisting of five stimuli groups. These groups are environmental, emotional, sociological, physiological, and psychological. The Dunn and Dunn model stresses the importance of teaching to the individual student's style (Honigsfeld & Dunn, 2006). Extensive research using the Dunn and Dunn LSI has made it one of the most widely documented assessment instruments (De Bello, 1990).

Joseph Hill was also among the earliest theorists in the field of learning style research. He defined learning style as the unique way in which an individual searches for meaning. According to Hill (1981) this included (a) the processing of theoretical and qualitative symbols; (b) modalities of inference; and (c) cultural determinants. The category of theoretical symbols is subdivided into auditory and visual categories, which are then subdivided into linguistic and quantitative symbol. In addition, Hill addresses 15 qualitative elements, including empathy, proxemics (social distance), and proprioceptivity, a sixth sense. Modalities of inference are the forms of inference that an individual uses in the process of actually obtaining meaning and including critical thinking, contrasting and comparisons, relationships between measures, and the development of hypotheses.

Cultural determinants played a key role in Hill's model. Hill saw cognitive style as having to do with how individuals interpret symbols, and he believed that the meaning assigned to symbols was shaped by one's culture. According to Hill (1981) family and peers make up a

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student's cultural influences. His work was a precursor to work that looks at cultural patterns and learning styles. Hill's instrument involves a self-report test which takes about 50 minutes to administer and includes an interview component. The Cognitive Style Interest Inventory has been revised during the years since his death, but still it remains complex (De Bello, 1990). As a result of Hill's work, many researchers attempted to synthesize knowledge about cognitive style with educational percepts (Spoon, 1996).

Albert Canfield, an industrial psychologist, drew on the work of Hill's Cognitive Style Profile and Maslow's hierarchy of need theory (L. J. Swanson, 1995). The Canfield learning style inventory includes scales in four areas. The first area concerns conditions of learning, including affiliation (the student's need to develop personal relationships with other students and the instructor), structure (their desire for organization and detail), achievement (their desire for goal-setting and independence), and eminence (their orientation toward competition and authority). The second area addresses student preferences with regard to content. This includes numerics (working with numbers and logic), qualitative (working with words or language), inanimate (working with things, such as building or repairing), and working with people. The third and fourth areas assess mode and expectations. Student preferences in term of mode include listening, reading, iconic, and direct experience. The area of expectation has to do with the grades students think they will receive (Canfield, 1988).

The Canfield Instructional Style Inventory measures the same dimensions as the learning style inventory. Use of this instrument allows studies to be conducted that examine teaching styles and learning styles of students in order to address concerns of matching student learning styles and teacher instructional styles (L. J. Swanson, 1995).

Categorization of Learning Style Models

Different learning style models view the construct of learning style through different theoretical frameworks. In the same way that there are variations in how learning style is defined, there are also variations in the way that reviewers have attempted to categorize the instruments and models.

Curry's Onion Model. Curry (1983) attempts to categorize learning style models by stating that the construct of learning style can be looked at as consisting of layers. She uses the metaphor of an onion to help explain the learning style construct, and her review is often referred to in the literature as Curry's onion model. The outermost layer of the learning style construct is the "instructional preference" layer. This is the most observable layer and the layer most susceptible to influence, which makes it the least stable level of measurement. The Learning Preference Inventory developed by Rezler and Rezmovic is an example of such a model (Cassidy, 2004).

According to Curry's (1983) model, "social interaction" provides the next layer of the learning style construct and also relates to student preference. It focuses on the individual's preference for social interaction. Reichmann and Grasha's Student Learning Style Scale (LSS) is an example of such a model. The LSS defines learners by their type and level of interaction. Learners are classified as independent or dependent, collaborative or competitive, and participant or avoidant (Riechmann & Grasha, 1974).

The third and more stable layer is the "information processing style." This refers to the individual's intellectual approach to the processing of information. Kolb's Learning Style Inventory is an example of a learning style model which defines learning style as the way in

which individuals process information (D. A. Kolb, 1984). Schmeck's (1977) Inventory of Learning Processes (ILP) is also associated with this layer.

The final layer is described as the "cognitive" personality layer (Curry, 1983). This is the most robust component and can only be observed when an individual's behavior is studied in various learning situations (Riding & Cheema, 1991). Witkin's field dependent/independent research is an example of a model based on this layer (Witkin et al., 1962). Field dependence/independence measures the extent to which a person is influenced by a surrounding field (L. J. Swanson, 1995).

Wholist-Analytic vs. Verbalize-Imager. Riding and Cheema (1991) organize learning styles based on two fundamental dimensions representing the way in which information is processed and represented: wholist—analytic and verbaliser—imager. The wholist—analytic dimension refers to how people tend to process information; whereas the verbaliser—imager dimension refers to the way in which individuals represent information in either words or images. Some learners process information by first breaking it down into parts, while others process information as a whole. When studying various learning style models, the terms "deductive," "rigorous," "constrained," "convergent," and "formal" may be used to describe the learner who leans toward the analytic. Learners who lean toward the "wholist" end of the continuum are often described by various models as being inductive, expansive, unconstrained, divergent, informal, diffuse and creative.

Cognitive-centered, learning-centered, and personality-centered. An alternative organization of existing learning style models is to categorize them as falling into one of three approaches: cognitive-centered, learning-centered, and personality-centered. Cognitive-centered models focus on individual differences in cognitive and perceptual functioning. Learning

centered approaches focus on the impact of style on the learner in the educational setting. These models are described in terms of being process models, preference based models, and cognitive skills-based models (Rayner & Riding, 1997).

Major Learning Style Models

The range of instrumentation found in the literature is diverse. A citation analysis found Kolb to be the most frequently cited first author in the learning style literature (Desmedt & Valcke, 2004). Others top theorists cited by Desmedt and Valcke were Dunn (1978), Schmeck (1977) and Witkin (1962). These theorists each developed an instrument which measures learning style according to the way that the theorists define learning style. Other instruments which surfaced frequently in the review were the Myers-Briggs Type Indicator (MBTI) and Gregorc's Style Delineator. These models were also included in Desmedt and Valcke's citation of authors with the greatest number of citations.

Dunn and Dunn model. The Dunn and Dunn (1978) learning style model identifies 20 elements that are divided into five strands. The environmental strand focuses on the learner's preference for sound, light, temperature, and seating design. The emotional strand focuses on levels of motivation, persistence, and responsibility (conformity versus. nonconformity). The sociological strand addresses preferences for learning alone, in pairs, in groups, with peers, with or with an authoritative figure vs. a collegial adult, and/or the ability to function in a variety of settings as opposed to working in patterns and routines. The physiological strand identifies perceptual strengths (visual, auditory, tactual, and/or kinesthetic), time-of-day patterns, the need for mobility vs. passivity, and/or intake. The psychological strand focuses on global versus analytic and impulsive versus reflective processing. These 20 variables are specifically concerned with individuals' preferences while concentrating on difficult material. The

Productivity Environmental Preference Survey (PEPS) is the tool used to measure these variables.

Gregorc's Style Delineator. The basis of Gregorc's (1984) model is that all individuals exhibit observable behaviors that provide clues as to how their minds work. Four distinct learning patterns emerge from the model. Concrete sequential learners learn through hands-on experience and appreciate order and direct step-by-step instruction. Concrete random learners, on the other hand, like to experiment using the trial-and-error approach and learn intuitively by trial and error.   Abstract sequential learners have excellent decoding abilities with written, verbal, and image symbols. They prefer learning in a sequential manner and will prefer learning from authorities as opposed to learning through experimentation. Abstract random learners are distinguished by their capacity to interpret vibrations and are very attentive to human behavior. They like to receive information in an unstructured manner, preferring discussions and activities that involve multisensory experiences. These learning styles come from in-born predispositions. The styles are assessed with the Gregorc Style Delineator, which is a self-report inventory based on the rank ordering of four words in each of ten sets. The instrument is similar in design and format to Kolb's (1984) Learning Style Inventory. Like many theorists, Gregorc emphasizes the matching of instructional materials and methods to the individuals' preferences. However, he also stresses that students be required to operate outside of their preferred learning styles at times, thereby strengthening those areas.

Myers-Briggs Type Indicator.   The Myers-Briggs Type Indicator (MBTI) is a forced-choice, self-report personality inventory which was developed to measure variables in Carl Jung's theory of psychological type. Jung's (1923) theory of type suggests that much of what appears random in the variation of human behavior is actually quite orderly and predictable.

These differences are due to certain basic differences in the way people prefer to use perception and judgment (Myers, 1962). The MBTI consists of four scales: Extraversion-Introversion (E-I), Sensation-Intuition (S-N), Thinking-Feeling (T-F), and Judgment-Perception (J-P). The four interacting preferences result in 16 personality types. In each type, one pole is preferred over the other.

The EI scale (extraversion vs. introversion) refers to one's direction of interest. Extraverts are attracted to the outer world of objects, people, and action. Introverts are drawn to the inner world of ideas and contemplation. The SN scale looks at sensing vs. intuition. Some people prefer to look at the immediate, real, tangible world of experience—this is referred to as sensing. On the other extreme, some have a preference for seeing the possibilities, meanings, and relationships of experience, often with only a passing interest in the facts themselves—these people score toward the intuition end of the scale (McCaulley, 1974).

The TF scale measures a preference for either thinking or feeling. Thinking is a preference for making decisions objectively, impersonally, analyzing facts and ordering them in terms of antecedents and consequences. Feeling types make decisions by a valuing process, weighing the importance of alternatives to oneself or others. Thinking types tend to like to work with materials which follow logical principles, whereas feeling types are more interested in working with or studying people. A preference for living in a planned, decided, orderly way, aiming to regulate life and control it is considered Judging. Those who prefer to live in a flexible, spontaneous way, aiming to understand life and adapt to it are regarded as Perceiving (McCaulley, 1974).

Kolb's Learning Style Inventory. Kolb (1984) bases his conceptual framework of learning styles on experiential learning theory. The core of his model is that adult experience is

translated into concepts, and these concepts are used as guides in the choices of new experiences.

Kolb views concrete experience as being the basis for observation and reflection. These

observations are assimilated into theory, and from theory implications for new action can be

deduced. There is a tension between concrete experience and abstract conceptualization, as well

as a tension between active experimentation and reflection. Learners have learning styles that

emphasize certain learning abilities over others. These styles are the result of experience and the

demands of the present environment. Kolb's model is discussed in greater detail in the following

section.

Kolb's Experiential Learning Theory

Kolb's (1984) experiential learning theory draws on the work of John Dewey, Kurt

Lewin, Jean Piaget, and Carl Jung. Dewey thought that hands on work (learning by doing)

would enhance academic work (Dewey, 1938). Experiential learning theory (ELT) builds on this

idea, grounded in the theory that all learning begins with an experience, which is then processed

into knowledge. This theory of learning is congruent with the technical college's focus on

hands-on application, where student experience has an essential role in the learning process.

Coursework is designed to give students experiences that relate to their program of study and

simulate tasks that are performed in the workplace.

Kolb characterizes experiential learning as consisting of six propositions, which are each

shared by the three major traditions of experiential learning. He believes that learning (a) is a

process, (b) is grounded in experience, (c) requires resolution of dissonant ideas, (d) is holistic,

and (e) is transactional between the individual and their environment. Experiential learning

theory emphasizes the important role that experience plays in the learning process. This

differentiates the model from other cognitive theories of the learning process. At the core of the

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model is what is referred to as the learning cycle. Put simply, it explains how experience is translated into concepts which are, in turn, used as guides in the choice of new experiences. The Kolb model defines learning as consisting of two dimensions: perceiving and processing (D. A. Kolb, 1984).

The perceiving of information is defined, in the Kolb model, on a continuum from concrete experimentation (CE) to abstract conceptualization (AC). This is represented on the vertical axis in Kolb's model. The processing of information is defined on a continuum from active experimentation (AE) to reflective observation (RO). This is represented on the horizontal axis in Kolb's model. These two dimensions are grounded in the cognitive development work of Jean Paiget. In his view, individual cognitive development from birth to adolescence moves from a phenomenolistic (concrete) view of the world to a constructivist (abstract) view and from an egocentric (active) view to a reflective, internalized mode of knowing (D. A. Kolb, 1984).

Based on life experiences and the demands of the present environment, most learners develop learning styles that emphasize some learning abilities over others. Through experiences with family, work, and school, individuals develop a preferred way of resolving the conflicts between action and reflection and between immediate experience and detached analysis (D. A. Kolb, 1984). Kolb developed a brief, self-descriptive inventory called the Learning Styles Inventory (LSI). It identifies four learning styles: accommodator, converger, diverger, and assimilator. When a student takes the LSI, they will fall into one of the four learning styles.

Convergers' dominant learning abilities are abstract conceptualization and active experimentation. Their greatest strength lies in the practical application of ideas. The label

"converger" is used because individuals with this style seem to do best in situations, like conventional intelligence tests, where there is a single correct answer. All of the available information "converges" to the correct answer. These individuals organize knowledge in such a way that they can focus it on specific problems. Convergers are generally unemotional, preferring to work with things rather than people (D. A. Kolb, 1984).

Divergers are the opposite of convergers. They are best at concrete experience and reflective observation, and their strength is in their imaginative ability. They can view a concrete situation from many different perspectives and excel at brainstorming sessions. They tend to specialize in the arts. Kolb observes that this style is characteristic of persons with humanities and liberal arts backgrounds. Counselor, organization development consultant, and personnel managers often have this learning style (D. A. Kolb, 1984) .

Assimilators' dominant learning abilities are abstract conceptualization and reflective observation—their greatest strength lies in the ability to create theoretical models. They excel in inductive reasoning by assimilating disparate observations into an integrated explanation. Like convergers, they are less interested in people and more concerned with abstract concepts. To the assimilator, it is important that a theory be logically sound and precise. This learning style is characteristic of the basic sciences and mathematics. In organizations, this learning style is found most often in the research and planning departments (D. A. Kolb, 1984).

Accommodators have opposite strengths from the assimilators—they are best at concrete experience and active experimentation. Their strength lies in doing things. They carry out plans and experiments and become involved in new experiences. They tend to be risk-takers more than learners with other styles. This style is labeled accommodator because learners with this style tend to excel in situations that call for adaptation to specific immediate circumstances. In

situations where the theory or plan does not fit the fact, they will likely discard the plan or theory. The opposite type, the assimilator, is more likely to disregard or reexamine the facts. Accommodators tend to solve problems in an intuitive trial and error manner. They rely heavily on other people for information as opposed to their own analytical ability. Accommodators are at ease with people but are often seen as being impatient. Their educational backgrounds are often in technical or practical fields such as business. People with this learning style are found in action-oriented jobs such as marketing or sales (D. A. Kolb, 1984).

Learning Styles and Higher Education

A review of the literature found that learning style studies fall roughly into one of three types: studies which focus primarily on how learning style is related to some student variable (such as age, gender, or academic major), studies which attempt to connect student learning style to academic performance, and studies which address the degree to which matching instructor teaching/learning styles to students' learning styles may be associated with student performance.

Learning Style and Student Variables

Martens (1976) conducted a study of 633 students from six community colleges. The purpose of the study was to gain insight into the learning styles of new students. New students were defined as those who scored at or below the thirty-third percentile on a conventional test of academic achievement. Cognitive style was defined according to Witkin's field dependence/independence model. The instrument used was the Group Embedded Figures Test (GEFT). The researcher hypothesized that new students would tend to be more field dependent when compared to traditional students. Findings indicated that the cognitive style of field dependence occurred significantly more frequently in the new student sample than in the traditional student sample. These findings confirm those of Cross (1976) who proposed

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techniques of individualized instruction that addressed non-traditional students' individual differences. This finding is relevant in that much of what is done in education favors the information processing style of the field-independent student.

Reese and Dunn (2008) investigated the learning styles of a diverse freshman population in a large, private metropolitan university by gender and age. The study examined learning style as it relates to gender. The Dunn and Dunn model was used in this study. The PEPS was administered to 1500 entering college freshmen during orientation. Males indicated a stronger preference for learning with an Authority Figure, were more Visual, and were more often Afternoon learners when compared with the females. Females tended to prefer Bright Light, warm Temperature, Formal Seating, Motivation, and Learning Alone or with Peers. Females were more Auditory, Tactual, and Kinesthetic, and consistently more Persistent and Responsible than the males in the sample. Females also differed from males in that they preferred learning in the Late Morning.

Ommen, Brainard, and Canfield (1979) conducted a study comparing younger and older community college students. Their findings indicated that students 25 and older preferred a different learning environment from that preferred by younger students. The learning style inventory (LSI) developed by Canfield and Lafferty (1974) was used in the study (the model would be revised by Canfield in 1988). The LSI measures four domains of learning preferences: conditions, content, mode, and expectation.

Ommen et.al (1979) conducted multiple two-tailed t-tests of mean differences to compare the preferential patterns of members of the two groups. Significant differences were found on 16 of the 20 scale scores. Major differences were found in each of the preference areas— conditions, content, and mode—and in the area of expectations. Older students exhibited a

strong preference for a classroom environment with a definite structure both in terms of organization and in detail. They tended to prefer instructors who represent and act the part of an authority figure. Younger students showed a preference for a learning environment with close peer and instructor affiliations. With regard to content, older students chose qualitative and people-oriented contents. Younger students expressed more interest in learning about the inanimate. Concerning mode, older students like to learn by listening and reading, while younger students showed a preference for learning by direct experience and through visual communication. Finally, with regard to expectancy, older students expected to be "A" students, while younger students more often expected themselves to be "C" students.

Matthews (1994) used the Canfield model to investigate the learning styles of students as they relate to specific college majors. Students majoring in mathematics and science fell into the applied categories, whereas students majoring in humanities, social sciences, and education fell mainly into conceptual categories.

Truluck (1996) examined the extent to which developmental stage influences learning style preferences. A convenience sample of 172 older adults in northeast Georgia participated in the study. Learning style preference was determined using Kolb's (1984) Learning Style Inventory (LSI). Descriptive research was used as the methodology for the study. The independent variable in the study was developmental stage, and the dependent variable was learning style preference. Chi-square analysis was used to look for relationships between developmental stage and learning style preferences. Truluck used the categorical data provided by the LSI (i.e. learning style type). Null hypotheses were: (1) there will not be a statistically significant relationship between developmental stage and learning style; (2) there will not be a statistically significant relationship between the demographic variables of gender, race, age and

educational level; (3) there will not be a statistically significant relationship between the demographic variables of gender, race, age and educational level and developmental stage. No statistically significant relationships were found.

Delargy (1991) investigated the relationship among age, gender, and learning style using Kolb's Learning Style Inventory. Kolb's learning style inventory (LSI) was administered to subjects drawn from technical college and college graduate classes, as well as adults from informal groups. Two-way analysis of variance (ANOVA) was employed to analyze scores on the six scales of the LSI: concrete experience (CE), reflective observation (RO), abstract conceptualization (AC), active experimentation (AE) and the combination scores AC-CE and AE-RO. A 2 x 2 factorial design included the two variables of gender and age. Age was defined by two variables—those under and those over age 55. The analysis revealed a significant effect of age on the AC scale, meaning that members of the older group leaned more toward abstract conceptualization than the younger group. Interactions were revealed between age and gender on the RO, AC, AE, and AE-RO scales of the LSI. Delargy was looking essentially at four groups of people: younger females, older females, younger males, and older males—and trying to determine how each group faired with regard to the six scales being measured. Younger females scored higher in active experimentation than older females, young males, and older males. Younger males and older females scored higher on reflective observation than younger females or older males. Older females were significantly more abstract than the younger females who scored higher than the other groups on concrete experience.

Males and females have been found to have different learning styles. Miller, Finley, and McKinley (1990) found males to be more kinesthetic, tactual, visual, and required more mobility than females. Females were found to be more conforming, and more self-, parent-, or teacher-

motivated than males. Females have also been found to have stronger preferences than males for social/conceptual learning styles and learned best through hands-on experience and in practical settings. Males tend to be classified as assimilators (abstract and reflective) more than females, and seemed to learn best by thinking and watching. Males tend to favor the abstract/sequential learning style.

Alumran (2008) studied university students' learning styles and their relation to gender, field of study, and academic achievement. The sample consisted of 877 students. The Felder-Solomon (1997) Index of Learning Styles was used to assess learning style. Results indicated that the total sample preferred Visual over Verbal and Sequential over Global. Males were shown to be more Intuitive learners, whereas females more Sensing. Information technology students were found to be more Active learners than law student and science students. Additionally, findings indicated that the learning styles of Visual/Verbal and Sequential/Global were good predictors of student GPA.

Brenner (1997) conducted research using Witkin's Group Embedded Figures Tests (GEFT). The study was conducted with a sample of 116 students in a two-year college, and focused on students who were enrolled in distance education courses during one semester. Chi-square analysis was used to investigate frequencies of learning style types by gender. The researcher used the Statistical Package for the Social Sciences (SPSS) software to compute the test statistic, which was tested at an alpha of .05. Findings suggested that women may be more likely to be field dependent than men. The study also addressed student achievement and sought to determine whether field independent students may be more likely to succeed in distance education courses than men. Findings did not support the hypothesis that field independent students were more likely to succeed.

Henry (2004) considered that the Felder-Solomon ILS, originally designed for engineering students, may prove useful in studying the academic behavior of accounting students. The ILS is similar to the Kolb (1984) model in that the vertical axis measures perception and the horizontal axis measures processing. The vertical axis is labeled "sensory" at the top and "intuitive" at the bottom (comparable to Kolb's "concrete experience" at the top and "abstract conceptualization") at the bottom. The horizontal axis measures processing and is characterized by "active" on the left end of the continuum and "reflective" on the right end of the continuum. These labels are comparable to Kolb's "active experimentation" and "reflective observation. The study analyzed 143 student responses to the ILS questionnaire. The sample included undergraduate business administration students from an introductory accounting course and MBA students enrolled in a required graduate level course. The study showed that business students' learning style profiles are similar to those of engineering students established in prior studies. Specifically, she found business students to be Active and Sensory. This aligns with what the Kolb model would call CE and AE (concrete experience and active experimentation), known by the Kolb model as *Accommodators*. In addition, she found that MBAs with accounting and finance majors were significantly more "sensory" than the other business majors. This is equivalent to the "concrete experience" mode as measured by Kolb.

Henry's (2004) work also showed a strong gender effect. Males in both undergraduate and MBA groups were significantly more visual than females (the ILS defines information input as being either visual or verbal). Females were found to be significantly more verbal. Among undergraduate business students, females were more Sensing, while males were more intuitive. Among graduate level business students, males were significantly more global than females, who

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were more sequential. ANOVA was used to analyze the data. According to Henry, more research is needed to confirm the gender effect in college classrooms.

In a study conducted by Loo (2002), the Kolb LSI was used with a sample of 437 business students. According to Loo, previous research shows that business students have different learning styles. Therefore, Loo's null hypothesis was that the styles would be equally distributed within each business major. Business students were grouped into hard and soft majors. Hard majors worked with quantitative or technical material (accounting, finance, information systems) while soft majors emphasized the people side of management, such as personnel management, organizational behavior, and marketing.

In addition to looking at the four learning styles, Loo's (2002) study also examined the four learning types: feeling (CE), thinking (AC), doing (AE), and watching (RO). The null hypothesis, again, was that there would be no preference among business students. In addition, Loo was interested in looking at the distinction between hard and soft majors (hard majors being accounting, finance, and technically-oriented fields and soft majors being the more people-oriented business programs such as marketing). Loo was also interested in the role of gender. The null hypothesis was that there would be no gender difference in preferences for learning styles. The chi-square test was used, which is a common test that is used when working with nominal data. A higher than expected preference for the assimilator type emerged. Additionally, Loo found accommodators and divergers to be present at a significantly lower percentage than expected.

Jones et al. (2003) conducted a study within a community college which sought to determine how learning style may be associated with academic discipline. Researchers used the Kolb LSI to measure learning style. In addition, the study addressed how learning style may be

associated with student performance. Student performance was measured by the student's GPA. A sample of 105 community college students (47 males and 58 females) were measured in four disciplines (English, math, science, and social studies). Analysis of variance (ANOVA) was used to determine whether or not there were differences across academic disciplines.

Student Learning Style and Academic Performance

Gadzella (2002) used the Inventory of Learning Processes developed by Schmeck, Ribich, and Ramanaiah (1977) to show how different learning styles are related to objective-type tests used in obtaining undergraduate Educational Psychology course grades. Learning style is defined as a predisposition by the learner to adopt a particular learning strategy regardless of the demands of the learning task. A learning strategy is defined as a pattern of information-processing activities that the learner uses to prepare for a test of memory. These information-processing activities range from the shallow, repetitive processing to deep and elaborative processing. Elaborative processors compare well with the higher levels of Bloom's taxonomy—they classify, compare, contrast, analyze, and synthesize. The Inventory of Learning Processes is geared toward college students. It is a self-report instrument comprised of 62 items which address four scales: synthesis analysis, study methods, fact retention, and elaborative processing.

The subjects were 105 university students who responded to four tests which were averaged and used as course grades. The best predictors of the course grade were the students' ages and two Inventory of Learning Processes (ILP) scales scores: Deep Processing and Fact Retention. The Deep Processing scale measures high-order type of items which include analyses, evaluations, and comparisons of information. The Fact Retention scale measures low-order type of items which include factual information and memory recall.

Swanson, Heath, and Edmiston (2005) examined the relationship between learning style and student performance in introductory accounting. The students in the sample attended a medium-sized university. All of the students in every section taking introductory financial accounting were invited to participate. Surveys were distributed within the first two weeks of the course. The researchers used three learning style models: the Canfield model, the Gregorc model, and the Myers Briggs model. The result of the study indicated that previous student performance moderated the relationship between learning style and student performance. The Canfield and Gregorc Models provided better explanatory power than the Myers Briggs model.

Coate and Lehman (2005) used the Solomon-Felder Index of Learning Styles (ILS) with 140 freshman students. The researchers examined learning style as it related to both overall GPA and to single course grades. The results provided evidence that both learning style and gender are predictive of student performance. The researchers used chi-square analysis to test for gender-based differences in learning style. The four ILS scales were active/reflective, sensing/intuitive, visual/verbal, and sequential/global. Only the Visual/Verbal scale showed a statistically significant gender based difference. Both genders tended to be visual learners; however, the ratio of male students classified as visual relative to verbal was 15:1; for females, this ratio was only 3:2. With regard to academic major, finance majors were found to be the most sensing and marketing majors were the least sensing. Sensing learners prefer facts and specific problem-solving methodologies.

The correlation analysis conducted by the researchers showed no correlation between SAT scores and any particular learning style. On average, sequential learners earned higher grades. SAT scores were found to be significantly correlated with student performance. Learning styles were found not to be correlated with any course during the freshman year, but

learning style was correlated with four of seven courses in the sophomore year (Coate &

Lehman, 2005).

To fully investigate the relationship between academic performance and predictive

variables, the researchers ran a series of stepwise regressions. The study used GPA at the end of

the sophomore year and final course letter grades in 14 foundational business courses.

Predictive variables were Math SAT score, Verbal SAT score, gender and the four learning

styles. The researchers first regressed student cumulative GPA against the seven predictor

variables (Math SAT, Verbal SAT, gender, and the four learning styles). Learning style was

defined by the four learning style scales of the ILS discussed above. The sequential/global

learning style was a significant predictor of success, with sequential learners having higher GPAs

(Coate & Lehman, 2005). Since gender was coded as "1" for male and "0" for female, the

negative coefficient for gender indicates that when the student is male, the GPA was lower. This

difference was found to be significant at $p<.001$. Math SAT was also found to be significant as

the $p<.001$. Because of the significance of the gender variable, the researchers ran the same

regression for sub samples based on gender. For both the male and female sample, Math SAT

was the most significant predictor of academic performance. In the male group, no particular

learning style was significant. However, for females the sequential/global learning style

remained significant as it was for the total sample of males and females, with sequential learners

performing better (Coate & Lehman, 2005).

The data was also analyzed by course. Learning styles were significant in only two

courses: financial accounting and managerial accounting. In financial accounting, reflective

learners did better than active learners; and in managerial accounting sequential learners

outperformed global learners.

Holley and Jenkins (1993) studied accounting student performance with regard to exam grade format. The researchers used Kolb's LSI to measure learning style. The researchers were interested in the association of the AC-CE combination score and the AE-RO combination score with student performance on exams of various formats. Forty-nine students participanted in the study. question formats included multiple choice theory, multiple-choice quantitative, open-ended theory, and open-end quantitative. Learning style was found to be significant for all formats except multiple-choice quantitative.

Matching Instructional Style to Learning Style

McCarthy (1981) developed a teaching method that moves students through all four cycles of the experiential learning cycle. In this way, all students' preferred learning styles are addressed. Like many theorists (Canfield, 1988; Dunn & Dunn, 1978; A. Y. Kolb & Kolb, 2005), McCarthy stressed the importance of matching instruction to student learning style.

McCarthy (1981) observed four learning style clusters, and the pattern was then synthesized into a model. Innovatives are curious, aware, and perceptive; analytics are critical, fact seeking, and philosophizing; common-sense people are hands-on, practical, and oriented toward the present; dynamics are risk taking, adaptive, inventive, and enthusiastic. McCarthy also incorporated hemisphericity into the model, indentifying the left-brain function as being associated with verbal, field-independence and the right-brain function being responsible for visuo/spatial, field-dependent activity. McCarthy proposed a spiral process of learning. The learner enters into the spiral through a right-brain, structured activity that is designed to motivate and arouse. This is the sensing/feeling activity for the innovative learner. The next phase is the dissection of the activity into detail, which provides an intellectual, investigative exercise. This phase appeals to the analytic learner. Once the concept has been formed, learners use the left-

brain to master the concept. This appeals to the common sense of the hands-on learner. Lastly, the learner must make right-brain choices of alternatives and apply them to real-world situations. This relates to the dynamic learner, who is the action-oriented doer who thrives on implementing programs. The idea is that all four styles are presented with accompanying left/right brain activities in each lesson. McCarthy's work is a well known example of how to design a curriculum to reflect the four stages of experiential learning as described by Kolb. Her approach to teaching requires that each learning activity move through all four styles.

Terrell (1976) studied the matching of teaching method to learning styles. Fifty-one freshman students enrolled in an audio tutorial course were the subjects of the study. Learning style was determined using the Hill Instructional-Preferences Model. Cognitive style maps of the students were obtained and cognitive style of the instructional mode determined. Students whose cognitive style matched that of the instructional mode tended to achieve higher grades and to have greater reduction in anxiety than non-matched students.

Felder and Silverman (1988) conducted research in engineering education which found that while 63% of engineering undergraduate students tended to be sensors (i.e. they favored practical application and hands-on experience), traditional engineering instruction tended to be oriented toward intuitors, emphasizing theory over practical applications. In addition, they concluded that while most undergraduates (83%) are visual learners, the engineering instruction was predominantly verbal and focused on written explanations over visual illustrations. The researchers found that 64 percent of the students were active learners, while the instruction focused heavily on readings and lectures. They concluded that the incompatibility of learning and teaching styles in engineering education results in society's potential loss of excellent engineers.

Packer and Bain (1978) studied the effect of cognitive style matching with teacher-student pairs. Teachers and students were matched or mismatched on one or two cognitive style dimensions (serialism-holism and field dependence-independence). The sample consisted of 32 first-year psychology students. The Group Embedded Figures Test (GEFT) was used to determine field dependence/independence. Matching effects were obtained on objective test performance and on teachers' and students' subjective ratings of each other. Findings indicated that the matching of teacher and student cognitive styles was significant in terms of improved student performance.

Martens' (1976) study of new students (those achieving in the thirty-third percentile on a conventional test of academic achievement) showed that these students tended to be field-dependent. Martens pointed out that much of what is done in education is geared for the field-independent learner. This bears directly on the issue of matching instruction to student learning style.

Lyons (1984) conducted a follow-up study to a previous investigation of the learning and teaching style of preservice elementary school teachers. In the original study, 20 female education majors were given the Myers-Briggs Type Indicator (MBTI) test to determine individual dominant personality types. The portable Rod and Frame Test, the Group Embedded Figures Test, and the Concealed Figures Test were used to assess cognitive style (field dependence/independence). Teaching style of the subjects was documented in diaries, observations, and interviews. Two student teachers were the subjects of the follow-up study. Observations were made of teaching style, and additional data were collected through tape recordings in which the teachers discussed concerns, strengths, and attitudes about teacher

performance. Findings from this study indicate that there is a relationship between a teacher's preferred learning style and his or her teaching style.

Daniel, Rasmussen, Jackson, and Brenner (1984) examined the relationship between student achievement and student evaluation of instructors based on the match/mismatch of cognitive styles was examined. The Group Embedded Figures Test was administered to 161 students and 10 teachers during the semester. At the end of the course, teacher evaluations and students' scores were obtained and analyzed through a multivariate analysis of variance. Results indicate that the field independent students with field independent teachers received the highest grades, while field dependent students with field dependent teachers received the lowest grades.

Spoon (1996) examined the influence of gender, ethnicity, and age on learning style. In addition, the researcher examined the association between academic performance and the level of congruence/incongruence of student learning style and teachers' teaching style. The sample was the adult basic skills students and teachers at Griffin Technical College, a unit of the Technical College System of Georgia. Congruence between teaching style and learning style was determined and compared to students' scores on the Tests of Adult Basic Education (TABE). A three-way ANOVA was used to analyze these three variables, as well as a chi-square test to analyze categorical data. Chi-square values were calculated on the frequency distributions of congruent and incongruent groups by age, ethnicity, and gender.

A frequency distribution was used to describe the perceived learning styles of adult basic education students. A 2 x 2 x 4 ANOVA examined the influence of gender, ethnicity, and age on learning style. The dependent variable of learning style was calculated from the Principles of Adult Learning Scale (PALS). Chi-square analysis was used to analyze the congruent and incongruent groups in terms of age, ethnicity, and gender. Chi-square is appropriate when the

data is categorical (Mendenhall, Beaver, & Beaver, 2001). A one-way ANOVA was conducted to determine if there were any statistically significant differences among the groups with regard to academic achievement, which was measured by the TABE. No statistical significance was found on the TABE scores. In this particular study and with the instruments used, the analysis of the data suggested the academic achievement of adult basic skills students is not influenced by the congruence of the teacher's teaching style and the student's learning style (Spoon, 1996).

Summary

Literature was reviewed related to the origins and missions of two-year postsecondary institutions. The mission of the Technical College System of Georgia was reviewed. Various learning styles theories and models were reviewed, as well as their use in higher education. It was determined that Kolb (1984) is one of the most often cited theorists in learning style research, and that his experiential learning theory aligns with the "learning by doing" approach used within the TCSG. Previous studies have used either chi-square tests, ANOVA, regression, or some combination of these techniques to analyze the relationship of learning style to variables such as age, gender, learning style, and student performance. The studies reviewed were situated within four-year colleges/universities and community colleges. Studies were typically limited to studying students within a particular course (for example an introductory psychology course), a particular program of study (e.g. accounting majors), or a group of related programs (e.g. business majors). Technical colleges in Georgia focus on workforce preparation and offer a wide array of programs of study not addressed in the literature. Research is needed which focuses on students within a technical college and addresses the learning styles of students from the wide range of programs offered.

The literature also suggested the importance of matching student styles to instructional techniques. With this in mind, this study included a measure of student/instructor congruence/incongruence in learning style and examined this variable as it related to student performance.

CHAPTER 3

RESEARCH METHODS AND PROCEDURES

In this chapter, the research methodology used in this study is described. Specifically this chapter contains six sections: (1) Statement of the problem, (2) Research Questions, (3) Population, (4) Instrumentation, (5) Data Collection, and (6) Analysis of the Data.

Statement of the Problem

The problem of this study is to examine the degree to which student learning style is associated with student performance at a Georgia technical college. This includes collecting data regarding instructor learning style and determining if student and teacher congruency in learning style is associated with improved student performance.

Research Questions

The following research questions provided objectives for the study:

1. What are the learning styles (convergers, divergers, accommodators, assimilators) of the students and instructors at the technical college?

2. How are the styles distributed across age, gender, socioeconomic status (SES), and program of study?

3. Are there significant differences in student performance among the four learning styles?

4. If there are differences, between which learning styles are significant differences found?

5. Is student/teacher congruence in learning style associated with student performance?

Population

The students taking part in this study were those enrolled at a Georgia technical college in east central Georgia during summer quarter of 2010. The technical college is a unit of the Technical College System of Georgia (TCSG). In addition, the entire faculty of the college participated in the study.

The college offers associate degrees in accounting, business administrative technology, and early childhood education. In addition, three associate degrees are offered in the area of computer information systems. Below the associate degree level, the college offers diplomas in the areas of accounting, business administrative technology, computer information systems, cosmetology, early childhood education, electrical control systems, industrial systems technology, and welding. For students seeking shorter programs, the technical college offers technical certificates of credit. The technical college serving as the site of this study offers 47 technical certificates of credit (TCC) which are related to these diploma areas.

Enrollment during summer quarter of 2010 by program area is shown in Table 1. The initial enrollment at the college for summer quarter 2010 was 782 students. For purposes of this study, all degrees, diplomas, and TCC's were collapsed into four program areas—Health, Trade, Business, and Early Childhood Education. For example, all students enrolled in a diploma, technical certificate of credit, or associate degree in Computer Information Systems, Business Administrative Technology, and Accounting were collapsed into the Business Area. Likewise, certificates of credit in carpentry, electrical control systems, industrial systems, and welding are all similar in nature and were grouped together and as the Trade area. Table 1 shows the initial student enrollment after it was collapsed into the four program areas.

Table 1

Student Enrollment by Program Area

Program Area	Enrollment
Business Services	152
Early Childhood Education	112
Healthcare	237
Trade	275
Special	1
Transient	5
Total	782

Special admission and transient students did not have an identifiable program of study at the technical college. Special admission students are those who chose to enroll in coursework without choosing a program major.

Students withdrawing before mid-term received a "W" for the course. A "W" did not calculate into grade point average (GPA). Therefore, if a student withdrew from all coursework prior to mid-term, the student had no grades to report at the end of the quarter. These students were excluded from the study. One hundred students withdrew from all of their coursework prior to mid-term in summer quarter 2010.

Of the remaining 684 students who had final grade data that could be analyzed, 516 usable surveys were collected (75% response rate). Three surveys were completed by transient students whose programs of study were not identifiable. These students were excluded, for a total of 513 student participants. Unusable surveys, student attendance on the days surveys were administered, and students choosing not to participate account for the 168 students for which no survey data was available.

All of the instructors at the technical college completed a survey, which allowed for the inclusion of all grade data from all courses taken by the students who participated in the study. All information needed with regard to student identification, courses, final course grades, and course instructors was accessed through Banner. Banner is the database that is used by all

schools in the TCSG to house student records. The researcher accessed the rosters of all

courses being taught during summer quarter. In addition, the researcher was able to access

individual student schedules for summer quarter.

The researcher coordinated with the Vice President of Academic Affairs to have all

instructors take the Learning Style Inventory and to administer the LSI to students in their

courses during the first week of class. Although some students were enrolled in two or more

classes, each student was instructed to complete the LSI only once. For those cases in which a

student completed a survey more than once, only the data from the first survey was used.

Students who were enrolled in strictly online classes were presented the learning style

inventory in an online format. Many students taking online classes took at least one traditional

face-to-face class, thereby allowing the researcher to identify and access the student in the

physical classroom. The logistics of the college campus and the familiarity of the researcher

with faculty, staff, and administration made it possible to obtain a 75% return rate from the

student body and a 100% participation rate from the faculty.

Instrumentation

The Learning Style Inventory, developed by Kolb, is a forced-choice instrument on

which students are required to rank order four possible endings on 12 sentences. For example,

an item may state "I learn best when I…." Each of the four choices for the sentence ending

reflects a preference for one of the four modes of learning. Kolb's (1984) model is based on

experiential learning theory and views learning in terms of perceiving (how one takes in

information) and processing (how one interacts with that information). When a student takes the

LSI, six scores will be reported. They are defined and described according to Kolb's theory and

are as follows:

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- CE: This stands for "concrete experience" and represents one end of the information *perception* continuum. Information can be taken in by either concrete experience on one end of the continuum or abstract conceptualization on the other end. Each student will have a CE score that indicates to what extent he or she prefers taking in information through concrete experience.

- AC: this stands for "abstract conceptualization" and represents the other end of the information *perception* continuum. Each student will have an AC score that indicates to what extent he or she prefers taking in information using abstract conceptualization.

- RO: this stands for "reflective observation" and represents one end of the information *processing* continuum. Information can be processed by reflective observation or through active experimentation. Each student will have a score that indicates to what extent he or she processes information using reflective observation.

- AE: this stands for "active experimentation" and represents the other end of the information *processing* continuum. Each student will have a score that indicates to what extent he or she processes information using active experimentation.

- AC-CE: this is a combination score which takes into account the AC and the CE score. It indicates the individual's *perception* preference. The score for concrete experience is subtracted from the score for abstract conceptualization. The result is that is score reveals which mode an individual prefers when taking in information.

- AE-RO: this is a combination score that takes into account the AE and the RE scores. It indicates an individual's *processing* preference.

The learning style inventory is accompanied by a scoring grid that allows for the determination of learning style. The perception (AC-CE) continuum is graphed on the vertical axis, with CE (Concrete Experience) at the top and AC (abstract conceptualization) at the bottom. The processing continuum (AE-RO) is graphed on the horizontal graph, with AC (active experimentation) on the left end and RO (reflective observation) on the right end. By plotting an individual's AC-CE score and the AE-RO score, the individual falls into one of four quadrants. These quadrants represent the four learning styles as defined by Kolb (1984) and are labeled as follows:

- Divergers are individuals who experience information concretely and process what they take in reflectively. When an individual's AC-CE and AE-RO scores are calculated, they are found to be a combination of CE and RO.

- Assimilators are individuals who perceive experience abstractly and process what they take in reflectively. When an individual's AC-CE and AE-RO scores are calculated, they are found to be a combination of RO and AC. They are thinkers and watchers.

- Convergers are individuals who take in experience abstractly and then process what they take in actively. When an individual's AC-CE and AE-RO scores are calculated, they are found to be a combination of AC and AE. They are thinkers and doers.

- Accommodators are individuals who take in information concretely and process what they take in actively. When an individual's AC-CE and AE-RO scores are calculated, they are found to be a combination of AE and CE. They are characterized as being feelers and doers.

The instrument consists of 12 simple completion items written in plain language. The respondent is required to rank order four sentence endings that correspond to the four learning modes of CE, RO, AC, and AE. The respondent ranks sentence endings from four to one, assigning a four to the sentence ending that seems most appropriate and a one for the ending that seems least appropriate. Scores in any mode can range from 12 (if the student assigned a one to that mode on all 12 sentences) to 48 (if the student assigned a four to that mode on all 12 sentences). From these four raw scores, two scores are calculated that show the student's preference between abstractness and concreteness (AC – CE) and preference between action and reflection (AE – RO). Plotting these net scores on the instrument's scoring grid indicates the individual's preferred learning style.

Kolb's original 1976 learning style inventory instrument received some criticism with regard to the psychometric properties of the instrument (Freedman & Stumpf, 1980; Geller, 1979). Kolb revised the LSI in 1985 to improve its psychometric properties. Internal consistency of the revised instrument was found to be much improved, with an alpha of .85 (Sims, 1986)

Data Collection

Data collection procedures were as follows:

1. The researcher received permission from the technical college president to conduct this research study on the campus of the technical college.

2. Permission was obtained from the publisher of the learning style inventory (LSI) to use the instrument for this study. However, reproduction of the instrument in this study was prohibited.

3. The University of Georgia's Institutional Review Board approved the study and the data collection process.

4. The researcher visited classrooms and administered the LSI personally to students and collected instruments.

5. When more convenient and/or practical, the researcher asked the instructors to administer and collect the instrument.

6. All instructors at the college completed the LSI.

7. Student participation was voluntary

8. Students were asked to sign an informed consent form. It was explained to students that their surveys would be kept confidential. Survey data was collected only from students who signed the informed consent form.

9. An electronic version of the survey was created using Microsoft Excel. The spreadsheet file was made available to all online classes. Students were able to enter their responses into the electronic spreadsheet and return to the researcher via email within the technical college's online learning system.

10. Respondents were given unlimited time to take the LSI, although it generally only took 10-15 minutes to complete.

11. The Banner database system was used to access data related to student final grade. In addition, the Banner database provided information on student age and program of study.

12. An electronic workbook was designed to facilitate the process of data calculation and analysis. Numerical responses from a completed learning style inventory were entered into the spreadsheet. Extensive use of formulas, multiple worksheets,

macros, and hyperlinks facilitated the process of converting completed hardcopy

surveys into the format needed for data analysis. The workbook was carefully

designed to merge learning style survey data with the student, course, grade, and

instructor data downloaded from the technical college's Banner database.

Analysis of the Data

The data was analyzed using statistical analysis software and Microsoft Excel. This

section describes the statistical techniques and methods used to address each research question.

Table 2 provides a summary of the research questions, the variables, and the statistical

techniques used to address each question. To determine statistical significance, a p-value of .05

was used throughout this study. The p-value selected determines the probability of making a

Type I error. A Type I error occurs when a researcher concludes that there is a relationship

between variables when in fact there is none. By selecting a p-value of .05 for analyzing the

relationship between learning styles and variables of interest, there was a five percent chance of

reporting that there was a relationship between variables when in fact there was not a

relationship.

To address the first and second research question, the researcher used descriptive

statistics. The researcher presented frequency distributions that revealed how student learning

style was distributed across variables of age, gender, socioeconomic status, and program of

study. Socioeconomic status (SES) was determined based on whether or not students received

assistance through the federal Pell Grant program. This is a needs-based program which

provides grants to low income students. For purposes of this study, students were classified as

belonging to one of two groups—those who were Pell eligible (lower SES) and those who were

not eligible for Pell assistance (higher SES).

Table 2

Statistical Techniques Used to Address Research Questions

Research objective	Independent variable(s)	Dependent variable	Statistical procedure
1. What are the learning styles (convergers, divergers, accommodators, assimilators) of the students and instructors at the technical college?	Learning Style (categorical): Accommodator, Converger, Diverger, Assimilator		Frequency Distributions
2. How are the styles distributed across age, gender, socioeconomic status (SES), and program of study?	Learning Style (categorical): Accommodator, Converger, Diverger, Assimilator		Frequency Distributions Chi-Square Analysis Cramer's V
3. Is student learning style associated with student performance?	Student Learning Style (categorical)	Final Course Grade	One Way ANOVA
4. If so, is one learning style more associated with performance than the others?	Student Learning Style (categorical)	Final Course Grade	Tukey's Studentized Range (HSD) Test
5. Is student/teacher congruence in learning style associated with student performance (as measured by the final grade in the course)?	Congruence=1 Noncongruence=0	Final Course Grade	T- test

In addition to presenting frequency distributions of the learning styles across the variables of interest, an analysis was conducted on the frequencies using the chi-square test. The chi-square test is based on the null hypothesis that there is no relationship between the variables of interest. The chi-square test compares expected frequencies to observed frequencies (Gravetter & Walnau, 2007). If the null hypothesis is rejected, it is determined that the difference between the expected frequencies and observed frequencies is statistically significant. Differences that are found to be statistically significant suggest there may be a relationship between learning

style and the variable of interest. A chi-square analysis was conducted on the frequency distribution of each learning style across age, gender, program area, and socioeconomic status.

Statistical significance does not necessarily indicate a large effect. In the event of a statistically significant finding, it is recommended that the test be accompanied by a measure of effect size. When any of the chi-square tests indicated there was a statistically significant difference, the effect size was then calculated in order to determine magnitude. When the chi-square test involves a matrix larger than 2 x 2, Cramer's V can be used to calculate effect size (Gravetter & Wallnau, 2007).

To address the third, fourth and fifth research questions, the final course grades for each of the 513 students were retrieved from the Banner database at the end of summer quarter. These students generated a total of 1,209 final course grades. The final grades in some courses could not be used in the analysis. These were courses which resulted in a final grade of "W," "WP," or "I." None of these grades had any impact on student GPA. The "W" indicated that a course was dropped prior to mid-term. A "WP" indicated that the course was dropped after mid-term and the student was passing at the time of the withdrawal. The "I" indicated a student did not receive a grade during the current quarter but is being given an extra quarter in which to complete the course requirements. Because the "W," "WP," and "I" did not have any impact on GPA, these records were removed from the database. In this study, 89 such records were removed from the database (44 "Ws," 25 "WPs," and 20 "Is." Three additional records belonged to transient students whose program of study was not identifiable. Therefore, a total of 92 records were removed from the dataset, leaving 1,117 final grades that could be analyzed (1209 less 92).

In some cases, a student withdrew from a course after mid-term with a failing grade. These students received a grade of "WF", which was calculated into the student's GPA in the

same way that an "F" was calculated. Because a "WF" has the same impact on GPA as an "F"

all "WFs" in the database were recoded as "Fs". There were 11 "WFs" that were recoded as

"Fs".

Final grades were reported in Banner as letter grades. The grades were converted to

numerical values based on the score range associated with each letter grade. The process of this

conversion is shown in Table 3.

Table 3

Converting Letter Grades to Numerical Scores

Letter Grade	Score Range	Score used for Data Analysis
A	90-100	95
B	80-89	85
C	70-79	75
D	60-69	65
F	Below 60	55

To address the third research question, a one-way analysis of variance (ANOVA) was

conducted to compare mean grades among the four learning styles. While t-tests are often used

when comparing only two groups, ANOVA is appropriate for evaluating the mean differences

when comparing more than two groups. Because there are four possible learning styles,

ANOVA was appropriate for evaluating mean differences. A one-way ANOVA is appropriate

when the dependent variable is continuous and there is only one independent variable. In the

ANOVA procedure, the variable that designates the groups being compared is called a factor

(Gravetter & Wallnau, 2007). The factor in this study was the categorical variable for learning

style. The null hypothesis for the ANOVA was that the mean grades for the four learning styles

would not differ significantly. The alternative hypothesis stated that the mean grade for at least one learning style would be different from the mean grade of another learning style.

The first step in performing an ANOVA is to determine the total variability among all the scores in the study. Once this is done, it is necessary to analyze the total variability of the scores. This involves calculating two variances: a between-treatments variance and a within-treatments variance. The between-treatments variance will analyze the variance among scores across the four learning styles. The within-treatments variance will analyze the variance of the scores within each learning style. The overall goal is to evaluate the differences between treatments (learning styles) and determine whether they can be explained by chance alone or whether the differences are explained in part by learning style. If differences are observed among the four learning styles, they could be due to learning style or chance. The within-treatments variance provides a measure of how much difference is to be expected by chance alone.

The between-treatments variance is calculated by first determining the sum of squares between treatments. This sum of squares is then divided by the degrees of freedom. The degrees of freedom for the between-treatment variance is calculated as *k -1*, where k is equal to the number of treatments. Because this study is comparing four learning styles, the analysis used three as the degrees of freedom for the between-treatments variance.

The within-treatments variance is calculated by first determining the sum of squares within treatments. This sum of squares is then divided by the degrees of freedom. Degrees of freedom for the within-treatments variance is calculated as $N - k$, where N is equal to the total number of grades (1,117) and k is equal to the four learning styles. The resulting degrees of freedom associated with the within-treatments variance is 1,113.

The between-treatments variance is then divided by the within-treatments variance. The resulting statistic is referred to as an F-ratio. When there is no treatment effect, the computed value of the F-ratio should be approximately one. An F-ratio near the value one indicates that the between-treatments variance is about the same as the variance expected by chance. A larger the F-ratio indicates that there may be a treatment effect. The computed F-ratio is compared to the critical value of the F-ratio associated with the degrees of freedom for both the between-treatments variance (numerator) and the within-treatment variance (denominator. If the computed value is larger than the critical value, the treatment effect is statistically significant.

Statistical significance only indicates the differences are larger than expected by chance. To provide an indication of how large the effect really is, a measure of effect size should be reported. For ANOVA, the most direct way to measure effect size is to computer r-square. R-square measures how much of the observed difference in mean grades is accounted for by the independent variable learning style (Gravetter & Wallnau, 2007). R-square was reported in this study when the ANOVA procedure revealed statistically significant differences.

The fourth research question was designed to further explore any significant differences. ANOVA determines whether or not one of the means differed. In the event that a statistically significant difference was found among learning styles, a pos hoc test would be needed to determine exactly which learning styles differed. Tukey's Honestly Significant Difference (HSD) test is a post hoc test that is conducted following an ANOVA in order to determine which mean differences are significant and which are not. This post hoc test allowed the researcher to compare each of the learning styles two at a time.

The process of conducting these pairwise comparisons involves performing a series of separate hypothesis tests. As each test is performed, there is a chance of a Type I error

occurring. As a series of pairwise comparisons are conducted, the chance of a Type I error accumulates. This is known as the experimentwise alpha level. Experimentwise alpha level can be controlled by using Tukey's HSD test (Gravetter & Wallnau, 2007).

The fifth research question explored the relationship between grades and student-instructor congruency of learning styles. For this analysis, congruency was defined as existing when both the student and the instructor fell into the same learning style category as defined by the LSI. The 1,117 course grades were divided up into two groups. The first group of grades were earned by students whose learning styles were different from their instructors'. The second group of grades consisted of those earned by students whose learning styles were the same as their instructors. T-tests were used to determine if there was a statistically significant difference in mean scores between these two groups of scores. T-tests are appropriate when comparing the means of two groups (Gravetter & Wallnau, 2007). For each of the 1,117 grades, a dummy variable was created to account for congruency. Specifically, a "0" was recorded for grades earned by students whose learning style was different from the instructor and a "1" was recorded for grades earned by students whose learning style was congruent with the instructor's style.

Summary

In this chapter, the research methodology was described. The problem and research questions were restated, and the population was discussed. The instrumentation, Kolb's Learning Style Inventory, was described in detail. The process of accessing student records through the BANNER database system was discussed as well. The statistical techniques used to address each research question were discussed.

CHAPTER 4

RESULTS OF THE STUDY

The problem of this study is to examine the degree to which student learning style is associated with student performance at a Georgia technical college. This includes collecting data regarding instructor learning style and determining if student and teacher congruency in learning style is associated with improved student performance. This chapter presents findings of data analysis related to each research question. Specifically, this study addressed five research questions:

1. What are the learning styles (convergers, divergers, accommodators, assimilators) of the students and instructors at the technical college?

2. How are the styles distributed across age, gender, socioeconomic status (SES), and program of study?

3. Are there significant differences in student performance among the four learning styles?

4. If there are differences, between which learning styles are significant differences found?

5. Is student/teacher congruence in learning style associated with student performance?

Participants

The participants in this study were the instructors and students at the technical college. during summer quarter of 2010. One hundred percent of the instructors completed a survey. Student enrollment during this period was 782 students. One hundred students withdrew from

all of their coursework. Because this study is concerned with how learning style and teacher learning style are associated with final course grades, these students were excluded from the study. Of the remaining 682 students who had final grade data, 516 usable surveys were collected (75% of the student body for Summer quarter). Three surveys belonged to transient students whose program of study was not identifiable. These three students were removed, leaving 513 students who were included in the data analysis. Unusable surveys, student attendance on the days surveys were administered, and students choosing not to participate account for the 168 students for whom no survey data was available.

Analysis of Research Questions

This study addressed five research questions. These questions are listed below, along with the statistical analysis conducted to address each question. Findings are presented for each question.

Learning Styles of the Students

Research Question One: What are the learning styles (convergers, divergers, accommodators, assimilators) of the students and instructors at the technical college?

The distribution of learning styles among the students and instructors is presented in Table 4. More than half of the students were found to prefer a diverger learning style (51%), while a comparatively small percentage of the participants (7%) preferred the converger style.

Table 4 includes a frequency distribution of learning style types among instructors. As with the student survey data, the diverger learning style was the most frequently observed style among instructors (36%). Whereas convergers were by far the smallest group among student participants, the converger learning style was the second most observed style among the instructors at the technical college.

Table 4

Learning Styles of Student and Instructor Participants

Learning Style	Number of Students	%	Number of Instructors	%
Accommodator	94	18.3	12	19.1
Converger	36	7.0	15	23.8
Diverger	262	51.1	23	36.5
Assimilator	121	23.6	13	20.6
Total	513	100.0	63	100.0

Research Question Two: How are the learning styles distributed across age, gender, socioeconomic status (SES), and program of study?

Table 5 presents findings as to how learning styles were distributed across age. In addition to the frequency analysis, a chi-square test was conducted to determine whether actual frequencies differed significantly from expected frequencies. The null hypothesis in this chi-square analysis stated there would be no interaction between age and learning style. The chi-square analysis revealed that there was an association between learning style and age, $\chi^2(12, N = 513) = 22.09, p = .04$.

Statistical significance does not provide information about the strength of the relationship. Statistical significance simply means that a difference exists (at an alpha level of .05). Effect size must then be calculated in order to determine the strength of the association. Effect size was determined using Cramer's V, which can range in value from 0 to 1. The calculated effect size of 0.12 was considered a small effect size, as it falls between .06 and .17 (Gravetter & Walnau, 2007).

Table 5

Learning Styles by Age

Learning Style	Number of Students	18-24	%	25-34	%	35-44	%	45-54	%	Over 54	%
Accommodator	94	42	*23	19	16	19	18	8	12	6	16
Converger	36	5	3	8	7	11	10	8	12	4	11
Diverger	262	96	53	67	56	43	40	38	56	18	49
Assimilator	121	38	21	25	21	35	32	14	21	9	24
Total	513	181	100	119	100	108	100	68	100	37	100
%	100	35.3		23.2		21.0		13.3		7.2	

Note: Columns represent age ranges. For example, 18-24 is the number of students that range from 18 years of age to 24 years of age. % represents the distribution of each learning style *within* each age group. *Example: 23 % of those ages 18-24 were accommodators (42 accommodators age 18-24 divided by total of 181 accommodators)

Table 6 presents the frequency distribution of learning styles with regard to gender. The null hypothesis in this chi-square analysis stated that there would be no interaction between gender and learning style. The chi-square analysis revealed that there was an association between learning styles and gender, $\chi^2(3, N = 513) = 8.06$, $p = .04$.

Table 6

Learning Styles by Gender

Learning Style	Number of students	Male	%	Female	%
Accommodator	94	33	15	61	20
Converger	36	21	10	15	5
Diverger	262	102	48	160	53
Assimilator	121	57	27	64	21
Total	513	213	100	300	100
%	100	41.6		58.5	

Because statistical significance does not provide insight into the strength of the
relationship, effect size was calculated. Effect size was determined using Cramer's V, which can
range in value from 0 to 1. The calculated effect size of 0.13 was considered a small effect size,
as it falls between .06 and .17 (Gravetter & Walnau, 2007).

Table 7 shows the frequency distribution of learning styles by socio-economic status
(SES). Students' SES was determined based on whether or not they qualified for the Pell Grant,
which is a needs-based federal grant awarded to students with low income. A chi-square
analysis revealed that there was an association between learning styles and socioeconomic status,
$\chi^2(3, N = 513) = 10.64, p = .01$. Cramer's V was calculated at .14, which is considered a small
effect size.

Table 7

Learning Styles by Socioeconomic Status

Learning Style	Number of students	Pell Eligible	%	Not Pell Eligible	%
Accommodator	94	63	15	31	18
Converger	36	16	10	20	11
Diverger	262	171	48	91	52
Assimilator	121	89	27	32	18
Total	513	339	100	174	100
%	100	66.1		33.9	

Note: The column entitled "Pell Eligible" includes the number of students who, based on financial need, received the federal Pell Grant. The column "Not Pell Eligible" includes students who did not qualify for the federal grant because they did not meet the criteria for demonstrating financial need.

Table 8 presents the frequency distribution of learning styles by program area. A Chi-square analysis revealed that the distribution of learning styles by program areas was not statistically significant, $\chi^2(9, N = 513) = 6.06, p = .73$.

Table 8

Learning Styles by Program Area

Learning Style	Number of Students	Business	%	ECE	%	Healthcare	%	Trade	%
Accommodator	94	22	*19	14	19	27	19	31	17
Converger	36	10	8	1	1	9	6	16	9
Diverger	262	57	48	43	58	73	51	89	50
Assimilator	121	29	25	16	22	34	24	42	24
Total	513	118	100	74	100	143	100	178	100
%	100	23		14.4		27.9		34.7	

Note: ECE represents the Early Childhood Education program of study. Columns labeled % represent the distribution of learning styles *within* each program area. *Example: 19% (22 of the 118) of the business students were accommodators

Learning Style and Student Performance

Research Question Three: Are there significant differences in student performance among the four learning styles? Table 9 presents descriptive statistics regarding the 1,117 course grades, the learning styles of the students, and the standard deviation of the scores.

Table 9

Learning Styles and Final Course Grades

Learning style	Number of courses	Mean Grade	SD
Accommodator	203	83.82	11.7
Converger	85	89.24	10.0
Diverger	568	84.95	11.0
Assimilator	261	84.81	11.1

To investigate this question, a one-way ANOVA was conducted using student learning style and final grades to determine if there were statistically significant differences in mean scores among the learning styles. Table 10 summarizes the results of from the ANOVA. The analysis indicated that there was a statistically significant difference among learning styles (F [3, 1113] = 4.96, p = .002).

Table 10

One-Way ANOVA for Learning Styles and Final Grades

	SS	*Df*	*MS*	*F*	*P*
Between groups	1818.18	3	606.06	4.96	.002
Within groups	135980.39	1113	122.17		
Total	137798.57	1116			

When statistical differences are reported using ANOVA, it is typical to also report effect size. Statistical significance indicates that the mean differences are larger than expected by chance, but it does not explain how much larger these differences are. To provide an indication of how large the effect really is, a measure of effect size should be reported. For ANOVA, the most direct way to measure effect size is to compute r-square. R-square measures how much of the observed difference in mean grades is accounted for by the independent variable learning style. R-square was calculated at 0.013, which can be interpreted as a small effect. Only about one percent of the variation in grades can be attributed to the independent variable learning style.

Research Question Four: If there are differences, between which learning styles are significant differences found? In order to address this question and determine exactly which learning styles differed, Tukey's Honestly Significant Difference (HSD) test was conducted.

Tukey's HSD test controls for experimentwise alpha level and prevents an accumulation of the chance of Type I error as the series of pairwise comparisons are conducted.

Table 11 presents the findings from this analysis. The critical value of the studentized range was 3.64. Mean differences that exceeded this value were deemed statistically significant. Stated another way, a statistically significant difference exists when the confidence limits do not include zero. This means that there is only a five percent chance that a difference is reported when in fact no difference exists.

Table 11

Tukey's HSD Test: Pairwise Comparisons of Learning Styles

Learning Style Comparisons	Difference Between Means	Simultaneous 95% Confidence Limits	
2 - 3	*4.2881	0.9806	7.5956
2 - 4	*4.4269	0.8752	7.9786
2 - 1	*5.4176	1.7433	9.0918
3 - 2	*-4.2881	-7.5956	-0.9806
3 - 4	0.1388	-1.9880	2.2655
3 - 1	1.1294	-1.1961	3.4550
4 - 2	*-4.4269	-7.9786	-0.8752
4 - 3	-0.1388	-2.2655	1.9880
4 - 1	0.9907	-1.6708	3.6521
1 - 2	*-5.4176	-9.0918	-1.7433
1 - 3	-1.1294	-3.4550	1.1961
1 - 4	-0.9907	-3.6521	1.6708

Notes: *Statistically significant at p = .05. Student Learning Styles are coded in the first column as follows: Accommodators = 1; Convergers = 2; Divergers = 3; Assimilators = 4

Significant differences were found between the converger style and the diverger style, the converger and the assimilator style, and the converger and the accommodator style. The mean score earned by convergers was larger than mean scores earned by other styles, and this

difference was statistically significant. Differences among the other styles were not statistically significant.

Student/Instructor Congruency and Student Performance

Research Question Five: Is student/instructor congruence in learning style associated with student performance? For this analysis, congruency was defined as existing when both the student and the instructor fell into the same learning style category as defined by the LSI. The 1,117 course grades were divided into two groups as shown in Table 12.

Table 12

Student/Instructor Congruence in Learning Style and Mean Scores: Congruence vs.

Noncongruence

Congruency	N	Lower CL for Mean	Mean	Upper CL for Mean	Lower CL for SD	SD	Upper CL for SD	SE
0	816	84.372	85.147	85.922	10.752	11.274	11.849	0.3947
1	301	83.524	84.734	85.945	9.8838	10.674	11.602	0.6152
Difference		-1.058	0.4128	1.8836	10.673	11.115	11.597	0.7496

Note: Course grades in which instructor and student had different learning styles were coded as "0". Course grades earned when instructor and student had the same learning style were coded as "1". CL = Confidence Limits

T-tests were used to determine if there was a statistically significant difference in mean scores between these two groups. T-test are preferred to ANOVA when only comparing two means (Gravetter & Wallnau, 2007). There was no significant effect with regard to congruency, $t(1115) = .55$, p=.58.

Summary

This chapter presented the results of the study. The participants were described and the research questions were addressed. For each research question, the findings and interpretation of the statistical analysis were presented.

CHAPTER 5

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

This chapter contains a discussion of the results of this study. The background of the problem, statement of the problem, and research questions are included. The findings from the study are discussed and conclusions are drawn. Limitations of the study, implications for practice and research, and recommendations for future research are addressed. The chapter concludes with a summary of the study.

Background of the Problem

Previous research has examined the learning styles of post secondary students with regard to variables such as age, gender, and academic discipline (Alumran, 2008; Baker, Simon, & Bazeli, 1986; Bell, 1998; Giordano & Rochford, 2005; Jones, Reichard, & Mokhtari, 2003; A. Y. Kolb & Kolb, 2005; Loo, 2002). Studies also have focused on the relationship of learning style to academic performance (Alumran, 2008; Carthey, 1993; Coate & Lehman, 2005; O'Brien & Thompson, 1994). Scholars and practitioners also have addressed issues related to the teaching style of teachers and how the congruency between teaching style and the student's learning style may impact student performance (Dunn & Dunn, 1978; D. A. Kolb, 1984; McCarthy, 1981; Spoon & Schell, 1998). Most of these studies have addressed the learning styles of university, four-year college, and two-year college students.

Georgia's technical colleges operate outside of the University System of Georgia, which oversees universities, four-year colleges, and two-year colleges in the state. Collectively, Georgia's technical colleges form a separate system known as the Technical College System of Georgia (TCSG). Georgia's technical colleges offer programs of study that are specific and

directed toward addressing workforce needs.   Schools that are part of the TCSG offer training in

a variety of programs, such as accounting, automotive, carpentry, cosmetology, electrical control

systems, heating and air conditioning, industrial maintenance, and welding. These courses are

diverse in the types of skill and knowledge required. A full-time student may complete a

technical certificate of credit (TCC) in two 10-week quarters of study. A diploma can be

completed in four quarters. Programs focus heavily on specific occupational coursework. TCCs

have no general education component (e.g. math or English). There is little research that

examines learning style across the wide array of occupational and general education coursework

that students take in a Georgia technical college.

 This study was conducted within a single technical college in Georgia and included

students from all programs of study. Student performance in all coursework was included in the

study, from general education courses such as math and English to the highly specialized

occupational courses.

Statement of the Problem

The problem of this study is to examine the degree to which student learning style is

associated with student performance at a Georgia technical college. This includes collecting data

regarding instructor learning style and determining if student and teacher congruency in learning

style is associated with improved student performance.

Research Questions

The following research questions provided objectives for the study:

1. What are the learning styles (convergers, divergers, accommodators, assimilators) of

   the students and instructors at the technical college?

2. How are the styles distributed across age, gender, socioeconomic status (SES), and program of study?

3. Are there significant differences in student performance among the four learning styles?

4. If there are differences, between which learning styles are significant differences found?

5. Is student/instructor congruence in learning style associated with student performance?

Findings of the Study

This study examined the learning styles of students and instructors in a technical college in Georgia. Student performance was measured by the final course grade, which was converted from a letter grade to a numerical value for statistical analysis. Of the 782 students enrolled at the technical college during summer quarter 2010, 100 withdrew from all of their coursework. These students were excluded from the study since they had no final course grades. Of the remaining 682 students, 513 students completed a useable learning style inventory (75% of the student body). Of these 513 students, over one-half (51%) were found to be divergers. The remaining students were distributed fairly evenly, with assimilators accounting for 24% of the students and accommodators accounting for 18%.

Chi-square analysis indicated a statistically significant relationship between learning style and gender. This finding is supported by previous research (Alumran, 2008; Brenner, 1997; Delargy, 1991; Henry, 2004; Miller et. al, 1990; Reese & Dunn, 2008). This study also found the relationship between age and learning style to be statistically significant, which is supported by prior studies (Delargy, 1991; Ommen et. al, 1979). The data from this study indicated a

statistically significant relationship between socioeconomic status and learning style as well. All of these associations, while statistically significant, are of a somewhat limited practical significance since the effect size was determined to be small. While some studies have found a relationship between learning style and program of study (Alumran, 2008; Jones et. al, 2003; Loo, 2002), no statistically significant relationship was found in this study.

The analysis of final grades and learning styles revealed statistical differences between convergers and each of the other learning styles. Effect size was calculated as a way to explain how well the variation in grades (the dependent variable) was explained by learning style (the independent variable). The data suggests that learning style accounted for a small portion (1.3%) of the variation in final course grade.

The final analysis examined the matching of student and instructor learning styles. The 1,117 final grades were divided into two groups. One group consisted of grades earned under conditions of congruence in learning style—that is, the student and the instructor had the same learning style. The other group consisted of grades earned under conditions of incongruence— that is, the student learning style was different from that of the instructor. T-tests were performed to examine mean scores and variation. The results indicated that there was no statistically significant difference between the two groups of courses.

Conclusions

The frequency distribution of the learning styles of the students revealed that over one-half of the students were divergers. Only seven percent of the students were convergers. However, the converger learning style was the second most observed learning style (24%) among the technical college faculty. If further research indicated that these distributions are representative of the faculty and students within Georgia's technical colleges, the implications

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could be significant. Specifically, 93% of the students taking classes from an instructor who has a converger learning style would have a learning style that is different from that of their instructor. Lyons (1984) found that there is a relationship between a teacher's preferred learning style and his or her teaching style. To the extent that teachers with a converger learning style are likely to present material in the same way that they prefer to learn, this mismatch could have implications for the quality of the classroom experience.

The large number of students with the diverger learning style was unexpected, as one would expect the styles to be more evenly distributed (as they were with the faculty). Such a finding, if supported by future studies, could have implications for technical education. With such a large percentage of the students having a diverger learning style, it would be important that faculty employ instructional methods that appeal to the diverger learning style.

According to Kolb (1984) an individual with a diverging style prefers concrete experience and reflective observation. These individuals excel when viewing concrete situations from many different points of view. Divergers perform best in situations that call for generation of ideas, such as brainstorming sessions. People with this learning style have broad cultural interests and like to gather information. They are interested in people, tend to be imaginative and emotional, have broad cultural interests, and tend to specialize in the arts. In the classroom, divergers prefer to working in groups, listening with an open mind to different points of view and receiving personalized feedback from the instructor.

This finding may present an interesting implication for technical education. Technical programs focus primarily on the attaining of a very specific set of skills and the mastering of a specific list of competencies. Courses and programs within the TCSG are guided by state-wide course standards which dictate the specific skills that a student should possess upon course

completion. It is quite possible that technical instruction, by its nature, is not always presented in ways that would appeal to the imaginative and creative strengths of divergers. If further research confirmed that such a large percentage of technical college students have a diverger learning style, such a finding could have implications with regard to faculty development. It may be advisable that technical college administrators promote faculty development opportunities that enable instructors to present technical material in ways that appeal to the diverger learning style.

The final grades associated with the converger style were found to be statistically higher than the grades associated with the other styles. Kolb's (1984) theory states that people with the converger learning style are best at finding practical uses for ideas and theories. A converger's strength lies in taking abstract ideas and applying them to the practical problem at hand. Convergers tend to work best in situations where there is one correct answer and in situations where a practical solution is needed to solve a problem. This particular learning style is well suited for applying abstract theories and concepts into practical solutions. These students may be well suited for assignments utilizing a multiple choice and true/false format which require students to "converge" abstract theories into a single correct answer. If a significant weight were to be assigned to these types of assessments in a course, performing well on them could translate into a higher final course grade. Stated another way, using these types of assessments may not favor the other learning styles to the degree that they favor the converger style. Students who are divergers, for example, are the polar opposite of convergers in the way that they prefer to perceive and process information. These students prefer situations which allow for reflection, imagination, and creativity. These abilities may not be encouraged and rewarded in classes in which learning is measured by objective-type assessments (i.e. true/false, multiple choice exams).

The statistical analysis of the final grades indicated that learning style accounted for very little of the variation in student grades. In this study, only a small amount of the variation in student performance was explained by the independent variable learning style. The conclusion is that many other factors other than student and instructor learning style may affect student performance.   Future studies may aim to gain a better understanding of the importance of learning style in relation to other factors that may influence student performance.

With regard to the matching of instructor and student learning styles, this study revealed no statistically significant difference in student performance when student and instructor styles were congruent. This finding contradicts previous studies which have suggested matching student learning style and instructional style results in improved performance (Felder & Silverman, 1988; Packer & Bain, 1978; Terrell, 1976). According to Spoon and Schell (1998), one possible explanation is that adult learners have had years of experience in adapting to a variety of learning environments and may be more tolerant of different teaching styles.

Limitations of the Study

According to Kolb (1984) learning is best conceived as a process, not in terms of outcomes. This study used final course grades as a measure of student performance. However, earning an "A" is not necessarily an indication that learning has taken place. Conversely, a lower grade is not necessarily indicative that less learning has taken place. Perhaps a better indication of learning could have been obtained with the use of a pretest and a posttest in each course. Given the number of students and courses involved in this study, this was not a practical alternative.

It must be acknowledged that many factors affect student learning and student performance. Research models that allow for the controlling of a number of variables may

enable researchers to gain more insight as to the relative importance of learning style when compared to other factors that influence student performance.

This study was conducted within a single technical college in Georgia. The results may not be generalizable to the entire population of technical college students in Georgia. It is also important to note that experiential learning theory was the conceptual framework chosen for defining the construct of learning style. Kolb's (1984) learning style inventory was used as the instrumentation. Other learning style models, as discussed in the review of the literature, have been used to assess learning styles of students. Conducting this study utilizing a different conceptual framework and using different instrumentation could yield different results.

Students' programs of study were collapsed into four major areas. While this grouping was necessary due to the small number of students enrolled in some diplomas and certificates, it is possible that this procedure obscured a relationship between program of study and learning style. The business program area, for example, included students majoring in accounting as well as those majoring in business administrative technology. Previous research has shown there to be learning styles differences across specific programs of study within the business area (Loo 2002; Coate & Lehman, 2005).

This study was situated on the campus of a technical college that is accredited by the Council of Occupational Education (COE). Some of Georgia's technical colleges are accredited by the Commission on Colleges (COC) of the Southern Association of Colleges and Schools (SACS). COC accredited technical colleges may be more aligned with the missions of colleges and universities.

Implications for Practice and Research

This study reported statistically significant findings. However, effect sizes were calculated and determined to be small. While statistically significant, the findings are not necessarily of practical significance. Therefore, further research is needed to explore these statistically significant findings.

Based on the review of literature and the findings of this study, it may be advisable for technical college faculty to become more educated with regard to learning styles. This study revealed that students are distributed across all four learning styles. Therefore, it would be advisable for instructors to have a good understanding of the four learning styles and how students differ in the ways they perceive and process information. Kolb's (1984) model can inform faculty as to how individuals with each learning style prefer to learn. Designing instruction in a way that moves learners through each of the four modes of learning would ensure that each student is exposed to some instruction that is congruent with their learning style. McCarthy (1981) developed a teaching method that moves students through all four cycles of the experiential learning cycle. In this way, all students' preferred learning styles are considered in the instructional design of a course.

Recommendations for Further Research

Based on the findings of this study, the conclusions drawn, the limitations of the study and implications for further research, the following recommendations for further research are presented:

- Similar studies should be conducted using a pretest and posttest for each course. This would enable the researcher to measure learning by comparing scores before and after the course.

- Future studies should investigate this study's finding regarding the overwhelming preference for the diverger learning style among technical college students. Further research may seek to determine if this is a consistent finding across schools, colleges, and programs of study.

- Instructor and student congruence should be further investigated. One would expect to see congruence in instructor learning style and student learning style as being associated with student performance. This study did not find an association between congruence and student performance.

- Learning style explained only a small portion of the variation in final grades. Future studies should attempt to include other variables that may affect student performance.

- Future researchers may consider approaching the study of learning styles using a qualitative research design. According to Kolb (1984), learning is a process, not an outcome. Quantitative studies such as this one tend to translated construct of learning into numerical scores. If learning is to be considered to be a holistic process as opposed to an outcome, valuable insights into the depth of students' learning may be gained through the use of qualitative research methods such as interviews with students and instructors and classroom observations. Qualitative methods seek to find deeper meaning regarding a particular phenomenon as opposed to measuring it statistically.

- Future research may investigate how well instructors in technical colleges understand learning styles and whether or not they are using a variety of instructional methods to appeal to all styles. Such studies would inform researchers as to whether or not technical colleges are using the body of research related to learning style to create a learning space that is favorable to all students.

- This study may be replicated using other learning style models and instrumentation. Canfield's (1988) learning style inventory provides instrumentation that directly assesses teaching style as opposed to the teacher's learning style. Such instrumentation might be used in future studies that aim to measure the importance of matching student learning style to teaching style.

- Kolb's (1984) theory suggests that one of the benefits of the learning style inventory is in helping individuals understand how they learn best. Individuals may become more cognizant of their own style and the strengths and weaknesses associated with their style after having the instrument scored and explained to them. Future studies may compare the performance of students who have not taken the LSI to students who have taken the LSI and had the results interpreted and explained to them. The objective in such research would be to determine whether or not knowledge of one's own learning style leads to improved performance.

- Because they had no final grade data, students who dropped all of their coursework were excluded from the study. Further research may investigate whether or not there is an association between learning style and student retention. This study only captured data on students who had final course grades that impacted student grade point average (GPA).

- Courses for which students received a "W" (student withdrew prior to mid-term) or "WP" (students withdrew after mid-term with a passing average) were not analyzed because these outcomes had no effect on GPA. Further research should examine the learning styles of the students and instructors in the courses that were dropped.

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Withdrawing from a course is a student outcome that was not addressed in this study but may bear on educators' understanding of how learning style relates to student success.

- Further research may examine students' learning styles in a variety of situations. The Kolb instrument tends to label individuals outside of any context. Situated learning theory suggests that learning is embedded within a particular activity, context, and culture (Lave & Wenger, 1991). This learning theory asserts that classroom activities often present abstract knowledge which is presented out of context. Situated learning theory suggests that learning style will change depending on what is being learned and the context in which the learning takes place. Future studies may attempt to administer the Kolb instrument in particular contexts. For example, participants may be asked to complete the survey in the context of how they prefer to learn a particular subject. The question of interest to be to determine the Kolb instrument shows that students adapt their learning depending on what is being learned. Findings from such a study would give researchers insight into whether the context matters with regard to the instrumentation used by Kolb.

- It is the workforce education mission of the Georgia's technical colleges that differentiates this study from the many studies that have been conducted in community college settings. Schools in the TCSG were originally accredited by the Council on Occupational Education (COE), an accrediting agency which focuses on schools with a workforce education mission. During the past decade, however, more technical colleges in Georgia have gained accreditation from the Commission on Colleges (COC). This is the regional accreditation that is held by colleges and universities that make up the University System of Georgia. It would be interesting to replicate this study on the

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campus of a COC accredited technical college, as these technical colleges share some of the characteristics of the two-year USG schools with regard to the transferring of credits to four-year colleges. The question of interest would be whether or not students enrolled in a COC accredited technical college are different from those found in this study, which was conducted within a COE accredited school. The findings could add to the conversation regarding the degree to which student learning styles may or may not be associated with the workforce education mission of the technical college.

Summary

This study examined the learning styles of technical college students and instructors. The theoretical framework used to define learning style was Kolb's (1984) experiential learning theory. Student learning style was found be associated with age, gender, and socioeconomic status. Statistical analysis revealed that higher grades were associated with the converger learning style as opposed to other learning styles. Effect size, which measures the strength of these associations, was determined to be small. The implications of the findings were discussed and recommendations made for further research.

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APPENDICES

APPENDIX A

Approval Letter from Technical College President

SANDERSVILLE
TECHNICAL COLLEGE

April 28, 2010

Mr. Stan Lawson
Accounting Instructor
Sandersville Technical College
1189 Deepstep Road
Sandersville, GA 31082

Dear Stan,

Sandersville Technical College is pleased to assist you with research for your dissertation study. I hereby authorize you to survey students enrolled in the college for the purpose of your research. You may also have access to the faculty and staff at Sandersville Technical College for assistance.

Sandersville Technical College understands that the surveys will be anonymous and that students, faculty, and staff will not be identified in the results, however Sandersville Technical College student ID numbers will be used to prevent duplication of surveys. It is further understood that participation will be taken on volunteer basis.

I am interested to see which learning style our students identify with and feel that the information will be useful to the college in future planning.

If I can be of further assistance to you with your research please do not hesitate to contact me.

Sincerely,

Lloyd Horadan, Ed.D.
President

APPENDIX B

Informed Consent Form

INFORMED CONSENT FORM

I, _____, agree to participate in a research study titled "An Examination of the Relationship Among Student Learning Style, Instructor Learning Style, and Student Performance in a Georgia Technical College" conducted by Stan C. Lawson under the direction of Dr. Clifton L. Smith of the University of Georgia (Dr. Clifton Smith may be contacted by email at **csmith@uga.edu**, or by phone at 706-542-4208). I understand that my participation is voluntary. I can refuse to participate or stop taking part at anytime without giving any reason, and without penalty or loss of benefits to which I am otherwise entitled. I can ask to have all of the information about me returned to me, removed from the research records, or destroyed.

The reason for this study is to better understand how student learning styles and instructor learning styles may be associated with student performance. If I volunteer to take part in this study, I will be asked to complete a Learning Style Inventory. I understand that in order for the researcher to study the relationship between learning styles and student performance, the researcher will access final course grades from the BANNER database. BANNER will also be used to access information related to age, gender, and program of study so that these variables can be controlled for in the study.

The benefits for me (as a technical college student or a technical college instructor) are that this study may help instructors better understand how student learning style and teacher learning style are associated with student performance. Technical college instructors may be able to use the findings from this study to improve the classroom experience for technical college students.

I understand that no risk is involved in the completion of the learning style inventory. I understand that the duration of my participation will be limited to the time it takes to read this consent form and complete the learning style inventory. It is reasonable to expect the total duration of my participation will be between 10 and 20 minutes. Most participants can complete the 12 item learning style inventory within 5 or 10 minutes.

No individually-identifiable information about me, or provided by me during the research, will be shared with others.   I will be assigned an identifying number for purposes of data collection and this number will be recorded on the learning style inventory. I understand that once the researcher has all the data needed, all linkages between participants and the
data will be removed. I understand that as of October 31, 2010, all links between participants and data will have been destroyed.

The investigator will answer any further questions about the research, now or during the course of the project.

I understand that I am agreeing by my signature on this form to take part in this research project.

Stan Lawson_____   _____   _____
 NAME OF RESEARCHER   **SIGNATURE**   **DATE**
Telephone: 478-553-2122
Email: slawson@sandersvilletech.edu

_____   _____   _____
Name of Participant   **Signature**   **Date**

Additional questions or problems regarding your rights as a research participant should be addressed to The Chairperson, Institutional Review Board, University of Georgia, 612 Boyd Graduate Studies Research Center, Athens, Georgia 30602-7411; Telephone (706) 542-3199; E-Mail Address IRB@uga.edu